II Tamaso Ma Jotirgamaya II
Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR ENGINEERING COLLEGE

Waghalwadi - Someshwarnagar, Tal.Baramati, Dist. Pune (Pin : 412 306)
Approved by AICTE New Delhi, Recognised by Govt. of Maharashtra and
Affiliated to Savitribai Phule Pune University, Pune. Id.No.PU/PN.Engg./445/2012

Ref. No. : SEC/ 458 /2018-19

Date : 16 / 08 /2018

To,

____

Subject- Invitation for one day workshop on "**Environmental Audit & Sustainable Development**"

Date: 21st August 2018 (Tuesday)

Venue: S.S.P.M's Someshwar Engineering College, **Someshwarnagar**

Dear Sir/Madam,

Growing industrial pollution, population, climate change and sustainable development are the key issues of today's day and age. Henceforth, it is our collective responsibility to control and monitor the pollution from different sources so as to retain better and healthy environment for future generations. Environmental audit and sustainable development is the one way by which we can monitor the same and provide solution to upcoming dangers to society and the environment as a whole.

It is therefore necessary to provide exposure to the students, teachers as well as industry persons of the concerned subjects as early as possible so as to increase awareness regarding the same. Therefore, a workshop on **"Environmental audit and sustainable development", is planned by our institute on 21st August 2018.**

The workshop also aims at a summing up in the during the concluding session, in order to bring out innovative directions for future work. The sessions shall be conducted by **Dr. N.S. Raman, Head, Environmental Audit Cell (EAC), NEERI, Nagpur.**

The profile of the speaker and schedule of the program is attached herewith. For registration contact **Prof. Mayur Chatuphale, Cell: 9503680664, e-mail:** mayurchatuphale@gmail.com

Dr. Ajay V. Deshmukh
Principal

PRINCIPAL
Somes... gineering College
Somes... Tal-Baramati 412306

SOMESHWAR ENGINEERING COLLEGE
DTE CODE EN6795
SOMESHWARNAGAR, TAL BARAMATI 412306

Brief profile of speaker

Dr. N.S. Raman is **Senior Principal Scientist** and **Deputy Director** at National Environmental Engineering Research Institute (**NEERI**), Nagpur, India. He holds a B.E. degree from The University of Mysore (Rank Holder) and an M. Tech. degree in environmental engineering from The Indian Institute of Technology (I.I.T), Powai, Mumbai. He received a Doctorate (Ph. D.) in Environmental Engineering (Specialization Environmental Audit) from The Indian Institute of Technology (I.I.T), Roorkee. Currently, his Research activities focus on the fields of environmental auditing (EA), Natural Resources Accounting, Environmental Impact Assessment (EIA), ISO 14001, Environmental Economics, Municipal Solid Waste Management and Eco-Auditing.

Dr. Raman is a certified lead auditor by Marsden International (based in the United Kingdom) after successful completion of advanced ISO 14000 lead-auditor training accredited by the Environmental Auditors Registration Association and also a Lead Auditor of International Accreditation Service (IAS), Brea, California. He has developed Key Performance Indicators in urban Governance for environmental audit framework.

He has published over 90 research papers in national and international journals and is the recipient of several awards (including "best paper" awards) at international seminars and workshops. He is recognized as a PhD supervisor for environmental engineering in the Faculty of Engineering and Technology, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur; North Maharashtra University, Jalgaon; Gondwana University, Gadchiroli and R.K. University, Rajkot, In 2006, he authored the Handbook on Indian Environmental Standards in collaboration with Dr. Sukumar Devotta, director of NEERI. Further, he has authored two RESUME 2 books on Environmental Imapct Assessment (EIA) in 2014 and in 2016.

Dr. Raman is listed in the Asia edition of International Biographical Foundation and the World Who's Who of Men and Women of Distinction in recognition of his distinguished leadership in environmental engineering. He received The Bharatha Rathna Sir M. Vishveswaraiah National Parisara Rathna Award in recognition of his work in the field of environmental engineering. Recently "**Best Scientist of the year 2017**" award has been conferred upon him by ASDF-SIAA on April 08, 2017.

[illegible] Engineering College
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6795
Someshwarnagar, Tal. Barama[illegible] 412306

Shri. Someshwar Shikshan Prasarak Mandal's

Someshwar Engineering College, Someshwarnagar

Department of Civil Engineering

One Day Workshop on

"Environmental Audit & Sustainable development"

Schedule

Time	Scheduled Activity
09.00- 09.30	Registration & Inauguration
09.30- 11.00	**Session I** *"Environmental Audit"*
11.00-11.10	Tea Break
11.10-12.30	**Session II** *"Wastewater Engineering & Sustainable Development"*
12.30- 13.15	Lunch Break
13.15-14.45	**Session III** *"Opportunities in Environmental Engineering & NEERI"*
14.45- 15.00	Valedictory function

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Shri. Someshwar Shikshan Prasarak Mandal's

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Department of Civil Engineering

Registration Form

One day Workshop

On

"Environmental Audit & Sustainable development"

(21st August 2018)

Students: Rs. 200/- per registration

Faculty/ Industry personnel: Rs. 500/- per registration

Name- ____________________

Designation- ____________________

Department- ____________________

Organization/Institute- ____________________

____

Address- ____________________

____

____________________ Pin- ____________________

Phone No.- ____________________

Mobile No.- ____________________

Email ID.- ____________________

Mode of payment- ____________________

Amount- ____________________

Registration Date- ____________________

Signature of applicant- ____________________

Signature of payment receiver- ____________________

(Along with name and date)

Someshwar Engineering College ★ DTE Code 6795 ★ Someshwarnagar, Tal.Baramati 412306

II Tamaso Ma Jotirgamaya II

Shri Someshwar Shikshan Prasarak Mandal's

SOMESHWAR ENGINEERING COLLEGE

Waghalwadi - Someshwarnagar, Tal.Baramati, Dist. Pune (Pin : 412 306)
Approved by AICTE New Delhi, Recognised by Govt. of Maharashtra and
Affiliated to Savitribai Phule Pune University, Pune. Id.No.PU/PN.Engg./445/2012

Ref. No. : SEC/ 458 /2018-19 Date : 14/08/2018

To,

____

Subject- Invitation for one day workshop on **"Environmental Audit & Sustainable Development"**

Date: 21st August 2018 (Tuesday)

Venue: S.S.P.M's Someshwar Engineering College, **Someshwarnagar**

Dear Sir/Madam,

Growing industrial pollution, population, climate change and sustainable development are the key issues of today's day and age. Henceforth, it is our collective responsibility to control and monitor the pollution from different sources so as to retain better and healthy environment for future generations. Environmental audit and sustainable development is the one way by which we can monitor the same and provide solution to upcoming dangers to society and the environment as a whole.

It is therefore necessary to provide exposure to the students, teachers as well as industry persons of the concerned subjects as early as possible so as to increase awareness regarding the same. Therefore, a workshop on **"Environmental audit and sustainable development", is planned by our institute on 21st August 2018.**

The workshop also aims at a summing up in the during the concluding session, in order to bring out innovative directions for future work. The sessions shall be conducted by **Dr. N.S. Raman, Head, Environmental Audit Cell (EAC), NEERI, Nagpur.**

The profile of the speaker and schedule of the program is attached herewith. For registration contact Prof. **Mayur Chatuphale, Cell: 9503680664, e-mail:** mayurchatuphale@gmail.com

Dr. Ajay V. Deshmukh
Principal

PRINCIPAL
Someshwar Engineering College
Some... nagar, Tal-Baramati 412306

SOMESHWAR ENGINEERING COLLEGE
DTE CODE EN6793
SOMESHWARNAGAR TAL BARAMATI

Phone (02112) 283185
Website : www.secsomeshwar.ac.in

Fax. : (02112) 283185
Email : principal@secsomeshwar.ac.in

Shri Someshwar Shikshan Prasarak Mandal's
Someshwar Engineering College
Someshwarnagar,Tal – Baramati, Dist – Pune 412306
(Approved by AICTE New Delhi, Recognized by Govt. of Maharashtra & Affiliated to Savitribai Phule Pune University, Id.no.PU/PN.Engg./445/2012)
Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.secsomeshwar.ac.in *Email:principal@secsomeshwar.ac.in

Ref. No. SSPM/SEC/ / 2019-20

Date: 18 / 02/ 2019

To
The principal
SSPM'S SEC Someshwarnagar

Sub: Regarding permission For "**Workshop**" on **Entrepreneurship Development**"

Respected Sir,

With reference to above mentioned subject, Workshop is arranged on Entrepreneurship Development for all students and faculty members of engineering college on 26th February 2019. I would like to request you to please give permission for Entrepreneurship Development workshop on above mentioned date.

Objectives:-

1. Understand the process and procedure involved in setting up small scale enterprise
2. Know the pros and cons in becoming an entrepreneur.
3. Develop a broad vision about the Business
4. How to Prepare Proposal for Bank Loan
5. Various Government schemes available for small scale Industries
6. How to apply for bank loan

Outcomes:-

1. Sell themselves and their ideas
2. Find Problems Worth solving.
3. Mobilize people and resources.
4. Develop and cultivate endurance.

permitted
18/02/2019

Someshwar Engineering College
DTE Code 6795
Someshwarnagar, Tal.Baramati 412306

Yours Faithfully

Shri Someshwar Shikshan Prasarak Mandal's
Someshwar Engineering College
Someshwarnagar,Tal – Baramati, Dist – Pune 412306
(Approved by AICTE New Delhi, Recognized by Govt. of Maharashtra &
Affiliated to Savitribai Phule Pune University, Id.no.PU/PN.Engg./445/2012)
Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.secsomeshwar.ac.in *Email:principal@secsomeshwar.ac.in
****

Ref. No. SSPM/SEC/6 ı38/2019-20

To,
Mr. Surendra Arvind kakade
Head of Ayugraam Parishada

Date: 18/02/2019

Subject: Invitation for the One-day workshop on **"Entrepreneurship Development"** dated 26th Feb 2019

Dear Sir,

Someshwar Engineering College, established in 2012, is one of the self-financed Engineering colleges approved by AICTE New Delhi, Government of Maharashtra and DTE Mumbai. The institute is affiliated to Savitribai Phule Pune University (SPPU). The institute offers Engineering Courses in Mechanical Engineering, Civil Engineering, Computer Engineering, and Electrical Engineering leading to BE degree as per SPPU University Curriculum.

It is prestigious moment for us invite you for the conduction of one-day workshop on the topic **Entrepreneurship Development.**

We kindly request you to please guide our students.

We hope that it will be great opportunity for us and great experience of our students.

Thanking you,

Yours faithfully

SOMESHWAR ENGINEERING COLLEGE * SOMESHWARNAGAR, TAL BARAMATI 412306 * DTE CODE EN6795

PRINCIPAL
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Someshwarnagar, Tal-Baramati 412306

Shri Someshwar Shikshan Prasarak Mandal's
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Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.secsomeshwar.ac.in *Email:principal@secsomeshwar.ac.in
****

Ref. No. SSPM/SEC/ / 2019-20

Date: 22 / 02/ 2019

NOTICE

All the students and faculty members are hereby informed that the one day **workshop** on **"Entrepreneurship Development"** is arranged on 26 / 02 /2019 in our institute at 9.00 am to 5.30 pm. Expert faculty Mr. Surendra Arvind Kakade will guide on above topic. All the students should remain present for the Workshop.

Venue: - Someshwar Engineering College, Someshwarnagar

(HOD mechanical Engg.)

Someshwar Engineering College
DTE Code
6795
Someshwarnagar, Tal.Baramati 412306

Shri Someshwar Shikshan Prasarak Mandal's
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****

26/02/2019

Ref. No. SSPM/SEC/620/2019-20

To

Mr. Surendra Arvind Kakade

Head of Ayugraam Parishada

Sub: Vote of Thanks

Respected Sir,

On the behalf of Shri someshwar shikshan prasarak mandal's Someshwar Enggineering College, Someshwarnagar we wish to thank you for the valuable guidance given to our students and faculty members for **Entrepreneurship Development Program on** 26th February 2019. From the feedback we have received, the students and faculty members were satisfied and it was a great success.

We appreciate the time you took out of your busy schedule to join us and thank you for sharing your insight and expertise in this workshop with our students and faculty member's. We do expect your guidance in future also.

Thanking you for your time and effort.

Yours truly,

Principal

PRINCIPAL
Someshwar Engineering College
Someshwarnagar,Tal-Baramati 412306

Shri Someshwar Shikshan Prasarak Mandal's
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****

Ref. No. SSPM/SEC/ / 2019-20

WORKSHOP ON ENTREPRENEURSHIP DEVELOPMENT

Date: 26th February 2019

1. Expert Detail Name: Mr. Surendra Arvind Kakade

Organization: Head of Ayugraam Parishada

Total Experience: 7 Years

2. Brief details of the event:

The Workshop was organized by the Someshwar Engineering College's Department of Computer engineering on 26th February 2019. Mr. Surendra Arvind Kakade presided over as the guest speaker and topic of his discussion was **"Entrepreneurship Development"** during which various topics of Development were discussed.

How to start small scale industry?

How to do market survey? etc.

3. Response of the audience/ learning for the students:

It was nice learning experience for students and they thoroughly enjoyed the session. Speaker involved the students in various interfacing programs.

4. Faculty Coordinator Name: Prof. Shinde S.S. , Prof. Naik C.V. , Prof .Gawade K.P.

5. Number of participants (student: 100&Faculty29)

6. Learning objective:

1. Understand the process and procedure involved in setting up small scale enterprise
2. Know the pros and cons in becoming an entrepreneur.
3. Develop a broad vision about the Business

Someshwar Engineering College ★ Someshwarnagar,Tal.Baramati 412306 ★ DTE Code 6795

4. How to Prepare Proposal for Bank Loan
5. Various Government schemes available for small Scale Industries
6. How to apply for Bank Loan

7. Learning Outcomes:

1. Sell themselves and their ideas
2. Find Problems worth solving.
3. Mobilize people and resources
4. Develop and cultivate endurance.

8. Expert Narration: The focus of the lecture was on improving the Knowledge of inculcation, development and polishing entrepreneurial skills into a person needed to establish and successfully run his business.

Someshwar Engineering College ★ Someshwarnagar, Tal.Baramati 412306 ★
DTE Code
6795

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S **SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR**	Record No:- Revision:- Date:-

Department: Electrical **Academic Year:**2019-20 **Class:**B.E.

Roll No.	Name of Students	Sign
EE401	BHOSALE NIKHIL	
EE402	BODARE AISHWARYA	
EE403	GAWADE TUSHAR	
EE404	GHATE POOJA	
EE405	HOLKAR NIKEETA	
EE406	JADHAV KULDIPKUMAR	
EE407	KADAM TEJASHREE	
EE408	KALBHOR OMKAR	
EE409	MAGAR SANTOSH	
EE410	MANE RANI	
EE411	MOHITE AMOL	
EE412	MOTE VISHAL	
EE413	PAWAR VISHAKHA	
EE414	RAJBHAR SHANKARJI	
EE415	RAKESH NARAYAN	
EE416	RANAWARE OMKAR	
EE417	SHENDKAR PRIYANKA	
EE418	WAVARE KALYANI	
EE419	YELE HARSHALI	
EE420	JAGTAP PRATIMA	

Someshwar Engineering College
DTE Code 6795
Someshwarnagar, Tal.Baramati 412306

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S **SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR**	Record No:- Revision:- Date:-

Department: Electrical **Academic Year:**2019-20 **Class:**B.E.

Roll No.	Name of Students	Sign
EE421	SURVASE NITIN	
EE422	WABALE PRAJAKTA	PHWabale
EE423	KADAM NAVNATH	Badam
EE424	SHINDE AKSHAY	
EE425	NALE PRATIK	
EE426	CHANDANSHIV KIRAN	
EE427	KAKADE SHEKHAR	Kakade
EE428	KARGAL PRASHANT	

Someshwar Engineering College DTE Code 6795 Someshwarnagar, Tal.Baramati 412306

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S **SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR**	Record No:-ACD/R/08 Revision:-00 Date:-16/06/2014

ATTENDANCE LIST

Department: Mechanical Engineering **Academic Year:** 2018-19

Class: T.E

Roll No	Name of Student	Sign
ME401	LONKAR ATUL VITTHAL	Alonkar
ME402	DEDE MAHESH SOPAN	MDede
ME403	PAWAR PARSHURAM BABAN	[illegible]
ME404	BHATIA SHUBHAM BALKRISHNA	[illegible]
ME405	BHOSALE AVADHUT SADASHIV	[illegible]
ME406	BOBADE ANIKET VITTHAL	[illegible]
ME407	DHAIGUDE NIKHIL RAMCHANDRA	[illegible]
ME408	GADADARE DAYASAGAR BALASO	Gadadare
ME409	GAIKWAD AKSHAY BAPURAO	AGaikwad
ME410	HEGADE OMKAR DATTATRYA	[illegible]
ME411	HOLKAR AJAY SHANKAR	ASHolkAr
ME412	HOLKAR KRUSHNAKANT SHANTARAM	KSHolkar
ME413	JADHAV KIRAN LALSING	
ME414	JADHAV VIVEK SHAMRAO	[illegible]
ME415	JAGTAP AKASH DNYANDEV	[illegible]
ME416	JAGTAP SUSHMA ARJUN	SAJagtap
ME417	JAGTAP YOGESH MOHAN	Jagtap.y.m
ME418	KOLEKAR AMOL BHANUDAS	Kolekar
ME419	KUMBHAR ABHIJEET VIJAY	A.V.Kumbhar
ME420	MAHARNAVAR SURAJ GANPAT	[illegible]
ME421	NIMBALKAR HRUSHIKESH MAHADEO	[illegible]
ME422	RAJAPURE YOGESH BAPURAO	[illegible]
ME423	SANGILKAR DIGAMBAR TUKARAM	Sangilkar
ME424	SHELAR SHUBHAM BALASO	S.B.Shelar
ME425	SHEWALE AKSHAY GAJANAN	[illegible]
ME426	SONAWANE HARSHALI RAMESH	HSonawane
ME427	SORATE JAIKUMAR SANJAY	Sorate
ME428	TAWARE DATTATRAY PANDURANG	[illegible]
ME429	THOPATE NIKHIL NANASO	[illegible]

Someshwar Engineering College ★ Someshwarnagar, Tal.Baramati 412306 ★ DTE Code 6795

Roll No	Name of Student	Sign
ME430	THOPATE PRATHAMESH SHARAD	
ME431	WADKAR SHUBHAM ANIL	
ME432	HOLKAR PAVAN CHANDRAKANT	
ME433	MAHESH BABAN KACHARE	
ME434	JADHAV RANJIT Baban.	
ME435	KAKADE ROHIT Vasantrao	
ME436	TAMBOLI SAHIL Salim.	

CLASS COORDINATOR

HEAD OF DEPARTMENT

Someshwar Engineering College
DTE Code
6795

ROLL CALL LIST

Department: Computer Engineering
Class: T.E

Academic Year:
Date:

Roll No	Name Of Student	Sign
C0401	BHAGAT SAMIKSHA N.	S.N.Bhagat.
C0402	BHAGAT VAISHNAVI S.	[illegible]
C0403	CHOUDHARI KIRAN YASHWANT	[illegible]
C0404	GAIKWAD SAYALI SAHEBRAO	Gaikwad
C0405	HOLKAR MADHURI SANTOSH	[illegible]
C0406	JADHAV ASHWINI VISHWAS	Jadhav
C0407	JAGTAP SUPRIYA SANJAY	Jagtap
C0408	KADAM MAYURI	Kadam
C0409	KAJALE RAVI	Kajale
C0410	KASAR RANI D.	[illegible]
C0411	KALBHOR SUSHMITA MAHENDRA	[illegible]
C0412	KESKAR SARIKA BHIMRAO	Keskar
C0413	KAPSE SAYALI SUDAM	Kapse
C0414	KUMBHAR YOGITA GORAKH	[illegible]
C0415	LAVHE BHAGYASHREE	[illegible]
C0416	LONKAR SUPRIYA D.	[illegible]
C0417	NIGADE KAJAL RAMESH	Nigade
C0418	NIGADE MANALI SANJAY	Nigade
C0419	NIGADE PRATIKSHA VIJAY	Nigade.P.V
C0420	NIGADE SNEHAL RAVINDRA	Nigade
C0421	RAJWADE KALYANI	K.S.Rajwade
C0422	RASKAR ANIKET BALASAHEB	[illegible]
C0423	SHAIKH RAJWALA	Shaikh
C0424	SHENDKAR NIKEETA S.	Shendkar
C0425	SHINDE REKHA S.	Shinde
C0426	SORATE POOJA T.	[illegible]
C0427	TAMHANE RUSHALI B.	Rushali.
C0428	WAGH SAYALI SURESH	S.wagh
C0429	JAGADALE POOJA	P.R.Jagadale

Class Coordinator

Head of Department

Sumeshwar Engineering College
DTE Code 6795
Someshwarnagar, Tal. Baramati 412306

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Department Of Civil Engineering

Certificate

This Certificate is awarded to Mr./~~Ms.~~ Khutale Nikhil

for successful participation / ~~organization~~ of ONE DAY workshop on " **Environmental Audit and Sustainable Development** " *held at* Someshwar Engineering College, Someshwarnagar,

Tal - Baramati Dist - Pune Dated 21.08.2018

Prof.M.N.Chatuphale	Prof.C.V.Naik	Dr. Ajay V. Deshmukh
Co-ordinator	Head of Civil Engineering Department	Principal

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Engineering College
Department Of Civil Engineering

Certificate

This Certificate is awarded to Mr./~~Ms.~~ Jadhav Vivek Shamrao

for successful participation / ~~organization~~ of ONE DAY workshop on **" Environmental Audit and Sustainable Development "** *held at* **Someshwar Engineering College, Someshwarnagar,** *Tal - Baramati Dist - Pune Dated 21.08.2018*

Prof.M.N.Chatuphale
Co-ordinator

Naik C.V.
Prof.C.V.Naik
Head of Civil Engineering Department

Dr. Ajay V. Deshmukh
Principal

Engineering & Technology
DTE CODE
Someshwarnagar

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Department Of Civil Engineering

Certificate

This Certificate is awarded to Mr./~~Ms.~~ Bhandalkar Nagnath

for successful participation / ~~organization~~ of ONE DAY workshop on **" Environmental Audit and Sustainable Development "** *held at* **Someshwar Engineering College, Someshwarnagar,**

Tal - Baramati Dist - Pune Dated 21.08.2018

Prof.M.N.Chatuphale
Co-ordinator

Naik C.V.
Prof.C.V.Naik
Head of Civil Engineering Department

Dr. Ajay V. Deshmukh
Principal

Sharadchandra Pawar College of Engineering & Technology * Someshwarnagar *
DTE CODE

Shri Someshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Department Of Civil Engineering

Certificate

This Certificate is awarded to *Mr./~~Ms.~~* Mulik Ganesh Bhagawan

for successful participation / ~~organization~~ of ONE DAY workshop on **" Environmental Audit and Sustainable Development "** *held at* Someshwar Engineering College, Someshwarnagar,

Tal - Baramati Dist - Pune Dated 21.08.2018

Naik C.V.

Prof.M.N.Chatuphale
Co-ordinator

Prof.C.V.Naik
Head of Civil Engineering Department

Dr. Ajay V. Deshmukh
Principal

Sharadchandra Pawar College of Engineering & Technology
DTE CODE
Someshwarnagar

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S
SOMESHWAR ENGINEERING COLLEGE
At: Gate. No. 53 Waghalwadi, Post. Someshwarnagar, Tal: Baramati, Dist: Pune – 412306, (MH) India
Phone: 02112-283185 | Email: sspm1972@gmail.com | Website: www.secsomeshwar.ac.in

Approved by AICTE, New Delhi and Recognized by Govt. of Maharashtra, Mumbai, Affiliated to Savitribai Phule Pune University, Pune, ID No.: PU/PN/ENG/455/2012, DTE Code: EN-6795

SSPM/SEC/878/2019-20

Date: 05/12/2019

To

CEO,
Rubicon Skill Development Pvt. Ltd,
Pune, Maharashtra

Subject: - Invitation letter for Three days workshop on "**Life Skills training**"

Dear Sir/ Madam,

Someshwar Engineering College, established in 2012, is one of the self-financed Engineering colleges approved by AICTE New Delhi, Government of Maharashtra and DTE Mumbai. The institute is affiliated to Savitribai Phule Pune University (SPPU). The institute offers Engineering Courses in Mechanical Engineering, Civil Engineering, Computer Engineering, and Electrical Engineering leading to BE degree as per SPPU University Curriculum.

It gives us a pleasure to invite you, to conduct **three days workshop** for our Final year students on "**Life Skills training**". Your experience and expertise in this subject would enable our students to gain knowledge. The workshop also aims to focus on those skills which enable an individual to be more competent in dealing with the day to day challenges in a positive way.

The proposed dates for workshop will be from **26th December 2019 to 28th December 2019** and session will start from **9.00 am** onwards up to **5.00 pm**. Hence you are requested to accept our invitation and convey our coordinator for the same.

With regards.

Yours truly,

Someshwar Engineering College
DTE CODE
EN6795
Someshwarnagar, Tal.Baramati 412306

PRINCIPAL
Someshwar Engineering College
Someshwarnagar, Tal.Baramati 412306

SHRI SOMESHWAR SHIKSHAN PRASARAK MANDAL'S

SOMESHWAR ENGINEERING COLLEGE

At: Gate. No. 53 Waghalwadi, Post. Someshwarnagar, Tal: Baramati, Dist: Pune – 412306, (MH) India

Phone: 02112-283185 | Email: sspm1972@gmail.com | Website: www.secsomeshwar.ac.in

Approved by AICTE, New Delhi and Recognized by Govt. of Maharashtra, Mumbai, Affiliated to Savitribai Phule Pune University, Pune, ID No.: PU/PN/ENG/455/2012, DTE Code: EN-6795

SSPM/SEC/ 878 /2019-20 Date: 05/12/2019

To

CEO,
Rubicon Skill Development Pvt. Ltd,
Pune, Maharashtra

Subject: - Invitation letter for Three days workshop on **"Life Skills training"**

Dear Sir/ Madam,

Someshwar Engineering College, established in 2012, is one of the self-financed Engineering colleges approved by AICTE New Delhi, Government of Maharashtra and DTE Mumbai. The institute is affiliated to Savitribai Phule Pune University (SPPU). The institute offers Engineering Courses in Mechanical Engineering, Civil Engineering, Computer Engineering, and Electrical Engineering leading to BE degree as per SPPU University Curriculum.

It gives us a pleasure to invite you, to conduct **three days workshop** for our Final year students on **"Life Skills training"**. Your experience and expertise in this subject would enable our students to gain knowledge. The workshop also aims to focus on those skills which enable an individual to be more competent in dealing with the day to day challenges in a positive way.

The proposed dates for workshop will be from **26th December 2019 to 28th December 2019** and session will start from **9.00 am** onwards up to **5.00 pm**. Hence you are requested to accept our invitation and convey our coordinator for the same.

With regards.

Yours truly,

PRINCIPAL
Someshwar Engineering College
Someshwarnagar Tal.Baramati 412306

SHRI SOMESHWAR SHIKSHAN PRASARAKMANDAL'S

SOMESHWAR ENGINEERING COLLEGE

At: Gate. No. 53 Waghalwadi, Post. Someshwarnagar, Tal: Baramati, Dist: Pune – 412306, (MH) India

Phone: 02112-283185 | Email: sspm1972@gmail.com | Website: www.secsomeshwar.ac.in

Approved by AICTE, New Delhi and Recognized by Govt. of Maharashtra, Mumbai, Affiliated to SavitribaiPhule Pune University, Pune, ID No.: PU/PN/ENG/455/2012, DTE Code: EN-6795

Date- 18/12/2019

NOTICE

All the students of **Final Year Engineering** are hereby informed that, 3 days Training on ***Interview Skills*** (Communication and Employability skills) is organized on **26th , 27th and 28th (Thursday to Saturday)** of December 2019 in our college. Attendance is must; training will start on 8:30am to 5:00pm for all three days.

In Life training below topics will be covered:

1. Public speaking
2. Presentation skills
3. E mail Etiquette
4. Group discussion
5. Personal Interview etc.

Training & Placement Officer

Prof. Nigade Y. M.

(9975159181.)

Someshwar Engineering College ★ Someshwarnagar, Tal.Baramati 412306 ★ DTE Code 6795

Principal

PRINCIPAL

Someshwar Engineering Colle

Someshwarnagar, Tal-Baramati 4123

SHRI SOMESHWAR SHIKSHAN PRASARAKMANDAL'S
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Ref. SSPM/SEC/876/2019-20 Date- 18 / 12 / 2019

To,

Managing Director,

SSSK Someshwarnagar.

Sub: About arrangement of accommodation at Guest house for trainers.

Respected sir,

As per above mentioned subject, We Someshwar Engineering college have organized **three days training workshop** for our final year degree and diploma students. Three trainers are coming from Delhi (by Rubicon supported by Barclays) to train our students free of cost, We have to provide them accommodation.

So we kindly request you to provide two guest rooms for accommodation purpose for three days.

Thanking you,

Yours faithfully,

Principal

Dr.S.R.Gawade

PRINCIPAL
Someshwar Engineering College
Someshwarnagar, Tal.Baramati 412306

Someshwar Engineering College Someshwarnagar, Tal-Baramati 412306 DTE CODE EN-6795

23.12.19

श्री सोमेश्वर सह.साखर कारखाना लि.
सोमेश्वरनगर-४१२३०६ ता.बारामती(पुणे)

rubicon

Rubicon Training Outline

New Hire Training/ Personality Development/ Employability Skills			
Sr. No.	Topic	Learning Objectives	Duration
1	Expectation setting	To learn Industry expectations from freshers	1
2	Ice breaking	To know more about the trainer & candidates	1
3	Organizational Structure	To learn Organizational structure	2
4	SWOT Analysis	To identify their Strength/Weakness/Opportunities/ Threat	2
5	Corporate Jargons	To learn most commonly used words in corporates	1
6	Public Speaking	To eliminate stage fear	2
7	Presentation Skills	To articulate your thoughts through Power point presentation	2
8	E-mail Etiquette	To learn E-mail writing skills	2
9	Grooming	Dress to impress/ Proximity/ Personal hygiene/	2
10	Body language	To learn positive body language	1
11	Telephone Etiquette	To handle telephonic round of interview/ To learn call mechanics	2
12	Group Discussion	To access candidates' public speaking skills	2
13	Personal Interview	To perform well during interviews	4
		Total	**24 hrs**

Someshwar Engineering College
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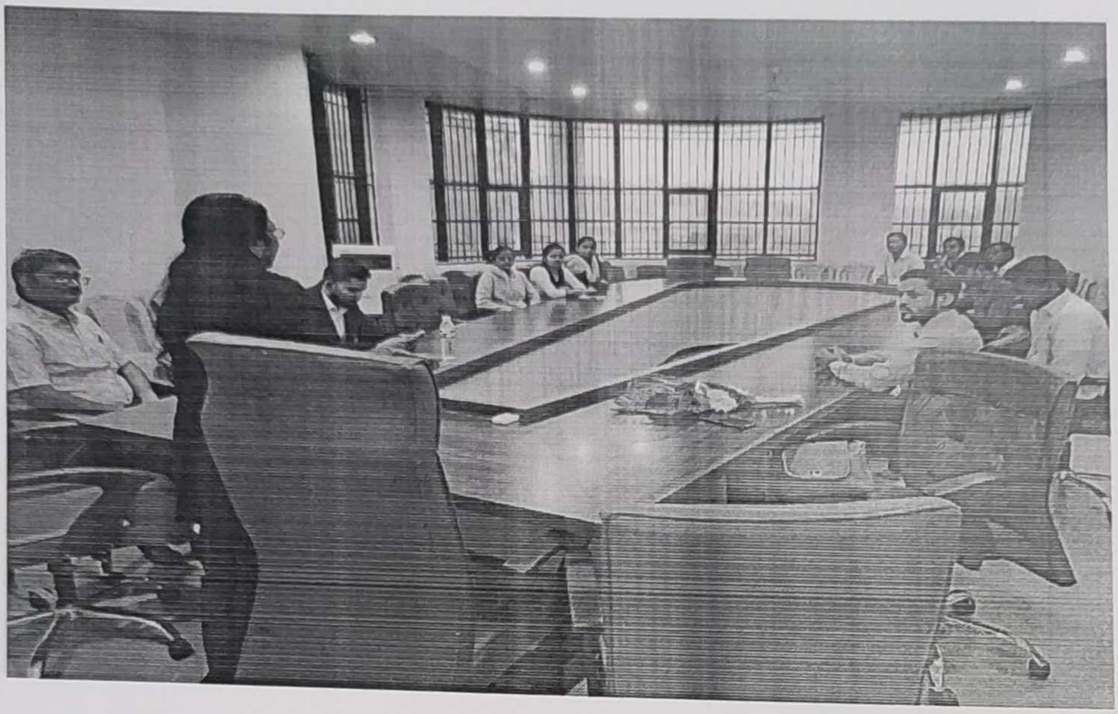

Guest Trainer Felicitation

Someshwar Engineering College
DTE Code 6795
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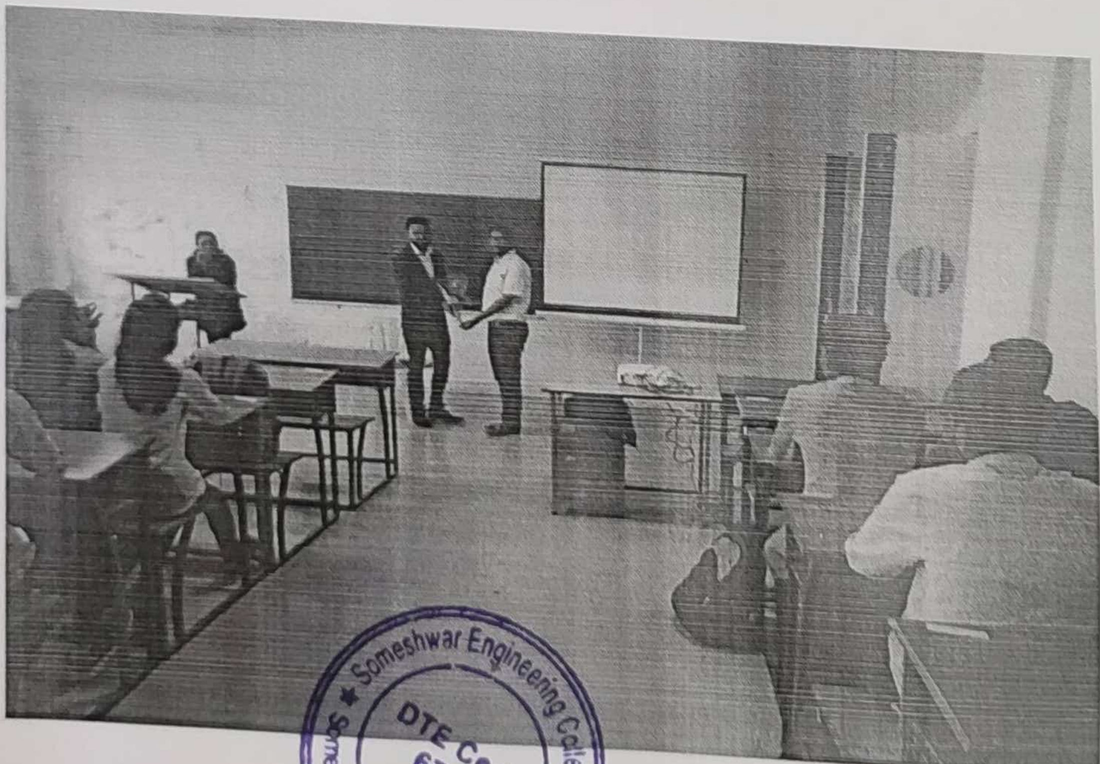
Skill Development Activities



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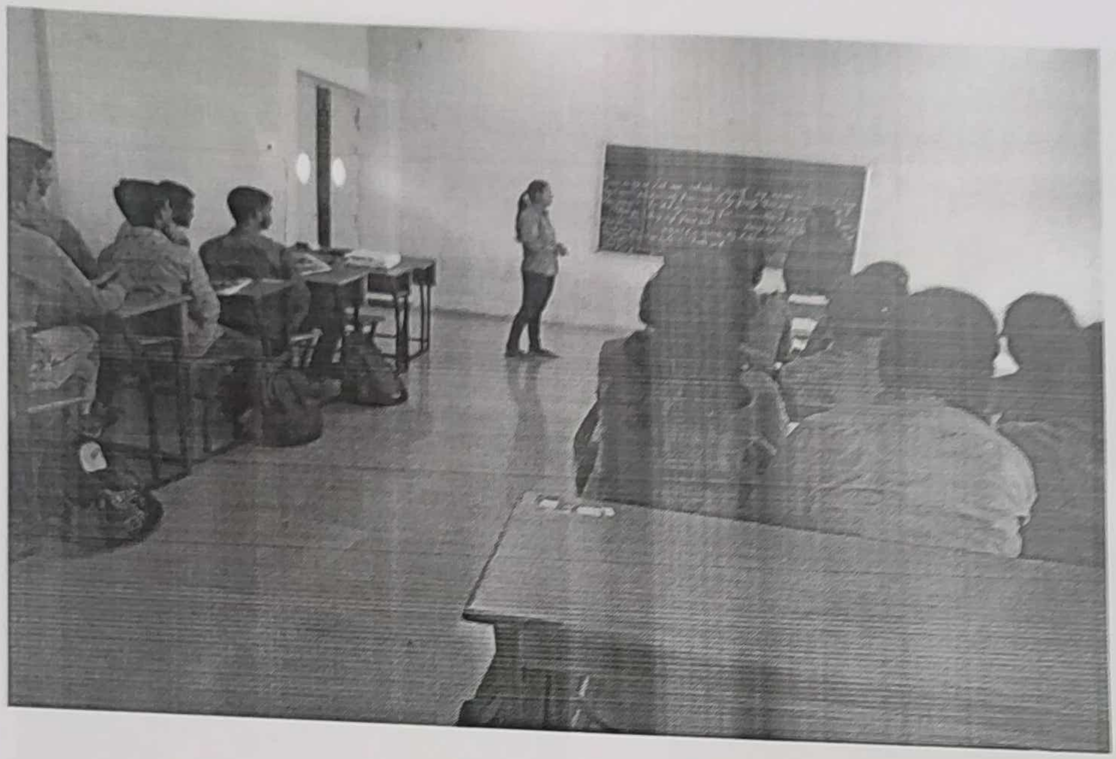

Skill Developement Activities

Someshwar Engineering College ★ DTE Code 6795 Someshwarnagar, Tal.Baramati 412306

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Workshop Report




Name of Guest speakers-

1. Mrs. Shakila M. Bhojani
2. Mr. Deepak Parmar

Organization – Rubicon Skill Development Pvt. Ltd. Pune, Maharashtra.

Dates of workshop- 26th, 27th and 28th December 2019

Staff Coordinator- Prof. Y.M. Nigade

Objectives- This lecture will be helpful to students in understanding:

2. Public Speaking
3. Presentation Skills
4. E-mail etiquettes
5. Group discussion
6. Personal interview skills

Outcome of Workshop-

- It developed the way of seeing problems and letting to prepare to handle difficult situations among students to make them ready for Job.
- It provided intrinsic motivation for personality development and made them confident in public speaking.

Information of Trainers in brief-

1. **Name of Trainer-** Mrs. Shakila M. Bhojani
   Designation- Soft Skills Trainer
   Qualification- M.A. M. Ed (English Literature),
   CAE/TKT/BEC (Cambridge English Recognition)

2. **Name of Trainer-** Mr. Deepak Parmar
   Designation- Soft Skills Trainer
   Qualification- M.A. (Psychology),
   Certified Trainer (Tata Inst. of Social Sciences)

Value addition through Workshop- Besides the objectives, following additional information understood by the students.

- Mock Interview
- Grooming and Body language during interview

Someshwar Engineering College
DTE Code 6795
Someshwarnagar, Tal.

Someshwar Engineering College, Someshwarnagar

Students Attendance

Three days Training workshop on "Life Skills"

Day : 1 (Thursday) Date 26/12/2019 Session –

ROLL NO.	NAME OF STUDENT	BRANCH	SIGN
1.	Jagatap Yogesh mohan	Mechanical	Jagtap y.m
2.	Sangilkar Digambar Tukaram	Mechanical	Sangilkar
3.	Nimbalkar Hrushikesh Mahadeo	Mechanical	[illegible]
4.	Holkar Pavan Chandrakant	Mechanical	[illegible]
5.	Sheldar Shubham Balaso	Mechanical	S.B.Sheldar
6.	Tamboli Sahil Salim	Mechanical	Tamboli S.S
7.	Raskar Aniket Balasaheb	Computer	Raskar A.B
8.	Raipure Yogesh Bapurao	Mechanical	[illegible]
9.	Kajale Ravi G	Comp	Kajale
10.	Kadam Tejashree S	Electrical	[illegible]
11.	Nigade kajal Ramesh	Computer	K.R.Nigade
12.	Kapse Sayali Sudam	Computer	Kapse S.S
13.	Bhagat Vaishnavi Sanjay	Computer	[illegible]
14.	Kakade Ajinkya Hanumant	Civil	A.Kakade
15.	Jadhav Ashwini Vishwas	Computer	Jadhav A.V
16.	Shinde Rekha Sunil	Computer	Shinde
17.	Nigade Pratiksha Vijay	Computer	Nigade.P.V.
18.	Jagtap Sushma Arjun	Mech.	S.A.Jagtap
19.	Sonawane Harshali R.	Mech.	H.Sonawane
20	Nigade Manali Sanjay	Comp	M.S.Nigade
21	Kumbhar Yogita Gorakh	Comp	Kumbhar

Someshwar Engineering College ★ DTE Code 6795 Someshwarnagar, Tal.Baramati 412306 ★

Someshwar Engineering College, Someshwarnagar

Students Attendance

Three days Training workshop on "Life Skills"

Day : 1 (Thursday) Date 26/12/2019 Session -

ROLL NO.	NAME OF STUDENT	BRANCH	SIGN
1.	Dugade Ketan Shrikrishna	Mechanical	Dugade
2.	Gole Sanket Vijay	Mechanical	[illegible]
3.	Lokhande shubham pramod	mechanical	[illegible]
4.	Dipak Sarang Dixit	Mechanical	Dixit
5.	Jagtap Tejas Baburao	Mechanical	Jagtap
6.	Jagtap Prakash Arjun.	Mechanical	Jagtap
7.	Mhaske ketan Raychand	Mechanical	KRMhaske
8.	Gawade Nikhil Pandurang	mechanical	[illegible]
9.	Bhoite Ganesh Mohan	mechanical	GBhoite
10.	Nikam Adesh Vikas	Mechanical	A.V.Nikam
11.	Bhapkar Rohan Sanjay	Mechanical	RBhapkar
12.	Ghadge Sourabh Dharmakumar	mechanical	Ghadge
13.	Kudale Tushar Arvind.	Electrical	[illegible]
14.	Bhandwalkar Sanket	electrical	Sanket
15	Bhilare Saurav	Computer	Bhilare
16	Shinde Ranjit	Computer	Shinde
17	Golande Ashwini Dilip	Computer	[illegible]
18	Rangole Sonal Dattatray.	mechanical	Rangole.
19	Gaikwad Pranali Jitendra	computer	Gaikwad
20.	kulkarni Vaishnavi Sandip	computer	Vkulkarni
21.	Dhumal Prachi Ashok	civil	Dhumal
22.	Gadhave Monika Gunvant	civil	Gadhave
23.	Nalawade Ashvini Ramhari	civil	[illegible]
24.	Bhosale Rohan parabati	Mechanical	[illegible]
25.	Jagtap Abhishek Dasharath	Mechanical	[illegible]

S.meshwar Engineering College ★ Someshwarnagar, Tal.Baramati 412306 ★ DTE Code 6795

Students Attendance

Three days Training workshop on "Life Skills"

Day : Date Session

ROLL NO.	NAME OF STUDENT	BRANCH	SIGN
26	Gade vishal Somnath	TY electrical	Gade
27	Durgade Shivam Chandrakant	TY Electrical	Durgade
28	Kalkhaire Varad Devidas	TY Computer	Kalkhaire
29	Mulik Nilesh Sukhadev	TY Electrical	Mulik
30	Dhaygude Ajay Shamrao	TY Electrical	A. Dhaygude
31	Kutwal Prashant Kantilal	TY EE	P. Kutwal
32.	Madane Prajwal Dhananjay	TY CE	Prajwal
33	Dadas Adesh Vitthal.	TYCE	A. Dadas

Someshwar Engineering College, Someshwarnagar

Students Attendance

Three days Training workshop on "Life Skills"

Day: 2 (Friday) Date 27/12/2019. Session

ROLL NO.	NAME OF STUDENT	BRANCH	SIGN
1)	Holker Pavan C	Mechanical	[illegible]
2)	Nimbalkar Hrushikesh mahadeo	mechanical	[illegible]
3)	Sangilkar Digambar T	Mechanical	[illegible]
4)	Jagtap Yogesh Mohan	Mechanical	Jagtap
5)	Rastrae Aniket Balasaheb	Computer	[illegible]
6)	Kakade Ajinkya Hanumant	Civil	Akakade
7)	Tamboli Sahil Salim	Mech	[illegible]
8)	Shelar Shubham Balasa	Mech	S.B.Shelar
9)	Rajpure Yogesh Bapurao	Mech	[illegible]
10)	Sonawane Harshali Ramesh	Mech	[illegible]
11)	Jagtap Sushma Arjun	Mechanical	SAJagtap
12)	Harihar swapnali sunil	civil	[illegible]
13	Bhagat Vaishnavi Sanjay	Computer	[illegible]
14	Sorate Puja Tanaji	Computer	Sorate
15	Holkar madhuri santosh	computer	MHolkar

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Someshwar Engineering College, Someshwarnagar

Students Attendance

Three days Training workshop on "Life Skills"

Day : 3 (Saturday) Date 28/12/2019 Session -

ROLL NO.	NAME OF STUDENT	BRANCH	SIGN
1	Kakade Ajinkya Hanumant	Civil	Akakade
2	Nimbalkar Hrushikesh M.	Mechanical	[illegible]
3	Raskar Aniket Balasaheb	Computer	[illegible]
4)	Holkar Pavan Chandrakant	Mechanical	[illegible]
5)	Sangilkar Digambar T	Mechanical	Sangilkar
6)	Jagtap Yogesh Mohan	Mechanical	YJ
7)	Sonawane Harshali Ramesh	Mechanical	[illegible]
8)	Jagtap Sushma Arjun	Mechanical	SAJagtap
9)	Harihar swapnali sunil	civil	SSharihar
10)	kadam mayuri sunil	comp	Kadamms
11)	Jadhav Ashwini Vishwas	Comp	Jadhav
12)	Nigade Snehal Ravindra	comp.	Nigade
13)	Nigade kajal Ramesh	comp.	KRNigade
14)	Nigade Pratiksha Vijay	Computer	Nigade.P.V
15)	Nigade Manali Sanjay	Computer	MSNigade
16)	Sorate Puja Tanaji	Computer	Sorate
17)	Holkar madhuri santosh	computer	MHolkar
18)	Bhagat Vaishnavi Sanjay	Computer	[illegible]

Someshwar Engineering College
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6795
Someshwarnagar, Tal. ... 412306

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR	Record No:- Revision:- Date:-

STUDENT FEEDBACK FORM

3 Days Workshop on

"Life Skill Training"

Sr. No.	Criteria	Excellent	Very Good	Good	Average	Poor
1	Usefulness of covered topics	✓				
2	Utilization of specified time for each session	✓				
3	Seating and presentation arrangement		✓			
4	Presentation skill of trainer	✓	~~✓~~			
5	Interaction with trainer	✓				
6	Helpfulness for placement and interview	✓				
7	Motivation to participant for active participation		✓			
8	Usefulness for personality development and upgrading confidence level	✓				
9	Institute's contribution in arranging the workshop		✓			
10	Value addition to regular curriculum		✓			
	How could this workshop be improved?					
	Any other comments or suggestions?	overall training is very good. & helpful for us				

Overall rating of workshop

Excellent	Very Good	Good	Average	Poor
	✓			

Someshwar Engineering College
DTE Code 6795
Someshwarnagar, Tal.Ba...

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR	Record No.- Revision:- Date:-

STUDENT FEEDBACK FORM

3 Days Workshop on

"Life Skill Training"

Sr. No.	Criteria	Excellent	Very Good	Good	Average	Poor
1	Usefulness of covered topics	✓				
2	Utilization of specified time for each session	✓				
3	Seating and presentation arrangement	✓				
4	Presentation skill of trainer	✓				
5	Interaction with trainer	✓				
6	Helpfulness for placement and interview	✓				
7	Motivation to participant for active participation		✓			
8	Usefulness for personality development and upgrading confidence level	✓				
9	Institute's contribution in arranging the workshop		✓			
10	Value addition to regular curriculum		✓			
	How could this workshop be improved?					
	Any other comments or suggestions?	overall training is very well.				

Overall rating of workshop

Excellent	Very Good	Good	Average	Poor
	✓			

Someshwar Engineering College
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Someshwarnagar, Tal. Baramati 412306

rubicon

Sr No:-	Student Name	Department	Trainers Communication Skills					Students Understandability from Trainers					Trainers Presentation skill					Signature of the student
			5	4	3	2	1	5	4	3	2	1	5	4	3	2	1	
59	Dipak Dixit	Mechanical	✓					✓					✓					Dixit
60	Sanket Gole	Mechanical	✓					✓					✓					[illegible]
61	Tejas Jagtap	Mechanical	✓					✓					✓					Jagtap
62	Prakash Jagtap	Mechanical	✓					✓					✓					Jagtap
63	Abhishek Jaytap	Mechanical	✓					✓					✓					Abhishek
64	Bhandwalkar Sanket	electrical	✓					✓					✓					Sanket
65	Gade Vishal	Electrical	✓					✓					✓					Gade
66	Durgade Shivam	Electrical	✓					✓					✓					Durgade
67	Rohan Bhosale	Mechanical	✓					✓					✓					Bhosale
68	Adesh Nikam	Mechanical	✓					✓					✓					Nikam
69	Shubham lokhande	Mechanical	✓					✓					✓					[illegible]
70	Ketan Durgade	Mechanical	✓					✓						✓				Durgade
71	Saurabh Jadhav	Mechanical	✓					✓						✓				Jadhav
72	Saurav Bhilare	Computer	✓					✓					✓					SBhilare
73	Ranjit Shinde	Computer	✓					✓					✓					Shinde
74	Gadade Shubham	mechanical	✓					✓					✓					[illegible]
75	Gawade Nikhil	Mechanical	✓					✓					✓					[illegible]
76	Bhapkar Rohan	Mechanical	✓					✓					✓					RBhapkar
77	Ghadge Saurabh	Mechanical	✓					✓					✓					Ghadge
78	Mhaske Ketan	mechanical	✓					✓					✓					KMhaske
79	Bhoite Ganesh	mechanical	✓					✓					✓					GBhoite
80	Dhumal Prachi	Civil	✓					✓					✓					Dhumal
81	Gadhave Monika	Civil	✓					✓					✓					Gadhave
82	Kulkarni Vaishnavi	Computer	✓					✓					✓					Kulkarni
83	Gaikwad Pranali	Computer	✓					✓					✓					P.J. Gaikwad
84	Golande Ashwini	Computer	✓					✓					✓					Golande
85	Rangole Sonal	Mechanical	✓					✓					✓					Rangole
86																		
87																		
88																		
89																		
90																		

THANK YOU FOR COMPLETING THIS EVALUATION FORM

Signature of Trainer:-

Someshwar Engineering College ★ DTE Code 6795 ★ Someshwar nagar, Tal.Baramati 412306

Date-16/11/2019

To,
The Principal,
Someshwar Engineering College,
Someshwarnagar,

Subject: - Regarding permission for arranging Three days workshop on
"Life Skills training"

Respected Sir,

With reference to above subject, it is proposed to arrange **three days workshop (24 Hrs)** on **"Life Skills training"** for all Final Year students. Following are the details of Trainers:

1. **Name of Trainer-** Mrs. Shakila M. Bhojani
   Designation- Soft Skills Trainer
   Qualification- M.A. M. Ed (English Literature),
   CAE/TKT/BEC (Cambridge English Recognition)

2. **Name of Trainer-** Mr. Deepak Parmar
   Designation- Soft Skills Trainer
   Qualification- M.A. (Psychology),
   Certified Trainer (Tata Inst. of Social Sciences)

Objectives- This lecture will be helpful to students in understanding:

1. Organizational structure
2. Public Speaking
3. Presentation Skills
4. E-mail etiquettes
5. Group discussion
6. Personal interview skills

We recommend it for enhancing our student's academic record and enabling them for interviews. So we request you to allow us for the arranging the same in last week of December 2019.

Thanking you in anticipation.

Someshwar Engineering College ★ Someshwarnagar, Tal.Baramati 412306 ★ DTE Code 6795

Yours faithfully,

16/11/19

(Prof. Nigade Yogesh M.)
(T.P.O.)

Date-16/11/2019

To,
The Principal,
Someshwar Engineering College,
Someshwarnagar,

Subject: - Regarding permission for arranging Three days workshop on
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Yours faithfully,

16/11/19

(Prof. Nigade Y. M.)
(T.P.O.)

	SOMESHWAR SHIKSHAN PRASARAK MANDAL'S SOMESHWAR ENGINEERING COLLEGE, SOMESHWARNAGAR	Record No:- Revision:- Date:-

STUDENT FEEDBACK FORM

3 Days Workshop on

"Life Skill Training"

Sr. No.	Criteria	Excellent	Very Good	Good	Average	Poor
1	Usefulness of covered topics	✓				
2	Utilization of specified time for each session	✓				
3	Seating and presentation arrangement	✓				
4	Presentation skill of trainer	✓				
5	Interaction with trainer	✓				
6	Helpfulness for placement and interview	✓				
7	Motivation to participant for active participation		✓			
8	Usefulness for personality development and upgrading confidence level	✓				
9	Institute's contribution in arranging the workshop		✓			
10	Value addition to regular curriculum		✓			
	How could this workshop be improved?	~~In this session~~				
	Any other comments or suggestions?	overall training is very good.				

erall rating of workshop

Excellent	Very Good	Good	Average	Poor
	✓			

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3 Days Workshop on

"Life Skill Training"

Sr. No.	Criteria	Excellent	Very Good	Good	Average	Poor
1	Usefulness of covered topics	✓				
2	Utilization of specified time for each session	✓				
3	Seating and presentation arrangement	✓				
4	Presentation skill of trainer	✓				
5	Interaction with trainer	✓				
6	Helpfulness for placement and interview	✓				
7	Motivation to participant for active participation	✓				
8	Usefulness for personality development and upgrading confidence level	✓				
9	Institute's contribution in arranging the workshop	✓				
10	Value addition to regular curriculum	✓				
	How could this workshop be improved?	Improve my English talking and also self confidence.				
	Any other comments or suggestions?					

Overall rating of workshop

Excellent	Very Good	Good	Average	Poor
✓				

Someshwar Engineering College ★ Someshwarnagar, Tal. Baramati 412306 ★ DTE Code 6795

PRASARAK MANDAL'S

SOMESHWAR ENGINEERING COLLEGE,
SOMESHWARNAGAR

Ref. No. -

Ref. No. -

Date-

STUDENT FEEDBACK FORM

3 Days Workshop on

"Life Skill Training"

Sr. No.	Criteria	Excellent	Very Good	Good	Average	Poor
1	Usefulness of covered topics	✓				
2	Utilization of specified time for each session	✓				
3	Seating and presentation arrangement	✓				
4	Presentation skill of trainer	✓				
5	Interaction with trainer	✓				
6	Helpfulness for placement and interview	✓				
7	Motivation to participant for active participation	✓				
8	Usefulness for personality development and upgrading confidence level	✓				
9	Institute's contribution in arranging the workshop	✓				
10	Value addition to regular curriculum	✓				
	How could this workshop be improved?					
	Any other comments or suggestions? #Awesome.					

Overall rating of workshop

Excellent	Very Good	Good	Average	Poor
✓				

Someshwar Engineering College ★ DTE Code 6795 Someshwarnagar, Tal. Baramati 412306

ShriSomeshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Someshwarnagar,Tal – Baramati,Dist – Pune 412306

(Approved by AICTE New Delhi, Recognized by Govt. of Maharashtra &
Affiliated to University of Pune, Id.no.PU/PN.Engg./445/2012)
Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.coesomeshwar.com * E-Mail coesomeshwar@gmail.com

TREE PLANTATION

Objectives of the programs :

To encourage the students about plantation & conservation of trees for the benefit of the environment and ecosystem.

Description of Programs :

The greenery around us provided by trees makes us live a healthy and pleasant life. Planting trees is vital to maintain a balance in the ecosystem For the preservation of the green environment, the Institute organized a tree plantation Drive program every year. The objectives of events to create awareness and educate the students for plantation of trees and about the protection of the environment.


Tree plantation by students on college campus

All faculty members and management body planting tree on college campus

ShriSomeshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Someshwarnagar,Tal – Baramati,Dist – Pune 412306

(Approved by AICTE New Delhi, Recognized by Govt. of Maharashtra &
Affiliated to University of Pune, Id.no.PU/PN.Engg./445/2012)
Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.coesomeshwar.com * E-Mail coesomeshwar@gmail.com

SOFT SKILL PROGRAM

Name of Guest Speakers: Mr. Abhishek Wakodkar

Organization: ABHISHRI ACADEMY Pvt. Ltd. Pune

Date of Workshop- 18th and 19th Feb 2020

Staff Coordinator: Mr. Khalate R. N.

Objectives: This Workshop will be helpful to students in understanding the following topics:

1. Presentation Skills
2. Group discussion
3. Personal Interview Skills
4. Aptitude Preparation

Outcomes of Workshop-

- It developed the student to handle the difficult situation as well as to make him ready for job.
- It's built up the student attitude and inspires him to develop personalities and made them confident.

Information of Trainers in Brief:

Name of Trainer: Mr. Abhishek Wakodkar

Designation: Founder and director

Organization: ABHISHRI Academy

Qualification: B.E. (Computer Engineering)

ShriSomeshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Someshwarnagar,Tal – Baramati,Dist – Pune 412306

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Votes of thanks to Guest Trainer on behalf of Someshwar Engineering College for conclude the Program.

Soft Skill and Aptitude Session

Sharadchandra Pawar College of Engineering & Technology
DTE CODE
Someshwarnagar

ShriSomeshwar Shikshan Prasarak Mandal's

Someshwar Engineering College

Someshwarnagar,Tal – Baramati,Dist – Pune 412306

(Approved by AICTE New Delhi, Recognized by Govt. of Maharashtra &
Affiliated to University of Pune, Id.no.PU/PN.Engg./445/2012)
Ph. (02112) 283185 * Fax : (02112) 283185
Web :www.coesomeshwar.com * E-Mail coesomeshwar@gmail.com

Student Activites during the Aptitude session

Savitribai Phule Pune University, Pune

Syllabus for BE Civil Engineering (2019 Pattern)

Implemented from Academic year 2022-23

Board of Studies in Civil Engineering

Faculty of Science and Technology

Savitribai Phule Pune University, Pune
BE (Civil Engineering) 2019 Pattern
(With effect from Academic Year 2022-23)

SEMESTER: VII

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
401001	Foundation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401002	Transportation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401003	Elective III	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401004	Elective IV	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401005	Project Stage I	--	04	--	--	--	50	--	50	100	--	01	--	02	--	03
401006	Transportation Engineering **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401007	Elective III **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401008	Elective IV **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401009	Computer Programming in Civil Engineering	01	02	--	--	--	50	--	--	50	--	02	--	--	--	02
401010	Audit Course I **Stress Management by Yoga / Communication Etiquette in Workplaces**	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**13**	**12**	**01**	**120**	**280**	**150**	**--**	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**

Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade

Elective III and IV

S N	Course Code	Elective III: Course Name	Course Code	Elective IV: Course Name
01	401003 a	Coastal Engineering	401004 a	Air Pollution and Control
02	401003 b	Advanced Design of Concrete Structures	401004 b	Advanced Design of Steel Structures
03	401003 c	Integrated Water Resources Planning & Management	401004 c	Statistical Analysis and Computational Method
04	401003 d	Finite Element Method	401004 d	Airport and Bridge Engineering
05	401003 e	Data Analytics	401004 e	Design of Prestressed Concrete Structures
06	401003 f	Operation Research	401004 f	Formwork and Plumbing Engineering

SEMESTER-VIII																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
401011	Dams and Hydraulics Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401012	Quantity Surveying, Contracts and Tenders	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401013	Elective V	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401014	Elective VI	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401015	Project Stage II	--	10	--	--	--	100	--	50	150	--	03	--	02	--	05
401016	Dams and Hydraulics Structures **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401017	Quantity Surveying, Contracts and Tenders **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401018	Elective V **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401019	Audit Course II **Social Responsibility / Human Rights**	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**16**	**01**	**120**	**280**	**150**	**--**	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																

Elective V and VI

S N	Course Code	Elective V: Course Name	Course Code	Elective VI: Course Name
01	401013 a	Earthquake Engineering	401014 a	TQM and MIS
02	401013 b	Structural Design of Bridges	401014 b	Advanced Transportation Engineering
03	401013 c	Irrigation and Drainage	401014 c	Geo Synthetic Engineering
04	401013 d	Design of Precast and Composite Structures	401014 d	Structural Design of Foundations
05	401013 e	Hydropower Engineering	401014 e	Green Structures and Smart Cities
06	401013 f	Structural Audit and Retrofitting of Structures	401014 f	Rural Water Supply and Sanitation

Programme Outcomes

S N	Programme Outcomes	Programme Outcomes Statement
01	Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
02	Problem Analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
03	Design/Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
04	Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
05	Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
06	The Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
07	Environment and Sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
08	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
09	Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-Long Learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401001: Foundation Engineering

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering Mechanics and Soil Mechanics

Course objectives

01 To know various methods for subsurface investigations for foundations.
02 To learn to perform geotechnical design of shallow and deep foundations.
03 To study the problems related to foundations on expansive soil and ways to solve them.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Perform subsurface investigations for foundations using different methods.
02 Estimate the bearing capacity of shallow foundations.
03 Calculate immediate and primary consolidation settlement of shallow foundations.
04 Decide the capacity of a pile and pile group.
05 Understand the steps in geotechnical design of shallow foundations and well foundations.
06 Analyze problems related to expansive soil and overcome them using design principles, construction techniques in black cotton soil.

Course Content

Unit 1: Subsurface Investigations for Foundations (06 hours)

Purpose and planning of subsurface exploration, methods of Investigation: trial pits, borings, depth & number of exploration holes, core recovery, RQD, core log, geophysical methods: seismic refraction and electrical resistivity method, disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler, field tests- SPT, N value correction and significance, DCPT, SCPT and introduction of advanced testing techniques like pressure meter test, borelog, contents of sample soil investigation report.

Unit 2: Bearing Capacity (06 hours)

Basic definitions, modes of shear failure, bearing capacity analysis- Terzaghi's, Hanson's, Meyerhof's, Skempton's, Vesics equations and IS code method - rectangular and circular footings, bearing capacity evaluation: plate load test and SPT, Housel's perimeter shear concept, bearing capacity of layered soil, effect of water table on bearing capacity, effect of eccentricity, presumptive bearing capacity

Unit 3: Immediate and Consolidation Settlement (06 hours)

Immediate Settlement: introduction, causes of settlement, pressure bulb, contact pressure, significant depth of foundation, allowable settlement, differential settlement - I. S. criteria, components of settlement, use of plate load test and SPT in settlement analysis and allowable soil pressure.

Consolidation Settlement: introduction, spring analogy, Terzaghi's consolidation theory, laboratory consolidation test, determination of coefficient of consolidation- square root of time fitting method and logarithm of time fitting method, time factor, rate of settlement and its applications in shallow foundations, introduction of normal consolidation, over consolidation and pre consolidation pressure.

Unit 4: Pile Foundations **(06 hours)**

Introduction: pile classification according to different criteria, pile installation - Cast in-situ, driven and bored pile, load carrying capacity of pile by static method, dynamic Methods: Engineering news formula, modified ENR formula and modified Hiley formula, pile load test and cyclic pile load test, group action: field rule, rigid block method, negative skin friction, settlement of pile group in cohesive soil by approximate method, uplift capacity of piles, micro piles.

Unit 5 Shallow foundations, Piers and Caissons **(06 hours)**

Shallow Foundations: types and applications, location and depth of footing, principles of design of footing, steps involved in proportioning of footing, proportioning of combined footings – rectangular, trapezoidal and strap footing, raft foundation- types, bearing capacity, floating raft, design of raft foundation- conventional (rigid) method and elastic (flexible) method (only design principles and steps, no numerical).

Piers and Caissons: definitions, types and uses, well foundation: components, sand island method, shapes of wells, tilts and shifts: precautionary and remedial measures, bearing capacity and depth of well foundation, forces acting on well foundations, lateral stability of well foundation – Terzaghi's method, IRC method, ultimate soil resistance method (only numerical on lateral stability analysis, no derivation for methods).

Unit 6: Cofferdams and Foundation on Black Cotton Soils **(06 hours)**

Cofferdams: types and applications, contiguous pile walls, RC Diaphragm wall method. Foundation on Black Cotton Soils: characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, swelling pressure measurement, foundations on black cotton soil: design principles, construction techniques, under reamed piles: design principles and its construction techniques, stone columns, pre loading with prefabricated vertical drains/sand drains.

Text books

01 Foundation Engineering by P. C. Varghese, PHI Learning Pvt. Ltd.
02 Soil Mechanics and Foundation Engineering by A. K. Arora, Standard Publishers.
03 Soil Mechanics and Foundation Engineering by V. N. S Murthy, Marcel Dekker, Inc. New york.
04 Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publicationselhi.

Reference books

01 Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. Rao, New Age International Publishers.
02 Principles of Foundation Engineering, Braja M. Das, PWS Publishing Company.
03 Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill.
04 Foundation Analysis and Design, J. E. Bowels, McGraw-Hill.
05 Geotechnical Engineering by Conduto, PHI, New Delhi.
06 Soil Mechanics & Foundation Engineering by Rao, Wiley

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022

401002: Transportation Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Infrastructural Engineering and Construction Materials

Course objectives
01 To learn principles and practices of transportation planning
02 To describe traffic studies, their analysis and their interpretation.
03 To learn Geometric Design of Cross Sectional Elements of pavement.
04 To study characteristic, properties and testing procedures of highway materials.
05 To enumerate different types of pavements and design of flexible and rigid pavement
06 To understand the fundamentals of Bridge Engineering and Railway Engineering

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand principles and practices of transportation planning.
02 Demonstrate knowledge of traffic studies, analysis and their interpretation.
03 Design Geometric Elements of road pavement.
04 Evaluate properties of highway materials as a part of road pavement.
05 Appraise different types of pavements and their design.
06 Understand the fundamentals of Bridge Engineering and Railway Engineering

Course Content

Unit 1: Highway development and planning (06 hours)
History , development plans, classification of roads, road patterns, road development in India: vision 2021, rural road development vision 2025, current road projects in India, highway alignment, highway project report preparation, (planning surveys & master plans based on saturation system).problems based on saturation system.

Unit 2: Traffic Engineering and control (06 hours)
Traffic characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings), accident studies, types of road intersections, parking studies; highway lighting, problems.

Unit 3: Geometric design of highways (06 hours)
Introduction, highway cross section elements, sight distance, design of horizontal alignment, problems of horizontal alignment, design of vertical alignment, design of intersections.

Unit 4: Pavement materials (06 hours)
Materials used in highway construction and related tests: soil subgrade and CBR Test, stone aggregates, bituminous binders, bituminous paving mixes, viscosity based gradation of bitumen, modified bitumen cutbacks, emulsions, crumbed rubber modified bitumen, polymer modified bitumen, foamed bitumen, Marshall stability mix design and test (All 5 test parameters).

.**Unit 5: Pavement Design** **(06 hours)**

Introduction to various types of pavement, flexible pavements: computation of design traffic (vehicle damage factor, lane distribution factor, and traffic growth rate), flexible pavements, computation of design traffic, problems, stresses in flexible pavements, design guidelines for flexible pavements as per IRC 37-2018 without numerical. Rigid pavements: components and functions, factors affecting design, ESWL, Stresses in rigid pavements, wheel load stresses and temperature stresses, design guidelines for concrete pavements as per IRC 58-2015 without numerical, Joints in CC pavements, problems, highway drainage: subsurface and surface drainage.

Unit 6: Bridge and railway Engineering **(06 hours)**

Bridge Engineering: classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads. Loads on bridges: brief specifications of different loads, forces and stresses coming on bridges as per IRC, Substructure: abutment, piers, and wing walls with their types. Railway Engineering: role and necessity of railway, merits of railways with respect to roadways and waterways, permanent way, component parts of permanent way, requirements of an ideal permanent way, gauge: types of gauges and their suitability

Text books

01 Highway Engineering, S. K. Khanna, C. E. G. Justo and A. Veeraragavan, Nem Chand and Brothers.

02 Principles and Practices of Highway Engineering, Dr. L .R. Kadiyali, Khanna Publishers Delhi

03 Principles of Highway Engineering and Traffic Analysis (4th edition), F. L. Mannering and Scott S. Washburn, Wiley India.

04 Highway and Bridge Engineering, B. L. Gupta and Amit Gupta, Standard publishers Distributors.

05 Principles of Railway Engineering, Rangwala, Charotar publication.

Reference books

01 A Course in Highway Engineering, S. P. Bindra, Dhanpat Rai and Sons.

02 Principles of Transportation Engineering, G. V. Rao, Tata MacGraw Hill Publication

03 Highway Engineering, Rangawala, Charotar publishing House.

04 Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, Prentice Hall of India Pvt. Ltd.

05 Railway Engineering, M M Agarwal

Indian Standards and Handbooks

01 IS 1201 to 1220 - 1978, IS 73, IS 2386 part I to V

02 IRC 58 - 2015, IRC37

03 Specifications for Road and Bridge works (MORTH) - IRC, New Delhi.

05 Specifications for Road and Bridge works (MORTH)-IRC, New Delhi.

06 Handbook of Road Technology, Lay M. G., Gorden Breach Science, Newyork

07 Civil Engineering Handbook, Khanna S. K.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401003 a Elective III: Coastal Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fluid Mechanics, Mathematics and Statistics

Course objectives
01 To make students aware about basics of ocean waves
02 To introduce students to the wave properties and analysis
03 To impart knowledge about tides and it's dynamic theory
04 To introduce students to important aspects of longshore transport
05 To impart knowledge about to the coastal structures, shore protection
06 To impart knowledge about coastal management

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand basic of ocean waves including wave generation, classification, propagation, wave theories, wave diffraction, wave refection and wave breaking.
02 Understand and apply short term and long-term wave analysis.
03 Understand basic characteristics of tides, tide producing forces, dynamic theory of tides.
04 Understand coastal process of erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) and estimation of wave induced sediment quantity.
05 Understand the coastal structures and shore protection methods.
06 Understand coastal zone management activities, issues related to integrated coastal zone management and regulation of coastal zone.

Course Content

Unit 1: Basics of Ocean Waves (06 hours)
Introduction to wind and waves, Sea and Swell, generation, classification of ocean waves, wave measurement, introduction to small amplitude wave theory, Linear (Airy) wave theory, use of wave tables, introduction to non-linear waves.

Unit 2: Wave Properties and Analysis (06 hours)
Basic understanding of wave mechanics including wave propagation, refraction, diffraction, breaking and shoaling, waves in shallow waters, introduction to waves of unusual character: currents, giant waves, tsunami etc, hindcasting and forecasting of waves, short term wave analysis, wave spectra and its utilities, long term wave analysis, statistical analysis of grouped wave data.

Unit 3: Tides (06 hours)
Definition and basic characteristics of tide, process of generation of tide, tide producing forces: earth moon and earth sun system, dynamic theory of tides- types of tides- tides and tidal current in shallow sea, storm surges, tides in rivers and estuaries, tidal power.

Unit 4: Coastal Processes **(06 hours)**

Coastal process: erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) estimate of wave induced sediment, budget, tides, effect of tides, stability of inlets, effect of construction of coastal structures on stability of shoreline/beaches.

Unit 5: Coastal Structures and Shore Protection **(06 hours)**

Introduction to coastal structures and their types, concept of risk analysis and design waves along with the concept of break water, introduction and necessity of shore protection, methods of shore protection, groins, seal walls, offshore breakwaters, and artificial nourishment.

Unit 6: Coastal Management **(06 hours)**

Introduction to coastal zones: beach profile, surf zone, off shore zone etc, introduction to coastal waters, coastal sedimentation, estuaries, wet lands and lagoons, coastal dunes. pollution in coastal zone, disposal of waste/dredged spoils, oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, issues related to integrated coastal zone management, coastal regulation zone.

Text books

01 Coastal Hydrodynamics, J.S.Mani, PHI India Publications

02 Ocean wave Mechanics-Applications in Marine Structure, V.Sundar, Ane Books Pvt Ltd

03 Harbour and Coastal engineering Vol I & II, Ocean and Coastal Engineering Publication

Reference Books

01 Port planning, Qeen A. D. Mc Grow Hill Book Co. New York.

02 Coastal engineering, Vol-I-II, Silvester Richard, University of Western Australia.

03 Shore Protection Manual, U. S. Waterways Experiment Station Corps of Engineer.

04 Costal Engineering Research Center, Vickburg and USA1984,Coastal Protection Manual 2002.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 003 b Elective III: Advanced Design of Concrete Structures

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Structural analysis and fundamentals of RC design.

Course objectives

01 To provide the students with advance design concepts of reinforced concrete structures.
02 To analyze, design and detail different types of reinforced concrete structures.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Understand yield line theory and apply it to analyze and design slabs of different shapes having different edge conditions.
02 Understand the concepts of ductile detailing
03 Analyze and design of flat slab.
04 Analyze and design of retaining walls.
05 Analyze and design of liquid retaining structures.
06 Analyze and design of RC frames and shear walls.

Course Content

Unit 1: Flat Slabs (06 hours)

Flat slabs, types, design methods, proportioning of flat slab, design moments, direct design method, distribution of moments, design of an intermediate panel, design of end panel, detailing of flat slab.

Unit 2: Yield Line Analysis and Design of Slabs (06 hours)

Yield line theory, assumptions, yield line patterns, characteristics of yield lines, equilibrium and virtual work method of analysis, analysis of rectangular, triangular, circular slabs with various edge and loading conditions using the yield line theory.

Unit 3: Earth Retaining Structures (06 hours)

Types of retaining walls, various backfill conditions, design of cantilever type retaining walls for different backfill conditions.

Unit 4: Liquid Retaining Structures (06 hours)

Types of liquid retaining structures, code provisions, analysis by approximate method and by using IS code method, design of circular and rectangular water tanks resting on ground.

Unit 5: Design of Shear wall and Ductile Detailing (06 hours)

Functions of shear walls, types of shear wall, code provisions, design of shear wall for given lateral loads.

Unit 6: Analysis and Design of RC Frames **(06 hours)**

Seismic coefficient method, substitute frame analysis, analysis of frames subjected to a load combination of gravity and lateral loads. Design of all elements of a frame subjected to combined effect of gravity and lateral loads.

Textbooks

01 Advanced Reinforced Concrete Design, N Krishnaraju, CBS Publishers and Distributors
02 Reinforced Concrete Design, S Unnikrishna Pillai, Devdas Menon, McGraw Hill Publications
03 Reinforced Concrete design, Vol I and II, Dr .H. J. Shah, Charotar Publishing house.
04 Advance R. C. C. Design, S. S. Bhavikatti, New Age International Publishers
05 Reinforced Concrete Structures Vol. II, B.C. Punmia, Ashok K. Jain, Arun K. Jain, Laxmi Publications, New Delhi
06 Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited.

Reference books

01 Design of Reinforced Concrete Structures, by Ramamrutham S, Dhanpat Rai Publications
02 Advanced Reinforced Concrete Design, P. C. Varghese, Prentice Hall of India Pvt. Ltd., New Delhi
03 Fundamentals of Reinforced Concrete, N. C. Sinha, S.K. Roy, S. Chand & Co. Ltd, New Delhi

Indian Standards

01 IS 1893 (Part 1): 2016, Reaffirmed in 2021, Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings, Bureau of Indian Standards, New Delhi.
02 IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi.
03 IS: 456-2000, Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
04 IS: 3370-2021, Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 003 c Elective III: Integrated Water Resources Planning and Management

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Basics of fluid mechanics, geology, geotechnical engineering, hydrology and surveying

Course objectives

01 To introduce connection of agriculture and water with IWRP & M and to make students aware about organizations like WALMI
02 To introduce the connection of IWRP & M with water
03 To impart knowledge of legal aspects

Course outcomes

On successful completion of this course, the learner will be able to,

01 Understand concerned organizations, IWRP & M objectives, principles, challenges, application & analysis of IWRP&M approaches & principles in a case study.
02 Understand PIM, WDS, WALMI, agriculture in the concept of integrated water resources, apply and analyse water requirements for food production
03 Understand assessment of surface and ground water quality, EIA, CPCB regulations, application & analysis of effluent quality standards as per CPCB
04 Understand water economics and funding, application & analysis of planning for a sustainable water future
05 Understand legal regulatory settings of IWRP & M, application & analysis of inter-basin water transfers and IWRP & M
06 Understand flood control & power generation for IWRP & M, application QIGIS for analysis of a basin for IWRP & M

Course Contents

Unit I: Introduction to IWRP & M (06 hours)

Concept, definitions, objectives, principles, challenges and needs, components, approaches of IWRP & M, water as a global issue, introduction of global water partnership (GWP), introduction of central water commission (CWC), national water policy (only introductory), discussion of one case study.

Unit 2: Agriculture & IWRP & M (06 hours)

Agriculture in the concept of integrated water resources, water requirement for food production (numerical to be covered), blue Vs green water disputes, global water security -virtual water trading, irrigation methods and efficiencies of these methods (numerical to be covered), current water pricing, ground water quality protection, sea water intrusion into fresh water aquifers due to human activities, ground water recharge (no numerical on ground water), participatory irrigation management (PIM), water distribution society's (WDS), introduction of water and land management institute (WALMI).

Unit 3: Considerations for Water Supply & Health (06 hours)

Importance of assessment of river water quality, prevention & control of surface & ground water pollution, cost effective water quality monitoring for basins, environmental impact assessment (EIA), central pollution control board (CPCB) regulations, need of training to water users for sustainability. application of polluters pays principle, need of treatment facilities for domestic sewage and industrial effluents, effluent quality standards as per CPCB and its strict implementation and monitoring, discussion of one case study.

Unit 4: Water Economics and IWRP & M (06 hours)

Water as economic good, economic value of water, water scarcity, importance of Water to the Indian economy, principles of planning and financing of water resources project: discussion on any two case studies, sustainability principles for water management, framework for planning a sustainable water future, economics and decision making.

Unit 5: Legal Regulatory Settings & IWRP&M (06 hours)

Global and national perspectives of water crisis, UN laws on non-navigable uses of international water courses, current water laws and regulation (national, state & local), water rights & priorities, CWC laws & guidelines, inter-basin water transfers and integrated water resources management, importance of arbitration in IWRM, Dublin Principles (1992), discussion of one case study.

Unit 6: Flood Control & Power Generation (06 hours)

Role of dams in flood control and power generation and its importance in IWRM, management of flood plains, flood risk mapping, flood forecasting and disaster relief, coordination between co-basins for flood management, use of QGIS for IWRM, effects of hydraulic structures on river surface profiles and sediment transport, hydro power generation, basic introduction of soft computing techniques for flood forecasting (only introductory).

Text Books

01 Integrated Water Resources Management: Water in South Asia Volume I, Peter P Mollinga, Ajaya Dixit and Kusum Athukorala, Sage Publications.

02 Ecosystem Principles and Sustainable Agriculture, Sithamparanathan, Rangasamy A. and Arunachalam, N, Scitech Publications (India) Pvt. Ltd, Chennai.

Reference Books

01 Water Resources System Planning & Management, M. C. Chaturvedi, Tata McGraw-Hill.

02 Water Resources Systems Engg, D. P. Loucks, Prentice Hall.

03 Economics of Water Recourses Planning, L. D. James & R. R. Lee, McGraw Hills, New York

04 Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs, Peter P Mollinga, SAGE Publication

05 Principles of Water Resources: History, Development, Management and Policy, Thomas V., John Wiley and Sons Inc., New York. 2003.

06 Watershed Management in India, Murthy, J. V. S., Wiley Eastern Ltd., New York, 1995.

07 Soil Conservation and Land Management, Dalte, S.J . C., International Book Distribution,

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 003 d: Elective III: Finite Element Method

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Basics of matrix and matrix operations

Course objectives

01 To learn basic principles of finite element analysis procedure.
02 To learn the theory and characteristics of finite elements that is used in the analysis of engineering structures.
03 To develop the knowledge and skills needed to analyze structural problems by using finite element method.

Course outcomes

On successful completion of this course, the learner will be able to,

01 To understand the basics of solid mechanics prior to learn finite element analysis.
02 Solve simple Engineering problems using 1D, 2D and 3D elements
03 Write shape functions of 1D, 2D and 3D elements
04 Determine the stresses in three dimensional finite elements using isoparametric formulation.
05 Analyze the truss and beam elements using stiffness matrix and finite element procedure.
06 Evaluate the forces and stresses in rigid jointed portal frame and grid elements using stiffness matrix and finite element procedure.

Course Content

Unit 1 **(06 hours)**

Theory of elasticity: strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems and Airy's stress function.

Unit 2 **(06 hours)**

General steps of the finite element method, applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria, Stability and possible sources of errors, principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit 3 **(06 hours)**

Displacement function for 2D triangular (CST and LST) and rectangular elements, use of shape functions, area co-ordinates for CST element, shape functions in Cartesian and natural coordinate systems, derivation of expressions for element stiffness matrix and element nodal load vector using principle of stationary potential energy, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.

Unit 4 **(06 hours)**

Introduction to 3D elements such as tetrahedron and hexahedron, theory of isoparametric elements: isoparametric, sub parametric and super-parametric elements, characteristics of isoparametric quadrilateral elements, iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, formulation of stiffness matrix for 1D and 2D Isoparametric elements in plane elasticity problem.

Unit 5 **(06 hours)**

Formulation of stiffness matrix, analysis of spring/bar assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, element matrices, assembling of global stiffness matrix, solution for displacements, reactions, stresses, applications to truss and beam not involving unknowns more than three.

Unit 6 **(06 hours)**

Formulation of stiffness matrix using member approach for portal frame and grid elements, transformation matrix, element matrices, assembling of global stiffness matrix, solution for displacements, reactions, stresses, applications to frame and grid not involving unknowns more than three, introduction to computer program algorithm and flowchart.

Textbooks

01 Introduction to Finite Elements in Engineering, T. R. Chandrupatla and A. D. Belegundu, Prentice Hall Publication

02 A First Course in the Finite Element Method, D. L. Logan, Cengage Publications.

Reference books

01 Introduction to the Finite Element Method, Desai and Abel, CBS Publishers & Distributors, Delhi

02 Matrix, Finite Element, Computer and Structural Analysis, M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.

03 Finite Element Analysis - Theory & Programming, C. S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.

04 An Introduction to the Finite Element Method, J. N. Reddy, TATA Mc Graw Hill Publishing Co. Ltd.

05 Theory & Problems -Finite Element Analysis, G. R. Buchanan, Schaum's Outline series. TATA Mc Graw Hill Publishing Co. Ltd.

06 Finite Element Analysis, S. S. Bhavikatti, New Age International (P) Ltd.

07 The Finite Element Method, O. C. Zien kiewicz, TATA Mc Graw Hill Publishing Co. Ltd.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401003 e Elective: Data Analytics

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering and discrete mathematics, basics of civil engineering

Course objectives

01 Impart knowledge and develop the ability of students to analyze the data for a given problem and represent in the mathematical and statistical form
02 Impart knowledge and develop the ability of students to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis
03 Impart knowledge and develop the ability of students to carry out test of hypothesis, and apply the concept of correlation and regression.
04 Impart knowledge and develop the ability of students to understand concept of machine learning and apply Regression, classification and clustering techniques

Course outcomes

On successful completion of this course, the learner will be able to,
01 Understand the basic concepts of Statistics and its analysis and applications
02 Solve the problems related to probability and various probability distributions.
03 Apply the concept of sampling and distribution and interpret problems using correlation
04 Analyze and test of hypothesis
05 Examine and prepare the data and use develop regression
06 Understand and Apply machine learning algorithms for Regression, Classification and Clustering

Course Content

Unit 1: Data Analysis (06 hours)

Types of data, levels of data, types of variables, data science, data analytics, classification of data analytics, importance of data analytics, central tendency: mean mode, percentile, and dispersion: skewness, kurtosis, range, variance, and coefficient of variation, histogram, scattergram; uncertainty & outliers.

Unit 2: Probability Distribution (06 hours)

Introduction to probability and probability distribution, continuous probability distribution: probability density function; normal (Gaussian's) probability distribution; properties of normal curve; lognormal distributions; exponential distribution. Discrete probability distribution: binomial probability, Poisson probability; gamma distribution; case studies: use of dataset/ problems in the field of civil engineering

Unit 3: Sampling distribution and Correlation (06 hours)

Sample, Types of samples, sample mean, Concept of Sampling Distributions; Impact of Sample Size on Sampling Distribution; Sampling Distribution of the Mean and the Central Limit, sample proportion, sample size determination, Correlation, coefficient of determination, correlation analysis, coefficient of correlation, Rank of correlation.

Unit 4: Hypothesis Testing **(06 hours)**

An estimator or point estimator, confidence interval; estimation of population mean, proportion, cd variance; student's t distribution; chi-square distribution. Confidence interval and hypothesis testing; null and alternative hypotheses; test statistics and rejection regions; critical values; one- or two-tailed test; introduction to type i and type ii errors, P value, F, chi- square, Z and T- test.

Unit 5: Prediction **(06 hours)**

Data analytics life cycle, data cleaning, data transformation, comparing reporting and analysis, analytical approaches: prediction, regression, general multiple regression model, computation of coefficients of the first order multiple regression model using least square method, non-linear regression, residual analysis.

Unit 6: Introduction to Machine learning **(06 hours)**

Introduction to machine learning introduction to machine learning and concepts, types of machine learning: supervised, unsupervised, reinforced learning, over fitting and train/test splits, regression: logistics regression, classification: decision trees, clustering: K means, support vector machines.

Text books

01 Statistical Methods, 43rd Edition, Gupta S. P, S. Chand Publication.
02 Higher Engineering Mathematics, 42nd edition, Grewal B. S, Khanna Publishers.
03 Probability and Statistics for Engineers: 9th edition, Johnson Richard A., Miller I., Freund J.E ,PHI publications.
04 Machine Learning: Jeeva Jose, Khanna Publishing House, Delhi.

Reference books

01. Probability and Statistics for Science and Engineering, Rao G. S, Universities press publication.
02. Applied statistics and probability for engineers, Montgomery, Douglas C. and George C. Runger, John Wiley & Sons.
03. Basic Engineering Data Collection and Analysis, Stephen B. Vardeman and J. Marcus Jobe, Duxbury Thomson Learning.
04. Machine Learning, Chopra Rajiv, Khanna Publishing House.
05. The elements of statistical learning, Hastie, Trevor et al., New York: Springer.
06. Machine Learning: An Artificial Intelligence Approach, Ryszard, S., Michalski, J. G. Carbonell and Tom M. Mitchell, Volume 1, Elsevier.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401003 f Elective III: Operation Research

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Engineering maths and project management

Course objectives
01 Engineers with the ability to analyse the data for a given problem and formulate mathematical model
02 Engineers with ability to optimize linear & non-linear programming problems
03 Engineers with the ability to apply the knowledge for optimisation for Civil Engineering Projects

Course outcomes
On successful completion of this course, the learner will be able to,
01 Ccorrelate applications of Operations Research in Civil Engineering field
02 Solve the problems related to stochastic programming
03 Optimize transportation and assignment problems
04 Optimize linear problems
05 Optimize non-linear problems
06 Suggest solution for the problems related to dynamic models, games theory and replacement of items

Course Content

Unit 1: Introduction of Operations Research (06 hours)
Introduction to operations research and optimization techniques, applications of operations research in civil engineering, introduction to linear and non-linear programming methods, formulation of linear optimization models for civil engineering applications (objective function, constraints), graphical solutions to L P problems, local & global optima, unimodal function, convex and concave function.

Unit 2: Stochastic Programming (06 hours)
Sequencing: n jobs through 2, 3 and M machines, queuing theory: elements of queuing system and its operating characteristics, waiting time and ideal time costs, Kendall's notation, classification of Queuing models, single channel Queuing theory: Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1): (FCFS/ /), simulation: Monte Carlo simulation.

Unit 3: Linear programming (06 hours)
The transportation model and its variants, assignment model and its variants

Unit 4: Linear programming (06 hours)
The simplex method, method of big M, two phase method, duality

Unit 5: Nonlinear programming (06 hours)

Single variable unconstrained optimization: sequential search techniques-dichotomous, Fibonacci, golden section, multivariable optimization without constraints: the gradient vector and hessian matrix, gradient techniques, steepest ascent/decent technique, Newton's Method, Multivariable optimization with equality constraints: Lagrange multiplier technique

Unit 6: Dynamic programming, Games Theory and Replacement Model (06 hours)

Dynamic programming: multi stage decision processes, principle of optimality, recursive equation, applications, Games theory: 2 persons games theory, various definitions, application of games theory, replacement of items whose maintenance and repair cost increase with time ignoring time value of money

Text Books

01 Operations Research, Premkumar Gupta and D. S. Hira, S. Chand Publications.
02 Engineering Optimization: Methods and Application, A. Ravindran and K. M. Ragsdell, Wiley India.
03 Engineering Optimization, S. S. Rao, New Age International (P) Ltd.
04 Quantitative Techniques in Management, N.D. Vohra, Mc Graw Hill
05 Operations Research, Pannerselvam - PHI publications.

Reference Books

01 Topics in Management Science, Robert E. Markland, Wiley Publication
02 A System Approach to Civil Engineering Planning & Design, Thomas K. Jewell - Harper Row Publishers
03 Operations Research, Hamdy A. Taha, Pearson Publication
04 Introduction to game theory, Stef Tijs, Hindustan Book Agency, New Delhi
05 Dynamic programming and optimal control, P. Bertsekas, Athena Scientific, Belmont.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 a Elective IV: Air Pollution and Control

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Basic concepts of sciences, mathematics

Course objectives

01 Impart the knowledge and understanding of outdoor and indoor air pollution, its impact and existing legislation and regulation.

02 Make aware about the meteorology, measurement techniques, emission inventory and modeling aspects.

03 Provide the scientific and technical background of state of the art air pollution control technologies.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Recall air pollution, legislation and regulations.

02 Evaluate air pollutant concentrations as a function of meteorology.

03 Interpret sampling results with prescribed standards.

04 Assess emission inventory and air quality models.

05 Compare the air pollution control equipments.

06 Infer indoor air pollution and its mitigation.

Course Content

Unit 1: Air Pollution, Legislations and Regulations (06 hours)

Air Pollution: Layers of atmosphere, Atmospheric temperature and altitude, Composition of air, Definition of air pollution, Air pollution episodes and accidents (Donora Pennsylvania 1948, Great London Smog 1952, Bhopal Gas Tragedy 1984), Classification of air pollutants (Based on sources, origin and state of matter), Criteria and hazardous air pollutants, Greenhouse gases, Sources of air pollution, Scales (micro, meso, macro), Processes and fates (Advection, convention, Diffusion, dispersion), Impact on human health and its valuation, Ozone depletion, Acid rain, Global warming, Climate change, Estimation of Carbon footprints (Numerical Included). Legislations and regulations: A case study (Air Act 1981, The Air Rules 1982, Central Motor Vehicles Act 1988, Environmental Protection Act 1986, National Environment Tribunal Act 1995, National Green Tribunal Act 2010, Draft Notice for e-Vehicles in National Capital Region 2022), Major Government Initiatives for managing ambient air quality (NAMP-National Air Quality Program, AQI-Air Quality Index (Significance, calculation method adopted by CPCB), NCAP-National Clean Air Program).

Unit 2: Meteorological Aspects (06 hours)

Meteorology, Meteorological parameters and measuring instruments, Wind rose diagram, Environmental lapse rate (ELR) and adiabatic lapse rate (ALR), Inversion and its types, Atmospheric stability, Pasquill-Gifford classification, Plume behaviour, Horizontal and vertical dispersion coefficients, mixing height, Determination of mixing height using radio-soundings and remote sounding system, Stack height determination (Numerical included), CPCB recommendations, Plume rise estimation using Brigg’s formula (Numerical included), Gaussian dispersion equation for point source; assumptions, advantages and limitations (Numerical included).

Unit 3: Ambient Air Sampling, Analysis and Standards **(06 hours)**

Ambient Air sampling and Analysis: Air pollution survey, basis and statistical considerations of sampling sites, Conversion of $\mu g/m^3$ to ppm, devices and methods used for sampling of particulates and gaseous air pollutants. Use of aerosol spectrometer and sensors, Stack emission monitoring for particulate and gaseous air pollutants, isokinetic sampling, Air Quality and Emission Standards: Components of air quality standards (Indicator, averaging time, form, level), National Ambient Air Quality Standards (NAAQS) 2009 and Emission standards in India, WHO air quality guidelines 2021, Interpretation of sampling results with case study.

Unit 4: Emission Inventory and Air Quality Modeling **(06 hours)**

Emission inventory: Definition, Role in air quality management, Utilization, Development approach (Bottom-up, Top-down), Basic equation of emission estimation, Types (Annual average, seasonal, forecasted and gridded), Emission inventory framework developed by CPCB, Air Quality Modeling: Introduction, Basic components, Importance, classification (Based on time period, pollutant type, coordinate system, level of sophistication), Types of air quality models (Physical, statistical, deterministic), AERMOD model USEPA (Assumptions, strengths and limitations).

Unit 5: Control of Air Pollution **(06 hours)**

Natural self-cleansing properties (Dispersion, gravitational settling, absorption, rainout, adsorption), Objectives, Control by process modification, change of raw materials, fuels, process equipment and process operation, Control of particulates from stationary sources: Removal Mechanism, collection efficiency, control equipment as Settling chamber, inertial separators, cyclone, fabric filter and electro Static precipitator. Scrubbers, Factors affecting selection of device (Numerical included). Control of gaseous pollutants from stationary sources: Absorption, adsorption, incineration/ combustion, carbon sequestration for CO_2, Control of emissions from mobile sources: Emission sources, Control of emissions from each source.

Unit 6: Indoor Air Pollution **(06 hours)**

Causes, sources, health impacts, factors affecting indoor air quality, sick building syndrome, General aspects of exposure assessment, Sampling design, Active and Passive samplers, monitoring of ventilation rates, Mitigating technologies: Source control, Improved ventilation, air cleaning, Types of air cleaners, Air cleaning technologies, Practical considerations using portable and in-duct air cleaners, Use of plants for control, Radon removal technique, Sources and remedial measures for odour control.

Text books

01 Air Pollution: Its origin and control, 3rd Edition, Kenneth Wark, Cecil F. Warner, Wayne T. Davis, Addison-Wesley Longman. 1998.

02 Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010

Reference books

01 Air Pollution, M. N. Rao, H. V. N. Rao, McGraw Hill, 2004.

02 Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015.

03 Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., Academic Press, 2005.

04 Methods of Air Sampling and Analysis, Lodge, J.P. (Ed.), CRC Press, 1988.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 b Elective IV: Advanced Design of Steel Structures

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Prerequisites:
Basic concept of Structural Analysis, Mechanics of Materials and fundamentals of design of steel structures

Course Objectives:
1. To study design of member subjected to combined forces with its connections
2. To study the design of section other than hot rolled steel section
3. To study the design of components of industrial structures

Course Outcomes:
At the end of the course, the learners will be able to
1. Understand the behavior and design of members subjected to combined forces
2. Design moment resisting connection
3. Design component / structure using cold form light gauge section
4. Design members of truss and scaffolding using tubular section
5. Design castellated beam
6. Analyze and design components of industrial structure such as Portal frame and gable frame

Course contents

Unit 1: Design of members subjected to combined forces (06 hours)
Introduction, combined shear with bending, design of section subjected to high shear, combined axial force and bending moment, section strength and member strength, design of beam column

Unit 2: Design of moment resisting connection (06 hours)
Type of connections, Moment Resisting Connections, Beam to Beam and beam to column connection, design of web and flange splice using bolt and weld

Unit 3: Cold form light gauge section (06 hours)
Introduction, advantage, type of cross section, stiffened multiple stiffened and un-stiffened element, flat-width ratio, and effective design width, design of compression, tension and flexural members using cold form light gauge section

Unit 4: Tubular Structures (06 hours)
Introduction, design of tubular trusses and scaffoldings using circular and rectangular hollow sections as per code, detailing of joints and design of Connections

Unit 5: Design of Castellated beam (06 hours)

Concepts, fabrication of the castellated beam from rolled steel section, advantage, mode of failure, design of castellated beam for bending and shear as per codal provisions by limit state method

Unit 6: Portal and gable frame **(06 hours)**

Introduction, plastic analysis of portal and gable frame, design of portal and gable frame as per limit state method by limit state method

Text books

01 Limit state design of steel structures, S K Duggal, Tata McGraw Hill Education, New Delhi.
02 Design of steel Structures, Volume II, Ram Chandra, Standard Book House, New Delhi.

Reference Books

01 Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi.
02 Limit state design in Structural Steel, M. R. Shiyekar, PHI, Delhi.
03 Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private Limited, New Delhi.
04 Limit state design of Steel Structure by V L Shah and Gore, Structures Publication, Pune
05 Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, New Delhi

IS Codes

01 IS: 800-2007, Code of practice for General Construction in steel, Bureau of Indian Standard, New Delhi.
02 IS: 806- Code of practice for use of steel tubes in general building construction, Bureau of Indian Standard, New Delhi.
03 IS: 811, Specification for cold formed light gauge structural steel sections, Bureau of Indian Standard, New Delhi.
04 IS: 875 ((Part I to V) Code of practice for design loads for buildings and structures, Bureau of Indian Standard, New Delhi.
05 IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members' in general building construction, Bureau of Indian Standard, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 c Elective IV: Statistical Analysis and Computational Methods

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering mathematics, ccollection, classification & representation of data, permutations and Combinations

Course objectives

01 Engineers with the ability to analyze the data for a given problem and represent in the mathematical and statistical form
02 Engineers with ability to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis
03 Engineers with the ability to carry out test of hypothesis, and apply the concept of correlation and regression, goodness of fit and distributions

Course outcomes

On successful completion of this course, the learner will be able to,

01 Understand the basic concepts of Statistics and perform statistical data analysis
02 Understand the concept of probability and fit Binomial, or Poisson or Normal distribution to the given data
03 Understand concept of sampling and perform chi-square test, z test, Student T test
04 Perform hypothesis test
05 Carry out correlation and regression analysis for the given data
06 Calculate variance and perform K-S test for goodness of fit

Course Content

Unit 1: **Introduction to Statistics** **(06 hours)**

Statistical methods: introduction, collection, classification and representation of data, various databases related to civil engineering applications (like hydrological, structural audit, etc) measures of central value (mean, median, mode), measures of dispersion, skewness, moment, Kurtosis.

Unit 2: **Probability and Distributions** **(06 hours)**

Probability and probability distributions including binomial, Poisson, normal: examples based on each distribution preferably based on various civil engineering problems.

Unit 3: **Data Sampling** **(06 hours)**

Population, sampling: meaning, 4 types of sampling, importance of population sampling, sample size determination, Chi-square test, Z test, student T test, examples to be framed and solved based on various databases related to civil engineering applications (like hydrological, structural audit, etc)

Unit 4: **Test of Hypothesis** **(06 hours)**

Test of hypothesis: three parts of hypothesis, steps in hypothesis testing: assumptions, test statistics, rejection region, calculations and conclusions, characteristics and qualities of a good hypothesis, students may use hypothesis (if any) from their PBL topic from SE civil curriculum, or any other suitable hypothesis example pertaining to civil engineering applications.

Unit 5: **Correlation and Regression** **(06 hours)**

Correlation analysis, regression analysis, coefficient of correlation, probable error, single and multiple regression, sample examples to be developed through data collected in unit iii and carry out correlation regression analysis for the same.

Unit 6: **Variance and Fitness Test** **(06 hours)**

K-S test for goodness of fit and distribution, analysis of variance on way and two-way classification, examine data using suitable data and frame examples to carry out analysis of variance and use classification rules for the same.

Text Books

01 Statistical Methods , S. P. Gupta, Sultan and Chand Sons

02 Higher Engineering Mathematics, B. S. Grewal, Publisher: Khanna Publishing House.

Reference Books

01 Probability and Statistics for Engineers, Richard A Johnson

02 An Introduction to Statistical Methods and Data Analysis Student Solutions Manual, R. Lymann Ott and Michael Longnecker, Jackie Miller

03 Statistical Methods, Rudolf Freund William Wilson, Academic Press USA

04 Probability and Statistics for Science and Engineering, G Shankar Rao

05 Fundamentals of Statistics, S C Gupta, Himalaya Publishing House

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 d Elective IV: Airport and Bridge Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basic of computer, understanding of drawings and specifications

Course Objectives
01 Introduce the aspect of airport and bridge system.
02 Study plans, specifications for planning and design.
03 Involve in the planning and design of new runways and terminal buildings
04 Select and design the bridge that will meet the needs of the area

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand the fundamental of airport.
02 Understand and design the runway and taxiway and drainage systems.
03 Understand the BIM, AR and VR in airport planning and pavement design.
04 Plan the lighting and marking of airport and heliport.
05 Estimate various components of bridge and loads on bridges.
06 Study and design of bridge structures.

Course Content

Unit 1: Introduction and Classification of Airport (06 hours)
General, transportation systems, typical air trip, the air age, world civil air transport, geographic distribution of world air transport, air ports characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons and hangers. zoning requirements regarding permissible heights of constructions and landing within the airport boundary, airport landslide planning, navigation and landing aids – ILS, air traffic control (ATC). Airport classification: community size and airport types, airport classification according to types of services, functional classification of airports, airport classification for the purpose of stipulating geometric standards, ICAO, FAA

Unit 2: Aircraft Characterizes and Geometric design (06 hours)
Introduction to Aircraft Characterizes: related to airport design characterizes of principle transport aircrafts, trends size, speed and productivity of transport aircraft, turning radii. airport planning, size and type of airport, selection of site for the airport. Geometric design: element of an airport, runway and taxi way width, runway profile and runway length, runway orientation, corrections and calculation, introduction to analytical methods for air travel demand for planning and casting, case study- airport master plan.

Unit 3: Airport Visualizing, Airport Capacity and Airport Pavements (06 hours)
Airports visualizing: introduction to visualizing airports in a virtual environment, building information modelling (BIM) for air ports, introduction to augmented reality (AR) and virtual reality (VR) in airport planning and design, Airport capacity: ultimate and practical runway capacity, runway

arrangement factors effecting runway capacity, practical annual capacity and practical hourly capacity, Airport pavements: comparison- highway and airfield pavement, design of rigid airport pavements, design of rigid pavement and design of flexible pavement, junction of flexible and rigid pavements, airport drainage.

Unit 4: Airport Marking and Lighting- Heliports (06 hours)

Airport Marking and lighting: the need for marking and lighting, runway lighting, runway marking , runway designation marking , runway center marking , threshold marking, fixed distance marking , touchdown zone marking , runway side strips marking, Heliports: helicopter characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, heliport marking and lighting, vertical takeoff and landing (VTOL), short takeoff and landing (STOL).

Unit 5: Introduction to Bridges (06 hours)

Classification, selection of bridge site and preliminary and detailed survey work, computation of discharge, linear waterway, economic span, afflux, scour depth, effective width, introduction to design loads for bridges, IRC loading standards, load distribution theory, bridge slabs, substructure: abutment, piers, and wing walls with their types based on requirement and suitability.

Unit 6: Types of Bridges (06 hours)

Culvert: definition, location, waterway of culvert and types, design of pipe culverts, design of box culvert (Single vent only). Temporary bridges: definition, materials used, brief general ideas about timber, floating- pontoon bridges. (Introduction only), Movable bridges: bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability. (Introduction only), Fixed span bridges: simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure. Bearing: definition, purpose and importance, types of bearings with their suitability (Introduction only).

Text books

01 Airport Engineering, by Saxena S.C., CBS Publishers & Distributors

02 Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee

03 Bridge Engineering by Rangwala, Charotar Publication

04 Aiport Engineering by Rangwala, Charotar Publication

Reference books

01 Ashford, N., and P. H. Wright. 1992. Airport Engineering, 3rd ed. New York: John Wiley & Sons

02 Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi.

Handbooks and Manuals

01 Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902

02 Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000

03 https://panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridges-direct-download-links-from-panchayatraj-engineers-blog

04 Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401004 e Elective IV: Design of Prestressed Concrete Structures

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Structural Mechanics, Structural Design: Concrete or equivalent course

Course objectives

01 To introduce the students to the basic concepts and principles of prestressed concrete structures.
02 Develop an insight into the behavior of prestressed concrete structural members both at service loads and overloads.
03 To explain fundamentals of prestressed concrete design.
04 To understand the applications of precast prestressed components in civil infrastructure.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Know the prestressed members.
02 Determining the stresses and various losses in prestressed concrete members.
03 Design the prestressed concrete structures
04 Design the prestressed concrete slab
05 Design the prestressed concrete flat slab
06 Analysis and design the prestressed continuous beams

Course Content

Unit 1: Prestressing Systems, Material Properties and Composite Sections (06 hours)

Basic concept, early attempts of prestressing, brief history, development of building materials, definitions, advantages of prestressing, limitations of prestressing, types of prestressing, prestressing systems and devices, introduction of composite sections of prestressed concrete beam and cast in-situ RC slab.

Unit 2: Analysis of Prestressed Members and Losses in Prestress (06 hours)

Analysis of prestressed concrete member, stress calculations and concept of cable profile and losses in prestressed concrete

Unit 3: Design of Determinate Beam (06 hours)

Design of post tensioned prestressed concrete simply supported rectangular and flanged sections for flexure and shear including end block.

Unit 4: Design of Slab (06 hours)

Design of one way and two way post tensioned slabs.

Unit 5: Design of Flat Slab (06 hours)

Introduction to flat slab, design of prestressed two way flat slab by direct design method

Unit 6: Statically Indeterminate PSC Beams **(06 hours)**

Analysis and design of two span continuous beams, choice of cable profile, linear transformation and concordancy.

Text books

01 Advanced Design of Structures, Krishnaraju, Mc Graw Hill.

02 Prestressed Concrete, N. Krishna Raju, Tata Mc Graw Hill Publication Co.

03 Earthquake Resistant Design of Structures, Agarwal and Shrikhande, PHI learning.

Reference books

01 Prestressed Concrete: A Fundamental Approach, Edward Nawy, PHI.

02 Design of Prestressed Concrete Structures, T Y Lin and N H Burns.

Indian Standards

01 IS: 1343: Indian Standard Code of Practice for Prestressed Concrete, Bureau of Indian Standard, New Delhi.

02 IS: 456: Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standard, New Delhi.

03 IS: 1893: Indian Standard Code of Practice for Criteria for Earthquake Resistant Design ff Structures, Bureau of Indian Standard, New Delhi.

04 IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401004 f Elective IV: Formwork and Plumbing Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Structural analysis, concrete technology, building technology

Course objectives

01 Exposure to formwork procedures in construction practice
02 Study different types of formwork, analysis and design of formwork
03 Exposure of type and components of plumbing.
04 Study different provision for the design of plumbing system.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Select appropriate material and type of formwork
02 Analyze the formwork for various loadings.
03 Illustrate the design aspects of formwork under various requirements.
04 Understand requirement of plumbing in a building.
05 Understand plumbing hydraulics and its components in plumbing system.
06 Illustrate the design aspects as per the requirement of Indian Standards.

Course contents

Unit 1: Formwork Introduction (06 hours)
Introduction to formwork as a temporary structure, formwork requirements, selection, classification (types) of formwork; Conventional formwork material like timber, plywood, steel; Advanced formwork material like aluminium, plastic, fibre reinforced polymer (FRP) composite materials; Accessories; Economy in formwork; Planning for formwork.

Unit 2: Formwork Analysis (06 hours)
Typical illustrative forms for walls, beams, column and slab with detailing, loads on formwork: dead loads, live loads, lateral pressure due to fresh concrete as per IS 14687: concrete density, height of discharge, temperature, rate of placing, consistency of concrete, vibration, hydrostatic pressure and pressure distribution, examples, design considerations, allowable stresses, deflection limits, common deficiencies in design.

Unit 3: Formwork Design (06 hours)
Formwork design concepts for slab, beams, columns and footing, design of formwork for slabs and wall, illustration of formwork system for beams and, columns

Unit 4: Introduction to Plumbing in Buildings (06 hours)
Water borne disease, importance of premise plumbing, history of plumbing, codes on plumbing, organizations and institutes in plumbing across India and the world, need for sustainable practices in

plumbing, role of plumbing designer, role of plumber, plumbing system installations, future challenges in plumbing.

Unit 5: Plumbing Hydraulics and components of the plumbing system (06 hours)
Frictional losses in pipes, minor losses in pipes, common plumbing fixtures, water efficient fixtures, pipe materials and roughness coefficients, types of fittings, types of valves, types of traps, equivalent lengths for fittings and valves as per standards, water demand in different types of buildings as per standards, components of water supply systems in buildings, types of water supply systems in buildings, types of drainage systems in buildings.

Unit 6: Plumbing system design (06 hours)
Code provisions on pressure and velocity in plumbing systems, simultaneous demand, different methods of pipe sizing in building (fixture unit, water demand calculator, fixture value method, etc.), fixture unit method of pipe sizing in building, water supply fixture units and drainage fixture units for different plumbing fixtures, sizing pipes of 3- storey building using segmented loss method, the layout of plumbing fixtures in a toilet, plumbing plans of buildings.

Text Books

01 Modern Practices in Formwork for Civil Engineering Construction Works, Dr. Janardan Jha & Prof. S. K. Sinha, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.
02 Formwork for Concrete Structures, Robert L. Peurifoy and Garold D. Oberlender, McGrawhill Publication.
03 Plumbing: Design and Practice, Deolalikar S. G., Tata Mcgraw-Hill Publication.
04 Water Supply and Sanitary Installation (Within Building), Design, Construction and Maintenance Panchdhari A. C., New Age International publishers.

Reference Books

01 Formwork by Michael P. Hurst, Addison-Wesley Longman Ltd; First Edition (June 1, 1983).
02 Formwork for Concrete, Hurd, M.K., Special Publication No.4, American Concrete Institute, Detroit; Fifth edition
03 Design and Construction of Formwork for Concrete Structures by A.E. Wynn, George Philip Manning, Cement & Concrete Association.
04 Austin C.K., Formwork for Concrete, Cleaver-Hume Press Ltd., London, 1996.

Indian Standards

01 IS 6461: Part V: 1972, Reaffirmed 2002; Glossary of terms relating to cement concrete: Formwork for concrete, Bureau of Indian Standard, New Delhi.
02 IS 14687: 1999, Falsework for Concrete Structures – guidelines, Bureau of Indian Standard, New Delhi.
03 IS 12183-1-1987, Code of practice for plumbing in multi-storeyed buildings (Part 1 water supply), Bureau of Indian Standards, New Delhi, India.
04 Uniform Illustrated Plumbing Code - India 2018, International Association of Plumbing and Mechanical Officials India.
05 International Plumbing Code - 2018, Appendix E, International Code Council, USA.
06 National Building Code of India - 2016, Vol. 2, Part 9, Bureau of Indian Standards, New Delhi, India.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 005: Project Stage I

Teaching scheme	**Credits**	**Examination scheme**
Practical: 04 Hours/week	01	Term Work: 50 Marks
	02	Oral: 50 Marks

Pre-requisites
Fundamentals of Civil Engineering

Course objectives
01 Identify latest technical/practical problems in the field of Civil Engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The Project Stage I report should contain the following. Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of minimum two and maximum five students.

01 Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
02 Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years.
03 Problem statement and methodology
03 Theoretical contents related to the chosen topic or case studies if applicable.
04 Concluding remarks or summary.
05 References

Oral Examination: The students must prepare presentation on Project Stage I and present in presence of pair of examiners through a viva-voce examination.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401006: Transportation Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of the following. Oral examination based on term work.

A. Practical

I. Tests on Aggregate (Any Five)

1 Aggregate Impact Value Test
2 Aggregate Crushing Strength Test
3 Los Angeles Abrasion Test
4 Shape Test (Flakiness Index and Elongation Index)
5 Specific Gravity and Water Absorption Test by basket method
6 Stripping Value Test
7 Soundness Test

II. Tests on Bitumen (Any Five)

1 Penetration Test
2 Ductility Test
3 Softening Point Test
4 Flash Point & Fire Point Test
5 Bitumen Extraction Test (compulsory)
6 Viscosity Test (Tar Viscometer)
7 Specific Gravity Test

III. Tests on Aggregate Bitumen Combined: (Compulsory)

1 Marshall Stability Test

B. Technical visits

1. Road Construction and/or RAP Site
2. Hot mix Plant with detailed report

C. Mandatory Assignments

1. Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat

2. Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC)

3. Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflect meter FWD)

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401007 a Elective III: Coastal Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work will consist of the following. Oral examination based on the term work.

01 Assignment on Linear (Airy) wave theory
02 Assignment on calculation of wave refraction, diffraction, wave breaking and shoaling
03 Assignment on hindcasting of waves / short term wave analysis
04 Assignment on long term wave analysis/ statistical analysis of wave data.
05 Assignment on dynamic theory of tides.
06 Assignment on Coastal process of erosion/accretion due to waves / bed forms.
07 Assignment on long shore transport (Littoral drift) / estimation of wave induced sediment, budget.
08 Assignment on effect of construction of coastal structures on stability of shoreline / beaches (case studies)
09 Assignment on methods of shore protection /groins, seal walls, offshore breakwaters/ artificial nourishment (case studies)
10 Assignment on pollution in coastal zone/ disposal of waste/dredged spoils (case studies)
11 Assignment on coastal zone management: activities in coastal zone, CRZ, Issues related to Integrated coastal zone management / Coastal regulation zone (case studies)
12 Site visit to actual port / port models and preparing the report

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 007 b Elective III: Advanced Design of Concrete Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work will consist of the following. Oral examination based on the term work.

01 Assignment on analysis of slab using yield line theory
02 Design and detailing of flat slab
03 Design and detailing of retaining wall.
04 Design and detailing of ground resting water tank
05 Design and detailing of RC frame
06 Design and detailing of shear wall
07 Report on a site visit of ongoing construction of any structure mentioned in the syllabus
08 The drawings shall be prepared on full imperial drawing sheets. Detailing of reinforcement should be as per latest provisions of code.

Note: For term work, the group size should not be more than five students and each group should have different design data.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 007 c Elective III: Integrated Water Resources Planning and Management Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work will consist of the following. Oral examination based on the term work.

01 Detail report on components and approaches of IWRP & M
02 Detail report on national water policy
03 Detail report on participatory irrigation management and water distribution societies
04 Detail report on effluent quality standards as per CPCB
05 Detail report on economics in IWRP & M and decision making
06 Detail report on Dublin Principles (1992)
07 Detail report on water laws (National, State & Local)
08 Detail report on global water partnership (GWP)
09 Application of soft computing tool for flood forecasting
10 Application of QGIS for IWRM

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 007 d Elective III: Finite Element Method Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work will consist of the following. Oral examination based on the term work.

01 At least one assignment on each unit consisting minimum five numericals/theory questions.

02 One assignment based on FEM by using coding tools with program algorithm and flowchart for the following.
a) Formulation of stiffness matrix for any 1-D element.
b) Formulation of stiffness matrix for any 2-D element using isoparametric formulation.

03 Finite Element Method: Software applications of any one cases using suitable standard available software.
a) Truss/grid/beam/frame problem.
b) Plane stress/plane strain problem.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401007 e Elective III: Data Analytics Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of the following assignments, out of twelve 2, 4, 6, 8, 10 & 12 are compulsory and any 4 out of remaining 6. Oral examination based on the term work

01 Determine mean, mode, kurtosis, coefficient of variation etc.
02 Determine measures of central tendency for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
03 Assignment on continuous probability distribution and discrete probability distribution.
04 Assignment on Probability distribution for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
05 Assignment on Sampling distribution, sample size determination and coefficient of correlation.
06 Assignment on Sampling distribution and Correlation for a a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
07 Assignment on test of hypothesis.
08 Assignment on test of hypothesis for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
09 Assignment on Regression.
10 Assignment on Regression for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
11 Assignment on introduction to machine learning
12 Assignment on Logistic regression, Decision Trees, K means or Support Vector Machine (any two) for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401007 f Elective III: Operation Research Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of the following. Oral examination based on term work.

01 One exercise/assignment on each unit.
02 Out of this any one exercise/assignment to be solved using Computer programming/ Software
03 One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution)
04 One exercise on analysis and solution using any of the above methods for data collected from Government Sources.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 a Elective IV: Air Pollution and Control Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

A. Experimental Performance and Demonstration (S. N. 1 and 2 Compulsory and any 02 out of S. N. 3, 4 and 5)

01 Sampling and analysis of PM_{10} and $PM_{2.5}$ using (High Volume Sampler/ Fine Dust Sampler) in Ambient Air.
02 Sampling and analysis of SO_2 and NO_2 (High Volume Sampler/ Fine Dust Sampler) in Ambient Air.
03 Demonstration and report of Sampling and Analysis of PM_{10} & $PM_{2.5}$ using portable aerosol Spectrometer with the help of information and communication technology (ICT).
04 Demonstration and report of Stack Emission Monitoring (Isokinetic Sampling) with the help of information and communication technology (ICT).
05 Demonstration and report of Indoor Air Quality Assessment using Multi Gas Monitor with the help of information and communication technology (ICT)

B. Visits and Interactive Sessions (S. N. 4 is compulsory and any 01 out of S. N. 01, 02 and 03)

01 Visit to India Meteorological Department with reference to monitoring of meteorological parameters and its report.
02 Visit to air quality monitoring station and its report.
03 Visit to industry (sugar/cement/steel/thermal power plant/rubber/dairy) with reference to air pollution control device(s) and its report.
04 An interactive session with experts from Indian Institute of Tropical Meteorology/ Central Pollution Control Board/ State Pollution control board/ Municipal corporation or Nagar Panchayat/ smart city centers/ National Environmental Engineering Research Institute (NEERI)/any authority with reference to air quality and its report.

C. Reports and Case Studies (Any 03 of the following)

01 A report on “Application of remote sensing and satellite-based data in air quality management”.
02 A report on “International Environmental Treaties to Reduce Air Pollution and GHG Emissions”.
03 A report on “Impact of Lockdown on air quality”.
04 A Report on “Sector Wise (Transportation/ Thermal Power plants/ Industries/ Domestic/ Agriculture) Mitigation Measures to Control Air Pollution”.
05 A report on “Challenges and the Way forward to mitigate Air Pollution”.
06 A case study report on “Ozone layer depletion/ Global warming/ Climate change/ acid rain”.
07 A case study report on “Wind rose diagram construction and application using freeware”.
08 A report on “Status of Air Quality Status of any city”.
09 A report on any model (Screen3/ ISC/ CALINE4/ HIWAY2/ CAR-FMI/ OSPM/ CALPUFF/ AERMOD/ ADMS).

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 b Elective IV: Advanced Design of Steel Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

A. One assignment on each unit

01 Design of Beam Column
02 Design of beam to beam or beam to column connections
03 Design of cold form flexural member (Preferably purlin on sloping roof)
04 Design of rafter using tubular cross section with design of Connections showing detailing of joints
05 Design of castellated beam
06 Design of portal / gable frame

B. Two site visit cold formed light gauge section/tubular structure and gable frame

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 c Elective IV: Statistical Analysis and Computational Methods Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

01 Exercise/Assignment on Introduction to Statistics
02 Exercise/Assignment on probability and distributions
03 Exercise/Assignment on data sampling
04 Exercise/Assignment on test of hypothesis
05 Exercise/Assignment on correlation and regression
06 Exercise/Assignment on variance and fitness test
07 Out of above at least two exercise/assignment to be solved using Excel or SPSS or Any other software suitable for statistical analysis

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 d Elective IV: Airport and Bridge Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

A. Compulsory assignment

01 Runway design for length and related corrections, and sketches of essential runway markings.
02 Design of pipe culverts and design of box culvert (Single vent only) one each.
03 Structural design of flexible or rigid runway

B. Any six from the following

01 Report on study of recent trends in airport planning and design.
02 Selection of bridge site, alignment and collection of design data.
03 Site visit to bridge site or airport site (report on visit)
04 Seminar on one topic of building information modeling (BIM) system.
05 Report on guest lecture in applications of AR and VR in Airport or bridge engineering.
06 Prepare the drawing/plate (A3)/PPTs on airport marking and lighting (describing importance)
07 Collection of information and preparation of PPTs on Heliports.
08 Prepare report on movable bridges/ temporary bridges/bearing.
09 Power point presentation on bridge substructure.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 e Elective IV: Design of Prestressed Concrete Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

A. Compulsory assignment /design

01 Assignment on introduction, prestressing systems and material properties, composite sections
02 Assignment on calculation of losses in prestress and stress calculation
03 Design and detailing of design of prestressed concrete determinate beam
04 Design and detailing of prestressed concrete slab
05 Design and detailing of prestressed concrete flat slab.
06 Design and detailing statically indeterminate PSC beams
07 One site visit reports, on prestressed concrete structure.
08 Minimum Two full imperial sheets based on two projects on design of prestressed concrete structural elements.

Note: Should be separate design problem statement for a group of students not exceeding five.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 f Elective IV: Formwork and Plumbing Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

01 Assignment on design of timber/steel formwork for slab. (Group of maximum Five students)
02 Assignment on design of timber/steel formwork for wall. (Group of maximum Five students)
03 Prototype model of any formwork (Group of maximum Five students)
04 Analysis and design of any formwork using suitable software.
05 Prototype model of plumbing for G + 2 building (Group of maximum Five students)
06 Assignment on design of plumbing
07 Assignment on plumbing system installation as Indian Standard.
08 Assignment on plumbing hydraulics and plumbing components
09 Reports of two site visits.
i. One site visit to observe conventional formwork and formwork for special structure or special formwork.
ii. One site visit to industrial plumbing system

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 009: Computer Programming in Civil Engineering

Teaching scheme	Credits	Examination scheme
Theory: 01 Hours/week	02	In semester Exam: NA
		End semester Exam: NA
Practical: 02 Hours/week		Term Work: 50 Marks

Prerequisites
Basic knowledge of computer programming, Civil Engineering

Course Objectives
01 To understand the basics of python programming.
02 To develop Python programs for civil engineering problems

Course Outcomes
At the end of course the learner will be able to,
01 Understand basics of Python Programming
02 Write Python codes for variety of problems in civil Engineering

Course Content

Unit I: Introduction to Python **(06 hours)**
Introduction of programming, introduction of python and its programming cycle, python interpreter and interactive mode, introduction of python integrated development environment (IDE), variables and identifiers, arithmetic operators, values and types, statements, operators, boolean values, operator precedence, expression, conditionals: if - else constructions. Loops: purpose and working of loops, do-while loop, for loop, nested loops, break and continue.

Unit II: Functions and Data Structures in Python **(06 hours)**
Function: parts of a function, execution of a function, keyword and default arguments, scope rules. Strings: length of the string and perform concatenation and repeat operations in it, indexing and slicing of strings, python data structure: tuples, unpacking sequences, lists, mutable sequences, list comprehension, sets. Dictionaries higher order functions: treat functions as first class objects, lambda expressions, introduction to python related libraries like NumPy, Matplotlib, seaborn and applications Keras and Tensor Flow.

Reference Books

01 Learning Python, Romano Fabrizio, Packt Publishing Limited.
02 Head First Python- A Brain Friendly Guide, Paul Barry, SPD O’Reilly, 2nd Edition.
03 Python: The Complete Reference, Martin C. Brown, McGraw Hill Education.

Term Work

Term work consists of any 10 mandatory laboratory assignments from the following. Students should complete these assignments by their developing/writing their own codes. Term work marks will be based on continuous assessment.

01 Application of python for **Open Channel Flow** (Analysis of rrectangular/triangular/trapezoidal channel)

02 Application of python for **Hydrology** (Determine the infiltration capacity and infiltration indices)

03 Application of python for **Groundwater Engineering** (Determine the discharge of a steady flow in a confined aquifer using Dupuit's equation)

04 Application of python for **Transportation Engineering** (Design the plain cement concrete pavement for two lane highway based on given conditions)

05 Application of python for **Infrastructure Engineering** (Estimation of productivity of construction equipment's like earthwork equipment)

06 Application of python for **Concrete Technology** (Estimation of strength of concrete or any mix design problem as per IS :10262-2019)

07 Application of python for **Structural Engineering** (Determine main steel for simply supported one way slab. Effective depth of slab is 125 mm and maximum moment in a slab is 22 kN.m, M25 grade of concrete and Fe 500 grade of steel)

08 Application of python for **Structural Engineering** (Determine the magnitude and nature of forces in members of statically determinate pin jointed truss by method of section)

09 Application of python for **Solid Waste Engineering** (Determine the settling velocity of suspended solids)

10 Application of python for **Environmental Engineering** (To find out the residual chlorine from given water with specifically mentioned doses of chlorine)

11 Application of python for **Soil Mechanics** (Find out the stress distribution in a soil using Boussinesq's equation)

12 Application of python for **Foundation Engineering** (Find out the shear strength of a soil with given data)

13 Application of python for **Quantity Analysis** (Determine the total volume of concrete in the trapezoidal footing)

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401010 Audit Course I a: Stress Management by Yoga

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 01 Hours/week	--	Grade

Pre-requisites

None

Course objectives

01 Understanding concept of Yoga and its benefits
02 Learn different types of Yogasans
03 Develop an understanding and stress importance of Meditation
04 Learn different techniques of Pranayam

Course outcomes

On successful completion of this course, the learner will be able to:

01 Develop understanding of Yoga and its impact on human body and mind.
02 Learn different Yogasans
03 Develop an understanding of meditation through pranayama
04 Learn different techniques of Pranayam

Course Contents

Unit I: Yoga: Sukshma (subtle) yoga techniques, difference between physical exercises and yogasans, impact of yogasans on human body, benefits of yogasans, patanjali yoga sutras, technique of different yogasans like, Trikonasan, Ardhachandrasan, Padmasan, Akarnadhanurasan, Ardhamatsendrasan, Vajrasan, Pachhimottanasan, Bhujangasan, Shalbhasan, Dhanurasan, Naukasan, Makrasan, Pawanmuktasan, Halasan, Sarvangasan, Shavasan, Suryanamaskar(Sun Salutation), yoga and food.

Unit II: Meditation: breathing technique, pranayam, benefits of pranayam, precautions for pranayam, Kumbhak, Bandh (Locks), Chakras, Mudra, technique of pranayam, Anulom-Vilom Pranayam, Ujjayi Pranayam, Bhramari Pranayam, Bhastrika Pranayam, Agnisa rPranayam, Kapalbhati Pranayam, Meditation (Dhyan).

Reference books

01 Light on Yoga, B. K .S. Iyengar, Harper Collins Publishers India
02 Light on Pranayama, B. K. S. Iyengar, Harper Collins Publishers India
03 Yoga for Dummies, Georg Feuerstein and larry Payne, Wiley India publishing
04 Yoga, Pilates, Meditation & Stress Relief, Parragon Books Ltd

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401010 Audit Course I b: Communication Etiquette in Workplaces

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Pre-requisites
None

Course objectives

01 Develop an understanding of workplace codes, professionalism at workplace
02 Understand the workplace ethics
03 Develop an understanding of Business ethics, workplace privacy and ethics
04 Learn teamwork at workplace

Course outcome

On successful completion of this course, the learner will be able to,

01 Develop an understanding of workplace codes, professionalism at workplace
02 Learn the workplace ethics
03 Develop an understanding of Business ethics, workplace privacy and ethics
04 Learn teamwork at workplace

Course Content

Unit I: Ethics in engineering profession and roles of engineers, ethical codes and its need, codes from other profession, advertising standards of India, corporate codes, knowledge of ethical codes. Workplace ethics: needs, principles, development of personal ethics, workplace ethics for employees-ethical behaviour in workplace- professionalism, ethical violations by employees, employee attitude and ethics, employee etiquettes. Benefits of ethics in workplace employee commitment, investor loyalty, customer satisfaction, profits professionalism at workplace: unethical conduct for employees and employers. Factors leading to unethical behaviours, different unethical behaviours, measures to control unethical behaviours, rewarding ethical behaviour

Unit II: Business ethics: overview of business ethics, corporate governance, ethical issues in human resource management- the principal of ethical hiring, firing, worker safety, whistle blowing, equality of opportunity, discrimination, ethics and remuneration, ethics in retrenchment. Ethical dilemmas at workplace, ethical issues in global business, corporate responsibility of employers, workplace privacy & ethics: privacy at workplace, hardware, software and spyware, plagiarism and computer crimes, convenience and death of privacy, defence of employee privacy rights. Teamwork at workplace: teams, elements of team, stages of team development, team meetings, team rules, and teams work and professional responsibility, rules of professional responsibility, ASME code of ethics, discrimination, sexual harassment, creating awareness about workplace harassment, compulsory workplace guidelines, ethics of managing change in workshop.

Reference Books

01 Business Ethics, Kurt Stanberry and Stephen M. Byars, Tata Mc Graw Hill Publisher.

02 A Guide to Corporate Business Etiquette, How to Maintain Effective Communication at Work Paperback, Satish Babu Bachu, 4th Edition, 17 July 2014.

03 The Essentials of Business Etiquette and workplace through ethics, Barbara Pachter, 5th Edition, 2018.

04 The Etiquette Advantage in Business, Personal Skills for Professional Success, Daniel Post Senning, Peter Post, Anna Post, Lizzie Post, Peggy Post, 3rd Edition.

05 Subramanian Business Etiquette: 101 Ways to Conduct Business with Charm & Savvy, Ann Sabath.

06 The Unwritten Rules of Professional Etiquette, Ryan Sharma, 4th Edition.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401011: Dams and Hydraulics Structures

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Prerequisites

Basic knowledge of Fluid Mechanics and Geotechnical Engineering

Course Objectives

01 To study different types of dams and instrumentation
02 To study the stability analysis of Gravity Dam
03 To study the spillways and design philosophy of Ogee spillway.
04 To study the failures and stability analysis of an earthen dam
05 To study design of canals and types of canal structures
06 Analysis of design of diversion headwork and of Cross drainage work

Course Outcomes

At the end of course the learner will be able to,
01 Understand types of dams and instrumentation working
02 Execute stability analysis of Gravity Dam
03 Understand types of spillways & Design of Ogee spillway
04 Illustrate the failures and analyze stability of earthen dam
05 Design Canals and understand the canal structures
06 Analysis of the Diversion headwork and Cross Drainage work

Course Content

Unit 1: Introduction to dam **(06 hours)**

Introduction, historical development of dams, different terms related to dams, selection of site of dam, factors governing selection of type of dam, classifications of dam, classification based on purpose, classification based on material, classification based on size of project, classification based on hydraulic action, classification based on structural action, introduction of arch dam and buttress dam including classification, advantages and limitations. Significance of Instrumentation: introduction, objectives of dam safety and instrumentation. Working principles and functions of instruments: piezometer, porous tube piezometer, pneumatic piezometer, vibrating wire piezometer, vibrating wire settlement cell, inclinometer, joint meter, pendulums, inverted pendulum, hanging pendulum, automatic pendulum coordinator, vibrating wire pressure cell, extensometer, embedment strain gauge, temperature gauge, distributed fiber optics temperature tool, seismograph.

Unit 2: Gravity Dam **(06 hours)**

Introduction, components of gravity dam, conditions favoring gravity dam, forces acting on gravity dam, combination of loading for design, seismic analysis of dam, terms related to seismic analysis, determination of seismic forces (Zangger's method), effect of horizontal earthquake acceleration, effect of vertical earthquake acceleration, stress analysis in gravity dam (only concept no derivation),vertical or normal stress, principal stresses, shear stresses, middle third rule, modes of failure of gravity dam, elementary profile of gravity dam, concept of high and low gravity dam, various design methods of gravity dam (introduction only), details of gravity method or 2 D method, construction of gravity dam, colgrout masonry, roller compacted concrete (R.C.C), temperature controlling in mass concreting, crack formation in gravity dam, control of crack formation in dam, construction joints, keys, water seal, retrofitting.

UNIT 3: Spillway (06 hours)

Introduction, location of spillway, different key levels and heads in spillway, spillway capacity, components of spillway, approach channel, control structure, discharge channel, energy dissipation, energy dissipation device, tail channel, classification of spillway, classification based on operation, main or service spillway, auxiliary spillway, emergency spillway, classification based on gates, gated spillway, ungated spillway, classification based on features, straight drop spillway (free overflow spillway), saddle spillway, side channel spillway, overflow or ogee spillway, chute or open channel or trough spillway, shaft or morning glory spillway, siphon spillway, conduit or tunnel spillway, stepped spillway. Design of ogee spillway or overflow spillway, shape of crest, equations for spillway profile on upstream and downstream, energy dissipation below spillway, classification of energy dissipation devices, stilling basin, components of stilling basin, types of stilling basins, Indian Standard stilling basin, correlation between jump height and tail water depth, methods of energy dissipation for stilling basin, design of roller bucket and ski-jump bucket, introduction to orifice type of spillway and spillway gates.

Unit 4: Earthen dam (06 Hours)

Introduction, conditions favoring on earth dam, limitations of earth dam, classification of earth dam, classification based on materials, methods of construction, height; selection of type of earth dam, components of earth dam, requirements for safe design of earth dam, hydraulic (seepage) analysis, plotting of phreatic (seepage) line, homogeneous earth dam with horizontal drainage blanket, determination of seepage discharge using flow net. Composite earth dam with casing and hearting, properties of phreatic line, determination of seepage discharge through earth dam using flow net, structural stability analysis of homogeneous and zoned earth dam, forces acting on earth dam, method of stability analysis of an earth dam, procedure of analysis by Swedish slip circle method, fellenius method of locating center of critical slip circle, stability analysis for foundation, failure of earth dam, classification of failure of earth dams, hydraulic failure, seepage failure, structural failure, seepage control in earth dams, causes of seepage, seepage control measures, construction of earth dam.

Unit 5: Canals (06 Hours)

Introduction, classification of canals, classification based on alignment, classification based on soil, classification based on source of supply, classification based on discharge, classification based on lining, classification based on excavation, components of canal, data required for canal design, selection of canal alignment, design of stable canal in alluvial beds, Kennedy’s theory, design of canal by Kennedy’s theory, limitations of Kennedy’s theory, Lacey’s regime theory, design of canal by Lacey’s theory, design of lined canal, canal lining, necessity of canal lining, requirement of lining material and types of lining. Canal Structures: canal falls, canal outlets, canal escapes, canal regulators.

Unit 6: Diversion head works (06 Hours)

Introduction, function of diversion head works, selection of sites for diversion head works, components of diversion head works, design of weir on permeable foundation, criteria for safe design of weir floor, brief introduction to Bligh and Lane’s theory, Khosla’s theory based on potential theory approach, Khosla’s theory on independent variables, design of weirs on permeable foundations.

C. D. Works: Introduction, Necessity of Cross Drainage works, Selection of site for Cross Drainage work, Selection of suitable type of C. D. works, data required for design of cross drainage work, classification of cross drainage works. Drain over canal: siphon, super passage. Canal over drain: aqueduct, siphon aqueduct**.** Canal and drain water meeting at same level: level crossing, inlet and outlet, design considerations for cross drainage works.

Text books

01 Irrigation and Water Resources Engineering, Asawa G. L., New Age International (P) Ltd.
02 Irrigation Engineering and Hydraulic Structures, Garg S. K, Khanna Publication.
03 Irrigation Water Power Engineering, Punmia B. C., Laxmi Publication.

Reference Books

01 Design of Small Dams, United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co.
02 Design Textbook in Civil Engineering, Volume Six, Leliavsky, Serge-Oxford and IBH Publishing Co.Pvt. Ltd.
03 Irrigation, Water Resources and Water Power Engineering, Modi P. N., Standard Book House, New Delhi.

Indian Standards

01 IS 8605: 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, Third reprint, July 1999, Bureau of Indian Standards, New Delhi.
02 IS 6512: 1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, First reprint, September, 1998, Bureau of Indian Standards, New Delhi.
03 IS 457: 1957 (Reaffirmed 2005), Code of practice for general construction of plain and Reinforcement concrete for dam and other massive structures, sixth reprint, January 1987, Bureau of Indian Standards, New Delhi.
04 IS 1013: 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, Bureau of Indian Standards, New Delhi.
05 IS 14591: 1999, Temperature control mass concrete for dams - guidelines, Bureau of Indian Standards, New Delhi.
06 IS 11223: 1985, (Reaffirmed 2004), Guidelines for fixing Spillway capacity, edition 1.2 (1991-09), Bureau of Indian Standards, New Delhi.
07 IS 6934: 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways-Recommendation, First revision, Bureau of Indian Standards, New Delhi.
08 IS 11155: 1994, Construction of spillways and similar overflow structures- Code of practice, Bureau of Indian Standards, New Delhi.
09 IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
10 IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
11 IS 10317: 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, Bureau of Indian Standards, New Delhi.
12 IS 4997: 1968 (Reaffirmed 1995), Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, Bureau of Indian Standards, New Delhi.
13 IS 7365: 1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, Bureau of Indian Standards, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401012: Quantity Surveying, Contracts and Tenders

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Knowledge of building planning, roads and its structural components, construction materials

Course Objectives

01 Impart knowledge to prepare approximate and detailed estimate of Civil Engineering works
02 To teach concepts of tendering process, contract document & Arbitration
03 To draft detailed specification and work out rate analysis according to material, labor requirements as per specified norms.
04 Impart knowledge of valuation, depreciation to carry out valuation of properties

Course Outcomes

On successful completion of this course, the learner will be able to,

01 Understand concept of estimates and prepare approximate estimate for various for Civil Engineering works.
02 Describe tendering process, construction contracts, and aspects of Arbitration and prepare tender documents.
03 Prepare detailed estimate of various items of work by different methods and calculate quantity of steel from Bar bending schedule.
04 Apply engineering knowledge to prepare estimate for roads, culverts, and water tank (Elevated storage tank)
05 Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis report.
06 Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend.

Course Content

Unit 1: Introduction and Approximate Estimates (06 hours)

Definition of estimation, valuation, purpose, and data required for estimation, types, concept of item of work, different items of work of buildings, units and mode of measurement for different items of work, measurement form and abstract form (Bill of Quantities). Administrative approval and technical sanction, prime cost, provisional sum and provisional quantities, contingencies, rate analysis, lead statement, work charge establishment, centage charges, , contents of S. S. R. Approximate estimate: Methods of approximate estimate of Civil Engineering works: like building, roads, irrigation, water supply & sanitary works with numerical.

Unit-2: Tenders, Contracts and Arbitration (06 hours)

Tenders: Definition, detailed tendering process and procedure, conditions regarding earnest money, security deposit, retention money, pre and post qualification of contractors, 3 bid, 2 bid and single bid system, qualitative and quantitative evaluation of tenders, comparative statement, pre-bid conference, acceptance/ rejection of tenders, BOT & Global Tendering, E-tendering. PWD procedure for executing, works piecework, rate list and daily labor, introduction to registration as a contractor in PWD.

Contracts: definition, objectives & essentials of a valid contract as per Indian Contract Act (1872), types of contracts, conditions of contract- defective work, subletting, etc. termination of contract, defect liability period, liquidated damages, interim payment or running account bills, advance payment, secured advance, final bill. Arbitration: Introduction to arbitrations as per Indian Arbitration & Conciliation Act (1996) - meaning and need of arbitration, qualities and powers of an arbitrator.

Unit 3: Taking out quantities & Detailed estimate (06 Hours)
Detailed estimates: factors to be considered while preparing detailed estimate, methods of detailed estimate-PWD and Centre line method, taking out quantities for load bearing and R.C.C framed structures as per IS 1200, bill of quantities. Bar Bending Schedule: introduction to bar bending schedule and its importance, preparing bar bending schedule for RCC members of building.

Unit 4: Estimates of other construction works (06 Hours)
Earthwork for road construction, estimate of road/highway works, estimate of steel roof truss, estimate of a culvert, water tank (elevated storage tank).

Unit 5: Specifications and Rate Analysis (06 Hours)
Necessity of specifications, purpose, types, drafting detailed specifications for major items of Civil Engineering works like earthwork, PCC, Masonry (stone & brick), RCC, Plastering, flooring, painting and road, Rate Analysis: purpose, importance, factors affecting rate of an item of work, overheads, task-work, procedure for rate analysis, rate analysis for major items of civil engineering works- like earthwork, PCC, masonry-stone & brick, RCC structural elements, plastering, flooring.

Unit 6: Valuation (06 Hours)
Introduction, valuation- purpose, types of property-real property and personal property, meaning of price, cost and value, factors affecting value, gross income, net income, outgoings, various forms of values. concept of free hold and lease hold property, depreciation, methods of calculating depreciation, obsolescence, sinking fund, years purchase, annuity. Methods of valuation of land and building: rental basis, direct comparison method, profit based method, development method, and rent fixation for building. Methods of Valuation of land: belting method of land valuation and other methods.

Text books

01 A Textbook of Estimating and Costing (Civil), D D Kohli and R C Kohli, S. Chand & company, New Delhi.
02 Civil Engineering Contracts and Estimates, B. S. Patil, Universities press
03 A Text Book of Estimating and Costing for Civil Engineering, G.S. Birdie, Dhanpat Rai Publishing Company

Reference Books

01 Estimating and Costing in Civil Engineering: Theory and Practice, B. N Dutta and S. Dutta , 28th revised edition, CBS Publishers and distributors.
02 Estimating, Costing Specifications & valuation in Civil Engineering, M. Chakraborty.
03 Estimating and Costing, R. C. Rangwala, Charotar Publishing House Pvt Ltd, Anand.
04 Theory and Practice of Valuation, Dr. Roshan Namavati, Lakhani Publications.
05 Valuation Principles and Procedures, Ashok Nain, Dewpoint Publication.
06 Laws for Engineers, Dr. Vandana Bhat and Priyanka Vyas, ProCare.

Hand books and Indian Standards

01 Standard contract clauses for domestic bidding contracts: ministry of statistics and program implementation, Government of India.

02 Document: Federation International Des Ingenieurs Conseils (FIDIC) i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.

03 Indian Practical Civil Engineers Handbook: P. N. Khanna, UBS Publication Distri. Pvt. Ltd.

04 Quantity Surveyor's Pocket Book by Duncan Cartlidge.

05 IS 1200: --- (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works, Bureau of Indian Standards, New Delhi.

06 IS 3861:1966, Method of measurement of areas and cubical contents of buildings, Bureau of Indian Standards, New Delhi.

07 D. S. R. (District Schedule of Rates) for current year.

08 PWD Redbooks, Vol 1 & 2.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 013 a Elective V: Earthquake Engineering

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering Mechanics, Engineering Geology, Structural design, Geotechnical Engineering, Engineering Mathematics

Course objectives

01 Introduce the aspect of earthquakes and vibrations.
02 Model real and physical dynamic problems.
03 Solve equations of motions for various oscillatory systems.
04 Perform static and dynamic seismic analysis for buildings.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Define the concepts of earthquakes, seismology and vibrations.
02 Model physical structures and develop equations of motion.
03 Solve the equations of motion for SDOF systems.
04 Solve the equations of motion for MDOF systems.
05 Perform static seismic analysis for buildings.
06 Perform dynamic seismic analysis for buildings.

Course Content

Unit 1: Earthquake and Seismology **(06 hours)**
Causes of earthquakes, seismic waves, magnitude and intensity of earthquakes, seismographs, accelerometers, ground motion parameters, peak acceleration, peak velocity, peak displacement, ground motion spectra

Unit 2: Vibration Analysis: SDOF Systems **(06 hours)**
Types of vibrations, dynamic equilibrium, mathematical modelling, stiffness, damping, types of damping, single degree of freedom (SDOF) systems, and solution to SDOF systems subjected to free and forced vibrations.

Unit 3: Vibration Analysis: MDOF Systems **(06 hours)**
Modeling of multi degree of freedom (MDOF) systems, solution to MDOF systems, Eigen values and Eigen vectors

Unit 4: Seismic Analysis: Static Approach **(06 hours)**
Types of seismic analysis, IS 1893 code provisions, equivalent static analysis.

Unit 5: Seismic Analysis: Dynamic Approach **(06 hours)**
Dynamic analysis, IS 1893-2016 code provisions, response spectrum analysis

Unit 6: Seismic Design **(06 hours)**
Seismic design factors – building configuration, damping, torsion, ductility. Lateral load resisting

systems, moment resisting frames, shear walls, diaphragms, braced frames, IS: 1893 code provisions. Strength and ductility of steel and concrete structures, ductile detailing of steel and concrete structures, IS 13920 provisions.

Text books

01 Structural Dynamics: Theory and Computation, Mario Paz & William Leigh, Springer Publications
02 Earthquake Resistant Design of Structures, S. K. Duggal, Oxford Publications
03 Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited.

Reference book

01 Dynamics of Structures, A. K. Chopra, Pearson Education India.

Indian Standards

01 IS 1893 (Part 1): 2016 Reaffirmed in 2021, Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings, Bureau of Indian Standards, New Delhi. India.
02 IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi. India.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 b Elective V: Structural Design of Bridges

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Concepts of structural analysis, Concept of structural steel design, Concept of reinforced concrete structural design, Concept of prestressed concrete

Course objectives

01 Know about various types of bridge structures.
02 Selection of appropriate bridge structures for given site conditions.
03 Analyze and design reinforced concrete, steel and prestressed concrete superstructures.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Identify loads on bridges and selection of type of bridge for the site condition as per Indian standards.
02 Design the reinforced concrete deck slab, culvert slab and T beam deck slab for highway bridges.
03 Analysis and design of reinforced concrete and post tension prestressed concrete girders.
04 Classify the types of rail bridges and design the plate girder steel bridges
05 Analyse and design the steel trussed bridges.
06 Study different types of bearing and thereby design the bearings for reinforced concrete highway bridges.

Course Content

Unit 1: Introduction to Highway and Railway Bridges (06 hours)

Types of bridges, classification, IRC loading standard for RC highway bridges, IRC loading standard for railway steel bridges, impact factors for moving loads as per IRC, concept of ILD/moving load and equivalent uniformly distributed load (EUDL).

Unit 2: RC Slab Bridge Deck for Highways (06 hours)

Analysis of slab decks considering cases solid slab spanning in one direction, solid slabs in spanning two direction and solid cantilever slab, design Aids and Tables of RC deck bridge slab as per Pigeaud‘s method, design of slab culvert, Design of RC slabs supported on all sides for T-beam and slab deck.

Unit 3: RC Bridge Girders and Post Tensioned Prestressed Girders (06 hours)

Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders as per Courbon’s theory, design of post tensioned prestressed concrete T beam bridge deck and girders.

Unit 4: Railway Plate Girder Bridges (06 hours)

Railroad bridge philosophy, railroad bridge types, elements of plate girder and their design such as web, flange, vertical stiffeners, end bearing stiffeners, intermediate stiffeners, and lateral bracing for plate girders.

Unit 5: Railway Truss Girder Bridges **(06 hours)**

Types and components, Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit 6: Bridge Bearings **(06 hours)**

General features and function of bearings, types of bearings, design of steel rocker and roller bearings, design of elastomeric pad bearing.

Text books

01 Design of Bridges, N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.

02 Design of Bridge Structures, T. R. Jagdish and M. A. Jayaram, Prentice-Hall of India Pvt. Limited., New Delhi.

03 Prestressed Concrete, N. Krishna Raju, Tata-McGraw Hill International.

Reference Books

01 Essentials of Bridge Engineering, Johnson Vector D, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.

02 Bridge Engineering Handbook, Wai-Fah Chen and Lian Duan, CRC Press Pvt. Ltd.

03 Bridge Engineering, Ponnuswamy S., Tata McGraw-Hill, New Delhi.

04 Design of Steel Structures, Ramachandra, Standard Publications New-Delhi.

05 Bridge Superstructure, Rajagopalan. N., Alpha Science International, New Delhi.

06 Plain and Reinforced Concrete, Vol.2., Jain and Jaikrishna, Nem Chand Brothers, New Delhi

Indian Standards

01 IS 456:2000, Code of practice for Plain and Reinforced Concrete, BIS, Bureau of Indian Standards, New Delhi.

02 Indian Railway Standard Code of practice for the design of steel and wrought iron bridges carrying rail, Govt of India, Ministry of Railways, 1962.

03 Standard specifications and code of practice for road bridges, IRC section I, II, III, V, VI. VII, and IX.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 c Elective V: Irrigation and Drainage

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Prerequisites

Basic knowledge of fluid mechanics, geotechnical engineering, and hydrology and water resources engineering

Course Objectives

01 To study different irrigation and drainage systems.
02 To introduce students about basic concepts of water, plant, and their interactions.
03 To calculate evapotranspiration and crop water requirement.
04 To develop analytical skills relevant to the design of irrigation and drainage projects, planning and management.

Course Outcomes

On successful completion of this course, the learner will be able to:

01 Summarize types of irrigation methods.
02 Estimate evapotranspiration and crop-water requirement.
03 Understand component parts and their design considerations of lift irrigation system.
04 Design drip and sprinkler irrigation systems.
05 Understand basics of salt affected soils and estimate leaching requirement.
06 Design surface and subsurface drainage systems.

Course Contents

Unit 1: Introduction (06 hours)

Definition, necessity of irrigation, benefits of irrigation, ill effects of irrigation, crop pattern, irrigation efficiency, cropping intensity, water use efficiency, canal and pipe distribution system, types of irrigation systems, techniques of water distribution in the farm, factors affecting the choice of irrigation methods, quality of irrigation water. Surface and subsurface irrigation methods, concept of deficit irrigation, micro irrigation (theory only), application of AI in irrigation and drainage.

Unit 2: Soil Moisture and Evapotranspiration (06 hours)

Soil Moisture: soil texture, soil structure, soil groups of India, field capacity, wilting point, maximum allowable deficiency (MAD), kinds of soil water, soil moisture tension, root zone, soil profile, soil-water relationships, soil-moisture characteristic curve, measurement of soil moisture, tensiometer.

Evapotranspiration (consumptive use): direct measurement of evapotranspiration: Lysimeters, field plots; evapotranspiration equations – Penman's equation, FAO Penman - Monteith equation, Blaney-Criddle formula, Thornthwaite formula, reference crop evapotranspiration, procedure to estimate actual evapotranspiration, frequency of irrigation, crop water requirement in peak fortnight, design discharge for canal and pipe distribution system. (**No** numerical should be asked on Penman's and FAO Penman - Monteith equation in theory exam).

Unit 3: Lift Irrigation and Drip Irrigation **(06 hours)**

Centrifugal pump (CP): working, component parts, heads of CP, NPSH, computation of power requirement, characteristic curves of CP. Lift Irrigation: general concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations involved in intake well, jack well, rising main, distribution systems. Drip Irrigation: definition and functions, advantages and disadvantages of drip irrigation systems, suitability of drip irrigation system, wetting pattern (width and depth of wetting front), components of drip irrigation system, planning and design of drip irrigation systems, installation and maintenance of drip assembly.

Unit 4: Sprinkler Irrigation **(06 hours)**

Introduction of sprinkler irrigation, advantages and limitations of Sprinkler Irrigation, types of sprinkler systems, components of sprinkler Irrigation system (Pumping set, main and lateral pipe lines, sprinkler heads, perforated pipes, debris screen and desilting basin, booster pumps, take off valves and flow control valves, fertilizer applicators), moisture distribution patterns and uniformity of coverage, uniformity coefficient. Design of sprinkler irrigation systems (inventory of resources and conditions, criteria for system layout, selection of sprinkler and its spacing, discharge capacity of the pump, hydraulic design of sprinkler systems- (discharge of sprinkler nozzle, main and lateral pipe sizes, pumps and power units), cost estimation, operation and maintenance.

Unit 5: Management of Salt Affected Soil **(06 hours)**

Salinity, salinity units, electrical conductivity, pH, quality of irrigation water, sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP), classification of saline and alkaline soils, osmotic potential, salinity stress coefficient, water stress coefficient, yield reduction, salt balance (mass balance) at farm level. Reclamation of saline soils: leaching requirement (LR) - Rhoades equation, requirement of irrigation water to meet crop demand and LR. Reclamation of alkali soils: Gypsum requirement.

Unit 6: Drainage of Irrigated Land **(06 hours)**

Definition and objectives of drainage, water logging, definition, classification and impact; types of drainage systems, surface, subsurface, vertical or tube well. Surface drainage system: design considerations for land drainage; design considerations for land grading/leveling, design consideration for field drains and field laterals; layout and design considerations of field drains and laterals - random field drain system, bedding field drain system, parallel field drain system; design of surface drainage channel (computation of design discharge only). Subsurface drainage systems: purpose and benefits; location and alignment of drains pipes; sub surface drainage system layouts- random system, parallel grid system, herringbone system, combined system; drain pipe envelope; structures of pipe drainage system- outlet of a pipe drain into a ditch or canal, junctions and inspection chamber, surface water inlets, bedding; drainage coefficient; drain spacing design – steady state formula (Hooghoudt formula), unsteady state formula (Glover-Dumm equation); design of drain pipe diameter; materials for drain pipe – clay, concrete, plastic, drainage wells. (No derivation of Hooghoudt and Glover-Dumm formulae).

Text Books

01 Irrigation Engineering and Hydraulic Structures, Garg, S. K., Khanna Publishers, New Delhi.
02 Irrigation, Theory and Practice, A. M. Michael, Vikas Publishing House Pvt. Ltd. New Delhi.
03 Irrigation Engineering and Hydraulic Structures, S. R. Sahasrabudhe, Kataria & Sons, New Delhi.
04 Engineering Hydrology, K Subramanya, McGraw Hill Education (India) Pv. Ltd.

Reference books

01 Drip and Sprinkler Irrigation, R. K. Biswas, New India Publishing Agency, New Delhi.

02 Land Drainage, Battacharaya A. K. & Michael A. M., Vikas Publ.

03 An introduction to Drip Irrigation Systems, Ajai Singh, New Delhi Publishers.

04 Irrigation Engineering, H. M. Raghunath, Wiley India.

05 Irrigation and Drainage Engineering, Peter Waller and Muluneh Yitayew, Springer.

06 Trickle Irrigation for Crop Production, F. S. Nakayama and D. A. Bucks, Elsevier.

07 Urban Drainage, David Butler and John W. Davies, Taylor & Francis.

08. Guidelines for Planning and Design of Piped Irrigation Network, Central Water Commission, Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi.

09 Pipe Distribution Network for Irrigation", WRD Handbook-Chapter 4 (Vol I, 2019), Water Resources Department, Govt. of Maharashtra.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 d Elective V: Design of Precast and Composite Structures

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Engineering Mechanics, Mechanics of Materials, Structural Analysis, Design of Steel and Concrete Structures

Course objectives
01 Learn the concepts and techniques of precast and composite construction.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Achieve knowledge of design and development of problem solving skills.
02 Explore the concept of precast construction.
03 Learn the principles and design of precast structures
04 Understand the need, advantages and limitations of composite material.
05 Apply basic mechanical principles in analysis of composite structures like beams, columns, floors, shear connectors.
06 Understand and apply various provisions as per Indian standards in design of structural components using composite materials.

Course Content

Unit 1: Introduction to Precast Concrete Construction (06 hours)
General principles of fabrication, need for prefabrication, comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization, materials, modular coordination, systems, production, transportation, erection.

Unit 2: Production and Fabrication (06 hours)
Production technology, choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening, hoisting technology, equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

Unit 3: Design of Precast Concrete Elements (06 hours)
Prefabricated load carrying members: types of beams, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses in beams, types of Slabs: construction of roof and floor slabs, design of hollow core slab, columns: construction and design principles of column, study of IS: 15916 and their applications.

Unit 4: Introduction to Composite Construction (06 hours)

Introduction to composite construction, basic concepts, types of composite constructions, Steel concrete composite, analysis and design of simply supported composite beams with solid steel beams.

Unit 5: Design of Shear Connectors **(06 hours)**

Types of shear connectors and its function, analysis and design of shear connection between concrete slab and beam**.**

Unit 6: Design of Composite Columns **(06 hours)**

Design of steel concrete composite columns, columns subjected to axial loads and moments, encased composite construction of beams and columns, concepts and design, introduction to of IS: 11384 and their applications.

Text Books

01 Design and Construction of Precast Concrete Structures, Ramachandra Murthy D. S., 1st Edition, Dipti Press OPC Private Limited, Chennai.

02 Precast Concrete Structures, Hubert Bachmann and Alfred Steinle, Earns and Sohn.

03 Steel-concrete Composite Structures, Narayanan R, Vol. 7, CRC Press.

Reference Books

01 Handbook of Composite Construction Engineering, Gajanan M. Sabnis and Van Nostrand Reinhold Inc., U.S.

02 Composite Structures of Steel and Concrete: Beams, Slabs, Columns and Frames for Buildings, Roger P. Johnson, 4^{th} Kindle Edition.

03 The Institute for Steel Development & Growth (INSDAG) course Material.

Indian Standards

01 IS 15916: 2010, Code of Practice for Building Design and Erection using Prefabricated Concrete, Bureau of Indian Standards, New Delhi.

02 IS 11384: 1985, Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi

03 IS 3935: 1966, Code of practice for composite construction, Bureau of Indian Standards, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 e Elective V: Hydropower Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basics of fluid mechanics, hydrology

Course objectives
01 Introduce the energy resources planning and potential concept.
02 Estimate the load factor and study the power house components and layout.
03 Understand the design of hydraulic turbines and study the economic consideration of hydroelectric power.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand the classification of power resources & trends in energy use patterns.
02 Identify the components of hydro power plant.
03 Analyze the load assessment for turbines.
04 Prepare the layout of power house based on the various structures need for it.
05 Design the turbines and surge tanks.
06 Understand the laws and regulatory aspects of hydroelectric power.

Course Content

Unit 1: Hydropower Plants & Its Classification (06 hours)
Introduction: sources and forms of energy, types of power plants, and elements of hydropower scheme, hydropower development in India. Power house structures-substructure and superstructure layout and dimensions, deign considerations. Hydropower plants classification: surface and underground power stations, low medium-high head plants-layout and components, pumped storage plants, tidal power plants, micro tidal units.

Unit 2: Energy Resources and Load Assessment (06 hours)
Estimation of electrical load on turbines, load factor, plant factor, peak demand and utilization factor, load curve, load duration curve, prediction of load, tariffs, hydro-thermal mix, combined efficiency of hydro-thermal-nuclear power plants.

Unit 3: Power and Energy Potential study (06 hours)
Processing of hydrological data, use of extreme and long term hydrological data, mass and elevation volume curves, flow duration curves, gross and net head and estimation, reservoirs and their regulation, need for flow regulation, source of sediment, sediment yield in rivers, life of the reservoirs, methods of fixing installed capacity of a hydropower plant, estimation of power and energy potential, mean and peak load, load curve, load factor.

Unit 4: Water Conductor System and Powerhouse (06 hours)
Water conductor system, alignment, intake structures, location and types, trash rack, penstock and pressure shaft, types of powerhouses, typical layout of powerhouse, components, power plant equipment's, instrumentation and control.

Unit 5: Design of Hydraulic Turbines **(06 hours)**

Components of hydraulic turbines, standardization and selection of turbine, Pelton turbine design, Francis turbine runner design, design of axial turbine runner including bulb turbine, draft tube theory, standardization and applications draft tube. Water hammer and surge tanks: rigid and elastic water column theories, water hammer pressure, behavior of surge tanks, types of surge tanks, hydraulic design, design of simple surge tank-stability

Unit 6: Economics of Hydroelectric Power: **(06 hours)**

Hydropower, economic value and cost and total annual cost. economic considerations – pricing of electricity, laws and regulatory aspects, policies, electricity act- 2003, investment in the power sector, carbon credits, participation of private sector.

Text Books

01 Water Power Engineering, Dandekar and Sharma, Vikas Publishin house, New Delhi

02 Water Power Engineering, R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.

03 Irrigation Engineering and Hydraulic Structures, Garg , S. K. Khanna Publishers, New Delhi

04 Water Power Engineering, P. K. Bhattacharya, Khanna Pub., Delhi.

05 Water Power Engineering, M. M. Deshmukh, Dhanpat Rai Pub.

Reference Books

01 Handbook of Hydroelectric Engineering, P. S. Nigam

02 Modern Power System Planning, Wang.

03 Hydropower Resources in India, CBIP

04 Hydro Power Structures, R. S. Varshney.

05 Water Power Development. E. Mosonvi, Vol. I & II.

06 Hydro-electric Engineering Practice, G. Brown, Vol. I, II & III.

07 Hydro – Electric Hand Book, Creager and Justin.

08 Centrifugal and axial flow Pump, A. J. Stephenoff, Krieger Publishing Company.

09 Hydraulic Structures, Novak, P. et al., Taylor and Francis, London.

10 Water Power Development, Volume 1: Low-head Hydropower Plants, Mosonyi, E., Academia Kiado, Budapest.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 f Elective V: Structural Audit and Retrofitting of Structures

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Structural analysis and structural design

Course objectives

01 To introduce Structural Audit: its necessity, procedure involved and report writing.
02 To introduce Retrofitting of structures: its necessity, materials & methods for retrofitting, retrofitting of RC, Steel & Masonry structures.
03 To make learners enable to design of retrofitting for RC beams and columns using FRP.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Identify causes of deterioration in RC and steel structures.
02 Explore entire process of structural audit.
03 Explore necessity and methods of structural health monitoring.
04 Explain method of retrofitting for RC, steel and historical structures.
05 Design retrofitting using FRP for RC column.
06 Design retrofitting using FRP for RC beams.

Course Content

Unit 1: Introduction **(06 hours)**

Causes of structural damages: mechanical actions, chemical attacks, earthquake, fire, damage to steel structures due to corrosion, damage to RC structures due to corrosion: corrosion induced by carbonation of concrete, chloride induced corrosion and corrosion induced by leaching of concrete. Introduction to structural audit, its necessity, introduction to retrofitting of structures, its necessity, repairs, difference between repairs and retrofitting

Unit 2: Structural Audit **(06 hours)**

Structural audit, assessment of health of structure, study of structural drawings, visual observations, nature of distress, collapse and investigation, limitations on investigator, tools for investigation, various NDT methods for assessing strength of distressed materials, concrete endoscopy. Investigation management, review of assimilated information, interviews and statements, evaluation and reporting, presentation of report, role of client, architect, consulting engineer and contractor

Unit 3: Structural Health Monitoring (SHM) **(06 hours)**

Introduction to SHM, Local and Global techniques for SHM, short and long-term monitoring, active and passive monitoring, remote and wireless SHM Techniques. Instrumentation, data acquisition, data processing for SHM, Artificial Intelligence in SHM

Unit 4: Retrofitting of Structures **(06 hours)**

Methods of retrofitting: moisture barrier systems, mass reduction technique, jacketing, shortcreting, Ferro cement mesh, inserting new member, base isolation. Suitability of various retrofitting techniques for RC structures, steel structures and masonry structures and introduction to retrofitting of Historical Structures

Unit 5: FRP and Retrofitting of RC Columns (06 hours)

Fiber Reinforced Polymer (FRP), Types of FRP and their properties, advantages of FRP retrofitting, FRP retrofitting using FRP plates, FRP wrapping, FRP bars, National and International code provisions. Retrofitting of RC columns using FRP for axial confinement as per provisions of ACI 440

Unit 6: Retrofitting of RC Beams using FRP (06 hours)

Analysis and design of RC beam using FRP, Retrofitting of RC Beams using FRP for flexural strengthening, shear strengthening, Provisions of ACI 440.

Text books

01 Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.

02 Repairs and Rehabilitation, Compilation from Indian Concrete Journals

03 Building: Structural Audit, Repairs and Restoration, Arun Kelkar, Majestic Publishing House.

04 Concrete Building Pathology, Susan Macdonald, Blackwell Publishing

05 Diagnosis and treatment of structures in Distress, R. N. Raikar, R & D Centre, (SDCPL).

06 A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures), Jayakumar J. Shah.

Reference books

01 ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, American Concrete Institute.

02 Xilin lu (2010), Retrofitting Design of Building Structures, Science Press, New York.

03 Strengthening and Rehabilitation of Civil Infrastructures Using Fibre-Reinforced Polymer (FRP) Composites, L. C. Hollaway and J. G. Teng, Woodhead Publishing Series in Civil and Structural Engineering

04 Maintenance, Repair & Rehabilitation & Minor Works of Building, by P C Varghese, PHI

05 Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.

06 Durability of Cement and Cement Composites, C. L. Page, M M Page, Wood Head, Publishing.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401014 a Elective VI: TQM and MIS

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Project management & engineering economics, construction management

Course objectives
01 Engineers with the ability to propose total quality management system in the construction projects
02 Engineers with the ability to appraise quality system standards in the construction projects
03 Engineers with the ability to choose MIS for a construction organizations

Course outcomes
On successful completion of this course, the learner will be able to,
01 Recognize quality and contribution of quality gurus for evaluation of best practices
02 Relate the functioning and application of TQM & Six Sigma in the domain of construction sector
03 Recommend ISO 9001 principles in preparation of quality manual to construction business
04 Apply management control & certification systems for construction industry
05 Choose TQM process implementation and various quality awards for construction sector
06 Propose MIS for allied fields in construction sector

Course Content

Unit 1: Construction Quality **(06 hours)**
Quality: various definitions and interpretation, importance of quality on a project in the context of global challenges, factors affecting quality of construction, reasons for poor quality & measures to overcome, Contribution of various quality gurus (Juran, Deming, Crossby, Ishikawa). Evolution of TQM-QC, TQC, QA, QMS, TQM, PDCA cycle

Unit 2: TQM and Six Sigma **(06 hours)**
TQM: Necessity, advantages, old and new 7 QC tools, quality function deployment (QFD), Six sigma: iimportance, levels, run chart and case study. Defects & it's classification in construction, measures to prevent and rectify defects and case study.

Unit 3: ISO and Quality Manual **(06 hours)**
Study of ISO 9001:2015 principles. Quality manual: importance, contents, documentation, importance of check-lists in achieving quality, typical checklist for concreting activity, formwork activity, steel reinforcement activity. Corrective and preventive actions, conformity and NC reports

Unit 4: Management Control and Certifications **(06 hours)**
Benchmarking in TQM, quality circle, categories of cost of quality, CONQAS, CIDC-CQRA certifications

Unit 5: Techniques in TQM Implementation and Awards **(06 hours)**

Five S techniques, failure mode effect analysis (FMEA), zero defects, Japanses tools and practices: JIT, KAIZEN, KANBAN, total productive maintenance, National & International quality awards- Rajeev Gandhi Award, Jamunalal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award

Unit 6: MIS **(06 hours)**

Introduction to management information systems (MIS), overview, definition, MIS and decision support systems, information resources, management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control. Study of an MIS for a construction organization associated with building works.

Text Books

01 Total Quality Management, Dr. Gunmala Suri and Dr. Puja Chhabra Sharma, Biztantra
02 Quality Control and Total Quality Management, P. L. Jain- Tata McGraw Hill Publ. Company.
03 Total Quality Management, Dr. S.Rajaram and Dr. M. Sivakumar, Biztantra.
04 Total Engineering Quality Management, Sunil Sharma, Macmillan India Ltd. Publishing
05 Management Information System, James O'Brien, Tata McGraw Hill Publishing

Reference Books

01 Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges, Juran's Quality Handbook, Juran Publication.
02 Management: Principle, process and practices, by Bhat, Oxford University Press.
03 Juran's Quality Planning & Analysis, Frank Gryna, Richard Chua, Joseph Defeo, McGraw Hill Publishing.
04 Management Information Systems, Gordon B. Davis, Margrethe H. Olson, Tata McGraw Hill Publishing.
05 Total Project Management: The Indian Context, P. K. Joy, Macmillan India Ltd Publishing.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401014 b Elective VI: Advanced Transportation Engineering

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Surveying and leveling, concrete technology and infrastructure engineering

Course objectives

01 To develop an analytical approach to urban transportation system.
02 To impart knowledge of sustainable transportation system with emphasis on non-motorized mode of transport.
03 To enable the students to design efficient pavement structure.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Analyze travel demand model and forecasting.
02 Evaluate relative importance of various modes and their capacities.
03 Design facilities required for non-motorized transportation and pedestrians.
04 Estimate basic characteristics of traffic stream and signal design.
05 Design flexible pavements.
06 Design rigid pavements and overlays.

Course Content

Unit 1: Transport System Planning **(06 hours)**

Transportation planning process, types of origin: destination surveys. Origin: destination matrix, travel demand forecasting, trip generation: growth factor and synthetic models, modal spilt analysis, trip distribution and route assignment analysis, transportation system management (TSM), application in comprehensive mobility plan (CMP) and detailed project report (DPR).

Unit 2: Urban Transport Technology **(06 hours)**

Classification: light, medium, mass and rapid transit system, introduction to intelligent transportation system (ITS) and its application for urban roads (IRC SP 110:2017), public transport policy (National and Maharashtra State), introduction to BRT, Mono rail, Metro rail, Bullet train and Hyperloop, use of drone, concept of integrated inter model transit system, freight transportation. Environmental impact assessment: EIA requirement of highway projects, procedure and guidelines.

Unit 3: Introduction to Non-Motorized Transport (NMT) **(06 hours)**

Introduction, NMT Systems, NMT in developed countries, data collection techniques, mobility and NMT in sustainable urban development, role of city developers, analysis of NMT, Impacts, pedestrian characteristics, pedestrian level of service, pedestrian facility design (IRC 11-2015): footpath, zebra crossing, underpass, pedestrian actuated signals, bicycle level of service, bicycle facility design.

Unit 4: Traffic Systems **(06 hours)**

Traffic Stream Models: Greenshield's model and Greenberg's logarithmic model, concept of level of service (LOS) as per highway capacity manual (HCM) and Indo-HCM**.** Concepts of delay and queuing in traffic streams, design of traffic signal by Webster's method and IRC method, overview of IRC SP: 12 – 2015, guidelines for parking facilities in urban areas.

Unit 5: Study of Flexible Pavement **(06 hours)**

Analysis and design of flexible pavement as per IRC 37: 2018 (Complete design including the use of IITPAVE), distresses in flexible pavement and recommended rectification as per IRC 82: 2015, surface unevenness and measuring road roughness as per IRC SP: 16 - 2019.

Unit 6: Rigid Pavement and Overlay Design **(06 hours)**

Seismic design factors: building configuration, damping, torsion, ductility, lateral load resisting systems, moment resisting frames, shear walls, diaphragms, braced frames, IS: 1893 code provisions, strength and ductility of steel and concrete structures, ductile detailing of steel and concrete structures, IS 13920 provisions.

Text books

01 Traffic Engineering and Transport Planning, L R Kadiyali, Khanna Publishers.
02 Understanding Traffic System, Michel A Taylor, William Young, Peter W Bonsall.
03 Principles of Urban Transport Systems Planning, B. G. Hutchinson.
04 Principles of Transportation Engineering, Partha Chakraborty and Animesh Das.
05 Introduction to transport planning, M. J. Bruton

Reference books

01 Transport Networks, Potts Oliver (Academic Press).
02 Principles of Pavement Design, E. F. Yoder (John Wiley & Sons, lnc USA).
03 Fundamentals of Transportation Engineering, C. S. Papacostas.
04 Pavement analysis and Design, Huang Y H, Prentice Hall, Englewood Cliff, New Jersey.
05 Introduction to Transportation Engg. and Planning, Morlok E K, McGraw-Hill company.
06 Fundamentals of Traffic Flow Theory , Drew, McGraw-Hill book co.
07 A Course in Traffic Planning and Design, Saxena Subhash, Dhanpat Rai & sons,Delhi

Indian standards and handbooks

01 IRC 37-2018, Guidelines for the design of Flexible Pavement (Fourth Revision).
02 IRC 58-2015, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision).
03 IRC 81-1997, Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique (First Revision).
04 IRC 82-2015, Code of Practice for Maintenance of Bituminous Surfaces of Highways.
05 IRC SP 110: 2017, Application of Intelligent Transport System for Urban Roads.
06 IRC SP: 12 – 2015, Guidelines for Parking Facilities in Urban Areas (First Revision).
07 IRC 93: 1985, Guidelines on Design and Installation of Road Traffic Signals.
08 IRC SP: 16 – 2019, Guidelines on Measuring Road Roughness and Norms. (Second Revision).
09 IRC SP: 83 – 2018, Guidelines for Maintenance, Repairs & Rehabilitation of Cement Concrete Pavements.
10 Handbook of Road Technology, Lay M. G. Gorden Breach Science Pub. Newyork.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
4010 14 c Elective VI: Geo-Synthetic Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Geotechnical Engineering, Foundation Engineering

Course objectives

01 To deal with the geo-synthetics as construction materials in civil engineering project.
02 To introduce the manufacture, behaviour and concept of geo-synthetics.
03 Applications of geo-synthetics in different civil engineering projects.

Course outcomes

On successful completion of this course, the learner will be able to,

01 Explain types of Geo-synthetic material and its application in construction industry
02 Define physical and engineering properties of geo-synthetics material
03 Describe function of geo-synthetics material and its application in geo environment engineering
04 Analyse effect of geo-synthetics in design of flexible pavements
05 Design the reinforced soil retaining structures
06 Explain mechanism of soil reinforcement to improve bearing capacity of soil

Course Content

Unit 1: Overview of Geo-synthetics **(06 hours)**

Types of geo-synthetics: geo-textile, geo-grid, geo-nets, geo-membranes, geo-foam, geo-composite, introduction of geo-synthetic clay liners, primary functions of each geo-synthetics material, manufacturing of geo-synthetics, raw materials used, different types of geo-synthetics manufacturing system.

Unit 2: Properties of Geo-synthetics material **(06 hours)**

Geo-synthetics testing, various properties of geo-synthetics, physical properties, mechanical properties, hydraulic properties and endurance properties

Unit 3: Functions of Geo-synthetics material **(06 hours)**

Geo-synthetics in filtration, drainage and erosion control, mechanism of filtration and drainage function and their application, design step for erosion control and re-composite drainage, application of geo-synthetics in geo environment.

Unit 4: Geo-synthetics in Pavement **(06 hours)**

Mechanism and concept of pavement, design of unpaved road using geo-synthetic material, giroud and Noiray method, airfield pavement design.

Unit 5: Geo-synthetics in reinforced soil retaining wall **(06 hours)**

Types of the facing element, construction procedure, cost, design of geo-synthetics wrap around face wall, geo-grid reinforced soil wall, geo-cell wall and gabion wall.

Unit 6: Geo-synthetics in ground improvement **(06 hours)**

Consolidation technique, prefabricated vertical drain, ground instrumentation and monitoring, design of encased stone column, bearing capacity of geo-synthetics reinforced soil system, mechanism of geo-cell reinforced sand overlaying soft clay.

Text books

01 Advanced Soil Mechanics, Das. B. M. 2008, Taylor and Fracis group, London

Reference books

01 Designing with Geo-synthetics. Vols. 1 & 2, Koerner, R. M., 6th Edition, Xlibris Corporation, USA.

02 Geo-synthetics Design and Construction Guidelines, Holtz. R. D., Christopher. B. R. and Berg. R. R. Technical Consultant, Dr. DiMaggio, U.S. Department of Transportation, Washington DC, FHWA-H1-98-038

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 014 d Elective VI: Structural Design of Foundations

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basics of geotechnical engineering

Course objectives

01 To assess the soil condition at a given location in order to suggest suitable foundation based upon bearing capacity.
02 To study design procedure of raft foundation and Machine foundations.
03 To study design principles of pile foundation, pile caps, well and caissons foundations.
04 To have knowledge on methods of retaining structures.

Course outcomes
On successful completion of this course, the learner will be able to,

01 Judge suitable type of shallow foundation based on the available soil category.
02 Decide suitable type of pile foundation for different soil stratum and evaluation of group capacity by formulation.
03 Design Raft foundations.
04 Design well and caissons Foundations.
05 Design different types of Machine foundations.
06 Design Retaining Structures.

Course Content

Unit 1: Shallow Foundations **(06 hours)**
Review of soil investigation, estimation of bearing capacity, settlement and depth of foundation, types of foundations and their specific applications, structural design of combined footings: strip footing, trapezoidal and strap.

Unit 2: Raft Foundation **(06 hours)**
Structural design of rafts by conventional method, principles of design of buoyancy raft and basement (no design problems), pressure relieve valves or ground/rock anchors (no design problems), concept of modulus of sub-grade reactions.

Unit 3: Pile Foundation **(06 hours)**
Types of pile foundations and their applications, estimation of load capacity of piles by static and dynamic formulae, pile load test, settlement and detailing as per IS 2911, concept of negative skin friction, piles subjected to uplift load (including under reamed piles), structural design of piles and pile caps, modulus of sub-grade reaction for laterally loaded piles.

Unit 4: Well and Caisson Foundations **(06 hours)**

Review of well and caisson foundations, structural elements of caisson and well foundations, load carrying capacity, grip length, structural design of well foundation and lateral stability, design of individual components of caisson foundation (only forces acting and design principles).

Unit 5:Machine Foundations **(06 hours)**

General requirements and design criteria, analysis and design by Barkans method, determination of coefficient of uniform elastic compression, design of a machine foundation, IS. Method of design (IS 2974).

Unit 6: Retaining walls **(06 hours)**

Types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging, support systems for flexible retaining walls (struts, anchoring), construction methods, stability calculations, design of flexible and rigid retaining walls (Cantilever), types of reinforced earth (RE) walls, gabbions, soil nailing & rock bolting.

Text books

01 Soil Mechanics and Foundation Engineering, A. K. Arora, Standard Publishers
02 Soil Mechanics and Foundation Engineering, B. C. Punmia, Laxmi Publication.
03 Foundation Engineering, P. C. Varghese, PHI learning private limited
04 Principles of Foundation Engineering, Dass B. M., Thomson Learning

Reference books

01 Advanced Foundation Engineering, Murthy V. N. S., C.B.S. Publishers
02 Foundation Analysis and Design, Bowels J. E., McGraw-Hill International Book Co.
03 Foundation Design: Principles and Practice, Coduto, Donald P., Prentice Hall
04 Principles of Foundations Engineering, Braja M. Das, Thomson Asia (P) Ltd.
05 Foundation Design manual for Practicing Engineers, Nayak, N. V., Dhanpat Rai and Sons
06 Foundation Engineering Handbook, Robert W. Day, Tata McGraw- Hill Companies Inc.
07 Foundation Design and Construction, Tomlinson, M. J. and Boorman. R., ELBS Longman.

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Savitribai Phule Pune University, Pune
B E Civil (2019 pattern) w. e. f. June 2021
401014 e: Elective VI: Green Structures and Smart Cities

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 3 hours/week	03	In semester exam: 30 marks End semester exam: 70 marks

Pre-requisites
Understanding of basic civil and environmental engineering

Course objectives
01 To understand green structures and energy efficient materials and their impacts on sustainability
02 To describe different terminologies and engineering concepts involved in smart city.
03 To understand the importance of smart cities with available case studies from India.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Students should be able to describe the importance of energy and minimization by altering the building materials.
02 Students should be able to understand the importance green construction and green rating system
03 Students should be able to introduce the applications of energy conservation and efficiency practices in buildings.
04 Students should be able to understand phases and approval involved in smart city project.
05 Students should be able to assess the national and global experience of smart cities.
06 Students should be able to understand the importance of sustainable development and current protocol of sustainable development goals.

Course contents

Unit 1: Introduction to Embodied Energy **(06 hours)**
Introduction to embodied energy, operational energy in building and life cycle energy, ecological foot print, bio-capacity and calculation of planet equivalent, introduction to civil engineering materials with embodied energy minimization concept and utilization

Unit 2: Green Construction Practices **(06 hours)**
Introduction to green construction practices, operational energy reduction and net zero building, introduction to optimization for design of building for energy efficiency, examples of optimization, introduction to radiation budget, surface water balance, effects of trees and microclimatic modification through greening, importance of rating and rating systems.

Unit 3: Building Integrated Photo Voltaic **(06 hours)**
Introduction to use of building integrated photo voltaic (BIPV) and other renewable energy in buildings their basic concepts and efficiency, introduction to energy conservation building code (ECBC-2017), mandaroty requirement for comfort system and control and electrical and renewable energy system, introduction to concepts of overall thermal transfer value (OTTV) etc.

Unit 4: Introduction to Smart Cities **(06 hours)**
Introduction to smart cities, introduction to city planning, dimensions of smart cities, phases, stages of project & their approval status, conventional Vs. smart city components, energy demand, green

approach to meet energy demand, index of Indian cities towards smartness, introduction to statistical analysis.

Unit 5: Singular-Hybrid Smart Cities (06 hours)

Conventional cities, consequences, alternative resources, reliability on predictability scale, solar options, PV and thermal; singular or hybrid, global experience of smart cities, smart cities, global standards and performance benchmarks, practice codes, India "100 smart cities" policy and mission, smart city planning and development.

Unit 6: Sustainable Smart City (06 hours)

Swachh Bharat mission and smart cities program, financing smart cities development, smart city case studies, governance of smart cities, introduction to artificial intelligence (AI) in smart cities, introduction to (sustainable development goal) SDG, the importance of SDG 11.

Text Books

01 Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition, Ross Spiegel, Dru Meadows

02 Mindful Smart Cities: Rethinking Smart Cities with Mindfulness Engineering, Shima Beigi PhD, VUB PRESS

Reference Books

01 Climate responsive architecture (A design hand book for energy efficient buildings), Arvind Krishnana, Simos Yannas, Nick Baker, S V Szokolay, McGraw hill Education, Seventh reprint.

02 Energy and the Environment, J M Fowler, McGraw Hill, New York, 2nd Edition.

03 Time-Saver Standards For Building Types, Joseph De Chiara, Michael J. Crosbie, McGraw-Hill.

04 Smart Cities: Foundations, Principles, and Applications, Houbing Song, Ravi Srinivasan, Tamim Sookoor, Wiley.

05 Beyond Smart Cities: How Cities Network, Learn and Innovate, Tim Campbell, Routledge.

IS Codes

01 Handbook on functional requirements of buildings (SP41), Bureau of Indian Standards, New Delhi, New Delhi, 1987

02 Energy Conservation Building Code (ECBC), Bureau of energy efficiency, 2017

03 Sustainable Building Design Manual- Volume I & II, TERI, 2009.

04 Green Rating for Integrated Habitat Assessment (GRIHA) guidelines

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Savitribai Phule Pune University, Pune
B E Civil (2019 pattern) w. e. f. June 2021
401014 f: Elective VI: Rural Water Supply Engineering

Teaching scheme	**Credits**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Understanding of basic civil and environmental engineering

Course Objectives

01 Students will gain knowledge of techno-economic issues related to Rural Water Supply.
02 Students will study interdisciplinary aspects of water supply engineering.
03 Subject will make students understand administrative aspects related to water supply.

Course Outcomes

On successful completion of this course, the learner will be able to,

01 Understand issues related to rural water supply with respect to source, water related issues in rural areas.
02 Understand role of various government departments and importance of participatory approach.
03 Understand various types of rural water supply scheme and infrastructure requirements therein.
04 Understand interdisciplinary requirements in RWS including Software
05 Understand Automation requirements for a Water Supply Project
06 Understand Documentation and O and M issues related Water Supply Project including Leak Detection.

Course Contents

Unit I: Introduction to Water Related Issues (06 hours)

Source vis-à-vis population (e.g. up to 2000 ground water, > 2000 surface), introduction to reservation of water, permissions of concerned authorities to lift water from notified river, water related issues in rural areas, water supply scheme for single gram Panchayat/Group gram Panchayat, geology/ certificate from GSDA, geology and its relation with groundwater, strengthening of source, introduction to RWH, horizontal bore, hydro-fracturing, well sinking, unconventional methods by GSDA, retrofitting of schemes. use of weep holes, yield test of open well, tube and bore well, introduction to Shivkalin Pani Sathawan Yojana, water quality and quantity.

Unit II: Socio- Economic Aspects of WS Schemes (06 hours)

Various departments involved in water conservation, participatory approach for success of project, financial scheme available with department, case studies: such as Palsoshi (Bhor), Hiware Bazar, Lamkani-(Dhule) available with MJP, capacity building of villagers.

Unit III: Various Types of Rural Water Supply Schemes (06 hours)

Introduction to single village scheme, introduction to regional rural W. S. Scheme, use of available infrastructure if any, retrofitting to available infrastructure, various components and layout of W. S. Schemes, scour depth calculation for well on bank/in a river bed, intake- Jack well (pump house), slotted pipe galleries and trench galleries, percolation wel, connecting mains, recuperation test (owner’s responsibility), introduction to rising main/gravity main, introduction to WTP SR-ESR/GSR/MBR, introduction to distribution, including house connection (Ferrule).

Unit IV: Interdisciplinary Aspects of Rural Water Supply (06 hours)

Introduction to electro mechanical aspects, pumping machinery, source-intake/WTP/ESR, introduction to hydraulic testing of pipelines, source: conveyance, selection of rising main and its appurtenances to control water hammer, flow, airlocks etc., introduction to pumps & pumping machinery, selection of types of pumps, calculation of hours of power required, requirements of electric supply (3 phase), availability of E. S. Software/Programmes for design of economical diameter of R. M., techno- economic comparison of various pipe materials (R. M./Gravity Main, as well as distribution lines), requirement of residual hydraulic pressure, calculation of hydraulic grade line HGL and frictional head with total head acting on pump, introduction to JALTANTRA software of IIT Bombay.

Unit V: Instrumentation in WSE (06 hours)

Introduction to auto pump controller, sensor for water quality monitoring cycle PH, turbidity meter, TDS meter, ultrasonic level sensor, hydraulic modeling, use of instrumentation and robotics in WSS, use of SCADA and introduction to SCADA based automation, PLC in WSE, application of GPS in WSE, application of GIS in WSE, introduction to the water meter, case study of Malakapur Town.

Unit VI: Documentation of Presentation (06 hours)

Record drawings of executed works, (As built drawings), periodical maintenance of pumping machinery, electrical components and other machinery, training requirements to villagers on operation and maintenance issues, introduction to preventive maintenance, leakage detection: techniques used and importance.

Text Books

01 Water Supply Engineering, S. K. Garg, Khanna Publications

02 Water Supply Engineering, Dr. P. N. Modi, Standard Book House

Reference Books

01 CPHEEO Manual on Water Supply and Treatment

02 Rural Water Supply And Sanitation by Sanjay Gupta

03 IWWA Technical Data Book (Available with IWWA Pune Local Centre)

04 Special Reference Material Recommended:
Compendium of Training Materials for the Capacity Building of the Faculty and Students of Engineering Colleges on Under the Unnat Maharashtra Abhiyan (UMA) Prepared By Institute for Resource Analysis and Policy, Hyderabad & CTARA, IIT Bombay Supported by UNICEF, Mumbai March, 2018

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 015: Project Stage II

Teaching scheme	**Credits**	**Examination scheme**
Practical: 04 Hours/week	03	Term Work: 100 Marks
	02	Oral: 50 Marks

Pre-requisites

Fundamentals of Civil Engineering

Course objectives

01 Identify latest technical/practical problems in the field of Civil Engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes

On successful completion of this course, the learner will be able to:

01 Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The Project Stage II report should contain the following. Internal guides may prepare a continuous evaluation sheet for each student and refer as continuous assessment for term work marks.

01 Introduction including aim and objective
02 Review of literature
03 Problem statement and methodology
03 Concepts associated with the project topic
04 Results and discussion
05 Validation of results
06 Conclusions and future scope of work
07 References
08 Students publication/achievements

In Project Work Stage II, the student shall complete the project and prepare the final report of project work in standard format duly certified for satisfactory completion of the project work by the concerned guide and Head of the Department/Institute. The final project report shall be submitted in hard bound copy as well as a soft copy. The term work of project stage II shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. It is recommended that at least one publication on the project topic to be presented in a conference or published in a referred journal.

Oral Examination: The students must prepare presentation on Project Stage II and present in presence of pair of examiners through a viva-voce examination.

Savitribai Phule Pune University, Pune
B.E. Civil (2019 Pattern) w. e. f. July 2022
401016: Dams and Hydraulics Structures Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of following compulsory assignments. Oral examination is based on term work.

01 Literature collection of introductions to dams (minimum 5 dams) or case study of failure of any hydraulic structure.
02 Stability analysis of gravity dam
03 Design of profile of spillway
04 Design of energy dissipation device below the spillway
05 Stability analysis of zoned earthen dam (Preferably use of AutoCAD sheet)
06 Analysis of weirs on permeable foundations
07 Design of lined canal
08 Site visits and reports with photographs (compulsory) of the following.
Gravity dam/earthen dam
Spillway
CD/Canal structures/Weirs/Barrage

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 017: Quantity Surveying, Contracts and Tenders Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of following compulsory exercise. Oral examination is based on term work.

01 Detailed estimate of load bearing structure (for a single storied building), calculation of steel reinforcement by percentage basis, using rates as per current SSR.
02 Working out detailed quantities for two storied (G+1) R.C.C. framed building based on prevailing SSR.
03 Preparation of bar bending schedule for the G + 1 building as in exercise No. 2.
04 Detailed estimate for any one of the following
    a. Factory Shed of Steel Roof Truss
    b. Elevated Water Reservoir
    c. Pipe/Slab Culvert
    d. Road / Railway Track/Runway
05 Detailed specifications for major construction items of building/road.
06 Working out rate analysis for major construction items of building/road.
07 Preparation of tender documents for exercise No. 2 (Preparation of schedule A & B, conditions of contract regarding time, labour payment, etc.) and collection of tender notice for different government construction works (minimum 3)
08 Preparing valuation report of a Residential building and writing report using O-1 form
09 Appropriate software/excel spread sheet for exercise in serial No 1 to 4 is recommended.
10 Site visit and reports for understanding of BBS with photographs (Mandatory)

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 a Elective V: Earthquake Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following experiments or assignments. Term work marks will be based on continuous assessment.

01 Assignments on each unit.
02 Using any programming language or spreadsheets, plot the response functions for various types of excitations.
03 Demonstrate the applications of horizontal and vertical shake tables.
04 Perform seismic analysis of a multi-story building using any software.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 b Elective V: Structural Design of Bridges Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following experiments or assignments. Term work marks will be based on continuous assessment.

01 One project on RC highway bridges which shall include: design of deck slab, longitudinal girder, cross-girder, bearings, abutment and pier. The detailing shall be shown in at least three full imperial sheets.

02 One project on railway steel bridges which shall include: design of steel trussed bridges 'or' the design of plate girder bridges. The detailing shall be shown in at least two full imperial sheets.

03 Report of at least two site visits covering the contents of the syllabus.

Note: 1. The projects can be done using suitable finite element and drafting software.

2. The term work can be prepared in a group of not more than four students in a group.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 c Elective V: Irrigation and Drainage Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following experiments or assignments. Term work marks will be based on continuous assessment.

01 Assignment to summarize types of irrigation methods and application of artificial intelligence techniques in irrigation and drainage.
02 Assignment on evapotranspiration estimation using Penman's equation or FAO Penman-Monteith equation. *(Hand calculations).*
03 Assignment on solution of Assignment 2 using computer programme/spreadsheet.
04 Assignment on design of drip irrigation system.
05 Assignment on design of sprinkler irrigation system.
06 Assignment based on Unit 5. (Min. 6 questions).
07 Assignment on design of surface drainage system and design of subsurface drainage system
08 Assignment on use of **CropWat** software to determine crop water requirement and irrigation scheduling.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 d Elective V: Design of Precast and Composite Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work should consist of the following. Term work marks will be based on continuous assessment.

01 Assignment one at least five questions on Unit 1 covering all the topics listed in syllabus.
02 Assignment two at least five questions on Unit 2 covering all the topics listed in syllabus.
03 Full imperial drawing sheet: detailing of any one design problem from Unit 3 or Unit 4
04 Full imperial drawing sheet: detailing of any one design problem from Unit 5 or Unit 6
05 Report on site visit (Precast or Composite Structures) covering the contents of the syllabus mentioned above.
06 Analysis and design of composite building using any suitable FE based software.

Note: The group size should not be more than five students and each group should have different design data.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 e Elective V: Hydropower Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work should consist of the following. Term work marks will be based on continuous assessment.

01 Calculating the electricity bill of upper middle class family that uses various electrical appliances.
02 Determination of power output for a run of river plant with and without pondage.
03 Justification of economics of pumped storage plants.
04 Design of Kaplan / Francis / Pelton turbine.
05 Design of straight conical draft tube.
06 Use of any software to calculate water hammer pressure.
07 Study of any hydropower project.
08 Design of intake of a hydropower plant with neat sketch**:** Design of settling basin of a hydropower plant with neat sketch.
09 Hydraulic Design of Forebay and preparation of plan and longitudinal sections **::** Hydraulic Design of Surge Tank and preparation of plan and vertical sections **::** Estimation of hydrodynamic pressure and steel thickness of penstock.
10 Report based on visit to any micro/small/mega hydropower project.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 f Elective V: Structural Audit and Retrofitting of Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work should consist of the following. Term work marks will be based on continuous assessment.

01 Report on various repair materials available in the market
02 Conduction of Visual observation of any damaged structure and preparation of report
03 Determination of compressive strength of polymer modified mortar
04 Determination of compressive strength of polymer modified concrete
05 Non-destructive test on concrete (any one)
06 Assignment on materials and methods of retrofitting.
07 Demonstration of Moisture barrier coatings and membranes
08 Assignment on Retrofitting of RC Beams using FRP
09 Assignment on Retrofitting of RC Columns using FRP
10 Site Visit to any structure where repair/retrofitting work is in progress
11 Conduction of Structural Audit of any nearby structure and preparation of detailed report

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401019Audit Course II a: Social Responsibility

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 01 Hours/week	--	Grade

Pre-requisites
None

Course objectives

01 Develop understanding of social responsibility
02 Understand the International framework for Social Responsibility
03 Know the drivers of social responsibility in India
04 Identify the key stakeholders of social responsibility

Course outcomes

On successful completion of this course, the learner will be able to:

01 Develop understanding of social responsibility
02 Learn the International framework for Social Responsibility
03 Know the drivers of social responsibility in India
04 Identify the key stakeholders of social responsibility

Course Contents

Unit 1: Introduction to social responsibility meaning and definition, history of social responsibility, concepts of charity, social philanthropy, citizenship, sustainability and stakeholder management, environmental aspects of social responsibility. International framework for social responsibility: millennium development goals, sustainable development goals, relationship between corporate social responsibility and millennium development goals, OECD corporate social responsibility policy tool.

Unit 2: Drivers of social responsibility in India: market based pressure and incentives, civil society pressure, the regulatory environment in India counter trends, review of current trends and opportunities in social responsibility, review of successful corporate initiatives and challenges of social responsibility. Identifying key stakeholders of social responsibility: role of public sector in corporate, government programs, non-profit and local self-governance in implementing social responsibility, global compact self-assessment tool, national voluntary guidelines by govt. of india, roles and responsibilities of corporate foundations.

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Reference books

01 Strategic Corporate Social Responsibility: William B. Werther Jr. and David Chandler, Stakeholders in a Global Environment, Second Edition, Sage Publications.
02 Corporate Social Responsibility in India: Sanjay K Agarwal, Sage Publications.
03 Corporate Social Responsibility: An Ethical Approach: Mark S. Schwartz, Broadview Press.

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401019 Audit Course II b: Human Rights

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Pre-requisites
None

Course objectives
01 Understand the concept of Human rights and Human rights Movement
02 Understand the Human rights and Indian Constitution
03 Gather Knowledge about Human Rights of the Different Sections and contemporary issues
04 Gather knowledge about international scene towards human rights with reference to engineering Industry

Course outcomes
On successful completion of this course, the learner will be able to,
01 Gather Knowledge about Human rights and Human rights Movement
02 Develop understanding of Human rights and Indian Constitution
03 Discuss Human Rights of the Different Sections and contemporary issues
04 Discuss International scenario towards human rights with reference to engineering Industry

Course Content

Unit 1: Human rights: concept, development, evolution-philosophical, sociological and political debates, benchmarks of human rights movement. Human rights and the Indian constitution: constitutional framework, fundamental rights and duties, directive principles of state policy, welfare state and welfare schemes. Human rights and state mechanisms: police and human rights, judiciary and human rights, prisons and human rights, national and state human rights commissions.

Unit 2: Human rights of the different sections and contemporary issues: unorganized sector, right to environment, particularly industrial sectors of civil engineering and mechanical engineering, globalization and human rights, right to development, citizens' role and civil society: social movements and non-governmental organizations, public interest litigation. Role of non-government organizations in implementation of human rights: right to information. Human rights and the international scene: primary information with reference to engineering. Industry: UN documents, International mechanisms (UN & Regional), International criminal court.

Reference Books

01 Human Rights in India- A Mapping: Usha Ramanathan.
Free download from http://www.ielrc.org/content/w0103.pdf
02 Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing
03 Study material on UNESCO, UNICEF web site
04 http://www.unipune.ac.in/pdf_files/final%20book_03042012.pdf
05 http://eclm.unipune.ac.in/Human rights

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Faculty of Engineering
Savitribai Phule Pune University, Pune

Maharashtra, India

Curriculum
for
Fourth Year of Computer Engineering
(2019 Course)
(With effect from 2022-23)

www.unipune.ac.in

Third Year of Computer Engineering
(2019 Course)
(With effect from 2022-23)

Prologue

It is with great pleasure and honor that I share the syllabi for Fourth Year of Computer Engineering (2019 Course) on behalf of Board of Studies, Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BoS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks,

Dr. Varsha H. Patil
Chairman, Board of Studies (Computer Engineering), SPPU, Pune

links for First Year, Second Year and Third Year Computer Engineering Curriculum 2019:

1. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf**
2. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf**
3. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt_03.072020.pdf**
4. **http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2021/Third%20Year%20Engineering%202019%20Pattern_16022022.rar**

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Table of Contents

Savitribai Phule Pune University
Bachelor of Computer Engineering

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO1	**Professional Skills-**The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills-** The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship-** The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

BE Computer Engineering 2019 Course tentative Curriculum structure:

Savitribai Phule Pune University
Final Year of Computer Engineering (2019 Course)
(With effect from Academic Year 2022-23)

Semester VII

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral\Pre	Total	Lecture	Practical	Tutorial	Total
410241	Design and Analysis of Algorithms	03	-	-	30	70	-	-	-	100	3	-	-	3
410242	Machine Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
410243	Blockchain Technology	03	-	-	30	70	-	-	-	100	3	-	-	3
410244	Elective III	03	-	-	30	70	-	-	-	100	3	-	-	3
410245	Elective IV	03	-	-	30	70	-	-	-	100	3	-	-	3
410246	Laboratory Practice III	-	04	-	-	-	50	50	-	100	-	2	-	2
410247	Laboratory Practice IV	-	02	-	-	-	50	-	-	50	-	1	-	1
410248	Project Stage I	-	02	-	-	-	50	-	-	50	-	2	-	2
										Total Credit	**15**	**05**	**-**	**20**
	Total	**15**	**08**	**-**	**150**	**350**	**150**	**50**	-	**700**	**15**	**05**	**-**	**20**
410249	Audit Course 7										**Grade**			

Elective III

410244(A) Pervasive Computing
410244(B) Multimedia Techniques
410244(C) Cyber Security and Digital Forensics
410244(D) Object Oriented Modeling and Design
410244(E) Digital Signal Processing

Elective IV

410245(A) Information Retrieval
410245(B) GPU Programming and Architecture
410245(C) Mobile Computing
410245(D)Software Testing and Quality Assurance
410245(E) Compilers

Laboratory Practice III:
Laboratory assignments Courses- 410241, 410242, 410243

Laboratory Practice IV:
Laboratory assignments Courses- 410244, 410245

Audit Course 7(AC7) Options:
AC7- I MOOC- Learn New Skills
AC7- II Entrepreneurship Development
AC7- III Botnet of Things
AC7- IV 3D Printing
AC7- V Industrial Safety and Environment Consciousness

Savitribai Phule Pune University

Final Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2022-23)

Semester VIII

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral/Pre	Total	Lecture	Practical	Tutorial	Total
410250	High Performance Computing	03	-	-	30	70	-	-	-	100	03			03
410251	Deep Learning	03	-	-	30	70	-	-	-	100	03			03
410252	Elective V	03	-	-	30	70	-	-	-	100	03			03
410253	Elective VI	03	-	-	30	70	-	-	-	100	03			03
410254	Laboratory Practice V	-	02	-	-	-	50	50	-	100		01		01
410255	Laboratory Practice VI	-	02	-	-	-	50	-	-	50		01		01
410256	Project Stage II	-	06	-	-	-	100	-	50	150		06		06
										Total Credit	**12**	**08**	**-**	**20**
	Total	**12**	**10**	**-**	**120**	**280**	**200**	**50**	**50**	**700**	**12**	**08**	**-**	**20**
410257	Audit Course 8										**Grade**			

Elective V	**Elective VI**
410252(A) Natural Language Processing 410252(B) Image Processing 410252(C) Software Defined Networks 410252(D) Advanced Digital Signal Processing 410252(E) Open Elective	410253(A) Pattern Recognition 410253(B) Soft Computing 410253(C) Business Intelligence 410253(D) Quantum Computing 410253(E) Open Elective
Lab Practice V: Laboratory assignments Courses- 410250, 410251	**Lab Practice VI:** Laboratory assignments Courses- 410252, 410253

Audit Course 8(AC8) Options:

AC8- I Usability Engineering
AC8- II Conversational Interfaces
AC8- II Social Media and Analytics
AC8- IV MOOC- Learn New Skills
AC8- V Emotional Intelligence

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. These **Program Outcomes (POs)** are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course, many a times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.
2. @**CO and PO Mapping Matrix**(Course Objectives and Program Outcomes) attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there isno correlation between CO and PO.
3. For each course, contents are divided into six units-I, II, III, IV, V and VI.

#Elaborated examples/Case Studies are included at each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *For each unit contents, the content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.
5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as the part of laboratory work. Inclusion of it will be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.
6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.
7. For each course, irrespective of the examination head, the instructor should motivate students to read articles/research papers related to recent development and invention in the field.
8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed.
9. **Term Work** –Term work is continuous assessment that evaluates a student's progress throughout the semester. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

10. **Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.**

Abbreviations

TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**Sem: Semester**	

Faculty of Engineering Savitribai Phule Pune University

SEMESTER VII

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410241: Design and Analysis of Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Fundamentals of Data Structures(210242, Data Structures and Algorithms(210252), Theory of Computation (310242)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- To develop problem solving abilities using mathematical theories.
- To apply algorithmic strategies while solving problems.
- To analyze performance of different algorithmic strategies in terms of time and space.
- To develop time and space efficient algorithms.
- To study algorithmic examples in distributed and concurrent environments
- To Understand Multithreaded and Distributed Algorithms

Course Outcomes:

On completion of the course, student will be able to–

CO1: Formulate the problem
CO2: Analyze the asymptotic performance of algorithms
CO3: Decide and **apply** algorithmic strategies to solve given problem
CO4: Find optimal solution by applying various methods
CO5: Analyze and **Apply** Scheduling and Sorting Algorithms.
CO6: Solve problems for multi-core or distributed or concurrent environments

Course Contents

Unit I	Algorithms and Problem Solving	07 Hours

Algorithm: The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues.
Problem solving Principles: Classification of problem, problem solving strategies, classification of timecomplexities (linear, logarithmic etc.)

#Exemplar/Case Studies	Towers of Hanoi
***Mapping of Course Outcomes for Unit I**	CO1,CO3

Unit II	Analysis of Algorithms and Complexity Theory	07 Hours

Analysis: Input size, best case, worst case, average case
Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, Θ, o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.

#Exemplar/Case Studies	Analysis of iterative and recursive algorithm

***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Greedy And Dynamic Programming algorithmic Strate**	**08 Hours**

Greedy strategy: Principle, control abstraction, time analysis of control abstraction, knapsack problem,scheduling algorithms-Job scheduling and activity selection problem.
Dynamic Programming: Principle, control abstraction, time analysis of control abstraction, binomialcoefficients, OBST, 0/1 knapsack, Chain Matrix multiplication.

#Exemplar/Case Studies	Rail tracks connecting all the cities
***Mapping of Course Outcomes for Unit III**	CO3, CO4

Unit IV	**Backtracking and Branch-n-Bound**	**08 Hours**

Backtracking: Principle, control abstraction, time analysis of control abstraction, 8-queen problem,graph coloring problem, sum of subsets problem.
Branch-n-Bound: Principle, control abstraction, time analysis of control abstraction, strategies- FIFO,
LIFO and LC approaches, TSP, knapsack problem.

#Exemplar/Case Studies	Airline Crew Scheduling
***Mapping of Course Outcomes for Unit IV**	CO3, CO4

Unit V	**Amortized Analysis**	**07 Hours**

Amortized Analysis: Aggregate Analysis, Accounting Method, Potential Function method, Amortized analysis-binary counter, stack Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

#Exemplar/Case Studies	cutting stock problem
***Mapping of Course Outcomes for Unit V**	CO3,CO5

Unit VI	**Multithreaded And Distributed Algorithms**	**07 Hours**

Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms,Parallel loops, Race conditions.
Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreadedmerge sort.
Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum SpanningTree.
String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm.

#Exemplar/Case Studies	Plagiarism detection

*Mapping of Course Outcomes for UnitVI	CO6

Learning Resources

Text Books:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, “ Design And Analysis of Algorithms”,Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, “Fundamentals of Algorithmics”, PHI, ISBN 978-81-203-1131-2

Reference Books :

1. Michael T. Goodrich, Roberto Tamassia, “Algorithm Design: Foundations,” Analysis and InternetExamples‖, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “ Introduction toAlgorithms”, MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 817371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms” Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, “Algorithms on Strings, Trees and Sequences”, Cambridge University Press,ISBN:0-521-67035-7

e-B ooks :

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/design_and_analysis_of_algorithms_tutorial.pdf
2. https://www.ebooks.com/en-in/book/1679384/algorithms-design-techniques-and-analysis/m-h-alsuwaiyel

MOOC Courses links :

- Design and Analysis of Algorithms - https://nptel.ac.in/courses/106106131

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	2	3	3	2	-	-	-	-	-	-	-	3
CO5	2	2	2	2	-	-	-	-	-	-	-	3
CO6	2	2	1	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410242: Machine Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Data Science and Big Data Analytics(310251)

Companion Course: Laboratory Practice III(410246)

Course Objectives:
- To understand the need for Machine learning
- To explore various data pre-processing methods.
- To study and understand classification methods
- To understand the need for multi-class classifiers.
- To learn the working of clustering algorithms
- To learn fundamental neural network algorithms.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Identify the needs and challenges of machine learning for real time applications.
CO2: Apply various data pre-processing techniques to simplify and speed up machine learning algorithms.
CO3: Select and apply appropriately supervised machine learning algorithms for real timeapplications.
CO4: Implement variants of multi-class classifier and measure its performance.
CO5 :Compare and contrast different clustering algorithms.
CO6: Design a neural network for solving engineering problems.

Course Contents

Unit I	Introduction To Machine Learning	07 Hours

Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science.
Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models.
Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches

#Exemplar/Case Studies	Suppose you are working for Uber where a task to increase sales is given.Understand the requirements of the client
***Mapping of Course Outcomes for Unit**	CO1

Unit II	Feature Engineering	07 Hours

Concept of Feature, Preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern. Introduction to various Feature Selection Techniques, Sequential Forward Selection, Sequential Backward Selection. Statistical feature engineering: count-based, Length, Mean, Median, Mode etc. based feature vectorcreation. Multidimensional Scaling, Matrix Factorization Techniques.	
#Exemplar/CaseStudies	You are a Data Scientist, and a client comes to you with their data. Client is running a few campaigns from the past few months, but no campaign seemseffective. Client provides you the data of customers, product sales and past campaign success. They want to increase their sales and figure out which marketing strategy isworking the best for them? Questions for data scientists: 1. What data analysis approach will you follow? 2. What statistical approach do you need to follow? How will you select important features?
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Supervised Learning : Regression**	**06 Hours**
Bias, Variance, Generalization, Underfitting, Overfitting, Linear regression, Regression: Lasso regression, Ridge regression, Gradient descent algorithm. Evaluation Metrics: MAE, RMSE, R2		
#Exemplar/Case Studies	Stock market price prediction	
***Mapping of Course Outcomes for Unit III**	CO3	

Unit IV	**Supervised Learning : Classification**	**08 Hours**
Classification: K-nearest neighbour, Support vector machine. Ensemble Learning: Bagging, Boosting, Random Forest, Adaboost. Binary-vs-Multiclass Classification, Balanced and Imbalanced Multiclass Classification Problems,Variants of Multiclass Classification: One-vs-One and One-vs-All Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation, Micro-Average Precision and Recall, Micro-Average F-score, Macro-Average Precision and Recall, Macro-Average F-score.		
#Exemplar/Case Studies	Prediction of Thyroid disorders such as Hyperthyroid, Hypothyroid, Euthyroid-sick,and Euthyroid using multiclass classifier.	
***Mapping of Course Outcomes for Unit IV**	CO4	

Unit V	**Unsupervised Learning**	**07 Hours**
K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering. Outlier analysis: introduction of isolation factor, local outlier factor. Evaluation metrics and score: elbow method, extrinsic and intrinsic methods		

#Exemplar/Case Studies	Market basket analysis/Customer Segmentation	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Introduction To Neural Networks**	**07 Hours**

Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, Back Propagation Learning, Functional Link Artificial Neural Network, and Radial Basis Function Network, Activation functions,
Introduction to Recurrent Neural Networks and Convolutional Neural Networks

#Exemplar/Case Studies	Movie Recommendation System
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning",Vol. 4.No. 4. New York: springer, 2006.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013

Reference Books:

1. Tom Mitchell, " Machine learning", McGraw-Hill series in Computer Science, 1997
2. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory toalgorithms", Cambridge university press, 2014.
3. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
4. Hastie, Trevor, et al., "The elements of statistical learning: data mining, inference, and prediction", Vol. 2. New York: springer, 2009.
5. McKinney, "Python for Data Analysis ",O' Reilly media, ISBN : 978-1-449-31979-3
6. Trent hauk, "Scikit-learn", Cookbook , Packt Publishing, ISBN: 9781787286382
7. Goodfellow I.,Bengio Y. and Courville, " A Deep Learning", MIT Press, 2016

e-Books :

1. Python Machine Learning : http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Python-for-machine-learning-2015.pdf
2. Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/
3. Dive into Deep Learning: http://d2l.ai/
4. A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf
5. Feature selection: https://dl.acm.org/doi/pdf/10.5555/944919.944968
6. Introductory Machine Learning Nodes : http://lcsl.mit.edu/courses/ml/1718/MLNotes.pdf

MOOC Courses Links:

- Introduction to Machine Learning : https://nptel.ac.in/courses/106105152
- Introduction to Machine Learning (IIT Madras): https://onlinecourses.nptel.ac.in/noc22_cs29/prevew
- Deep learning: https://nptel.ac.in/courses/106106184

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	1	1	1	1	1	1
CO2	2	1	-	1	1	1	1	1	1	1	1	1
CO3	2	2	2	1	1	1	1	1	1	1	1	1
CO4	2	2	2	1	1	1	1	1	1	1	1	1
CO5	2	2	2	1	1	1	1	1	1	1	1	1
CO6	2	-	2	1	1	1	1	1	1	1	1	1

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410243: Blockchain Technology

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice III(410246)

Course Objectives:

- Technology behind Blockchain
- Crypto currency, Bitcoin and Smart contracts
- Different consensus algorithms used in Blockchain
- Real-world applications of Blockchain
- To analyze Blockchain Ethereum Platform using Solidity
- To Describe Blockchain Case Studies

Course Outcomes:

On completion of the course, student will be able to–

CO1: Interpret the fundamentals and basic concepts in Blockchain
CO2: Compare the working of different blockchain platforms
CO3: Use Crypto wallet for cryptocurrency based transactions
CO4: Analyze the importance of blockchain in finding the solution to the real-world problems.

CO5: Illustrate the Ethereum public block chain platform
CO6: Identify relative application where block chain technology can be effectively used and implemented.

Course Contents

Unit I	Mathematical Foundation for Blockchain	06 Hours

Cryptography: Symmetric Key Cryptography and Asymmetric Key Cryptography, Elliptic Curve Cryptography (ECC), Cryptographic Hash Functions: SHA256, Digital Signature Algorithm (DSA), Merkel Trees.

#Exemplar/Case Studies	Compare the Symmetric and Asymmetric Cryptography algorithms
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Feature Engineering	07 Hours

History, Centralized Vs. Decentralized Systems, Layers of Blockchain: Application Layer, Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer, Why is Block chain important? Limitations of Centralized Systems, Blockchain Adoption So Far.

#Exemplar/CaseStudies	Study of a research paper based on Blockchain.
***Mapping of Course Outcomes for Unit II**	CO1

Unit III	**Blockchain Platforms and Consensus in Blockchain**	**06 Hours**
Types of Blockchain Platforms: Public, Private and Consortium, Bitcoin, Ethereum, Hyperledger,IoTA, Corda, R3. Consensus in Blockchain: Consensus Approach, Consensus Elements, Consensus Algorithms, Proof of Work, Byzantine General problem, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn.		
#Exemplar/Case Studies	Compare different consensus algorithms used in Blockchain Technology.	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**Cryptocurrency – Bitcoin, and Token**	**06 Hours**
Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics Types of Cryptocurrency, Cryptocurrency Usage, Cryptowallets: Metamask, Coinbase, Binance		
#Exemplar/Case Studies	Create your own wallet for crypto currency using any of the Blockchain Platforms.	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Blockchain Ethereum Platform using Solidity**	**06 Hours**
What is Ethereum, Types of Ethereum Networks, EVM (Ethereum Virtual Machine), Introduction to smart contracts, Purpose and types of Smart Contracts, Implementing and deploying smart contracts using Solidity, Swarm (Decentralized Storage Platform), Whisper (Decentralized Messaging Platform)		
#Exemplar/Case Studies	Study Truffle Development Environment.	
***Mapping of Course Outcomes for Unit V**	CO4	
Unit VI	**Blockchain Case Studies**	**06 Hours**
Prominent Blockchain Applications, Retail, Banking and Financial Services, Government Sector, Healthcare, IOT, Energy and Utilities, Blockchain Integration with other Domains		
#Exemplar/Case Studies	Study 2 uses cases of Blockchain and write a detailed report on every aspect implemented in the same	
***Mapping of Course Outcomes for Unit VI**	CO5, CO6	

Learning Resources

Text Books:

1. Martin Quest, "Blockchain Dynamics: A Quick Beginner's Guide on Understanding the Foundations of Bit coin and Other Crypto currencies", Create Space Independent PublishingPlatform, 15-May-2018
2. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018
3. Alex Leverington, "Ethereum Programming", Packt Publishing, 2017

Reference Books:

1. Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, "Beginning Blockchain ABeginner's Guide to Building Blockchain Solutions",2018
2. Chris Dannen, "Introducing Ethereum and Solidity", Foundations of Crypto currency andBlockchain Programming for Beginners
3. Daniel Drescher, "Blockchain Basics", A Non -Technical Introduction in 25Steps.
4. Ritesh Modi, "Solidity Programming Essentials", Packt Publishing,2018
5. Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, "Blockchain Technology", Universities Press, ISBN-9789389211634

e-Books :

1. https://users.cs.fiu.edu/~prabakar/cen5079/Common/textbooks/Mastering_Blockchain_2nd_Edition.pdf
2. https://www.lopp.net/pdf/princeton_bitcoin_book.pdf
3. https://www.blockchainexpert.uk/book/blockchain-book.pdf

MOOC Courses Links:

1. NPTEL Course on "Introduction to Blockchain Technology & Applications"
   https://nptel.ac.in/courses/106/104/106104220/
2. NPTEL Course on **b**
   https://nptel.ac.in/courses/106/105/106105184/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	2	2	-	-	-	-	-	-	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	2
CO6	2	2	2	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(A): Pervasive Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: -Internet of Thigs and Embedded Systems(310245A)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the characteristics, basic concepts and systems issues in pervasive computing.
- To illustrate smart devices and architectures in pervasive computing.
- To introduce intelligent systems and interactions in Pervasive computing.
- To identify the trends and latest development of the technologies in the area.
- To Understand Interaction Design – HCI and Wearable Computing Environment.
- To identify Security Challenges & Ethics in Pervasive Computing

Course Outcomes:

On completion of the course, student will be able to–

CO1.Demonstrate fundamental concepts in pervasive computing.

CO2.Explain pervasive devices and decide appropriate one as per the need of real timeapplications.

CO3.Classify and analyze context aware systems for their efficiency in different ICT systems.

CO4.Illustrate intelligent systems and generic intelligent interactive applications.

CO5.Design HCI systems in pervasive computing environment.

CO6.Explore the security challenges and know the role of ethics in the context of pervasivecomputing.

Course Contents

Unit I	Introduction To Pervasive Computing	07 Hours

Pervasive Computing: History, Principles, Characteristics, Problems/Issues & Challenges, Advantages of Pervasive Computing

Pervasive Computing Applications: Pervasive computing devices and interfaces, Device technology trends, Connecting issues and protocols.

#Exemplar/Case Studies	Pervasive Computing for Personalized medicine
*Mapping of Course Outcomes for Unit I	**CO1**

Unit II	Smart Computing with Pervasive Computing Devices	07 Hours

Smart Devices: CCI, Smart Environment: CPI and CCI, Smart Devices: iHCI and HPI, Wearable devices, Application and Requirements, Device Technology and Connectivity, PDA Device characteristics - PDA Based Access Architecture, Voice Enabling Pervasive Computing: Voice Standards, Speech Applications in Pervasive Computing.

#Exemplar/CaseStudies	Amazon Alexa

***Mapping of Course Outcomes for Unit II**	**CO2**	
Unit III	**Context Aware Systems**	**07 Hours**
Introduction, Types of Context, Context Aware Computing and Applications, Modelling Context-Aware Systems, Mobility awareness, spatial awareness, temporal awareness: Coordinating and scheduling, ICT system awareness, Middleware Support		
#Exemplar/Case Studies	Mobile Hanging Services systems	
***Mapping of Course Outcomes for Unit III**	**CO3**	
Unit IV	**Intelligent Systems and Interaction**	**07 Hours**
Introduction, Basic Concepts, IS Architectures, Semantic KBIS, Classical Logic IS, Soft Computing IS Models, IS System Operations, Interaction Multiplicity, IS Interaction Design, Generic Intelligent Interaction Applications.		
#Exemplar/Case Studies	Curious information displays: A motivated reinforcement learning IE application.	
***Mapping of Course Outcomes for Unit IV**	**CO4**	
Unit V	**User Interaction Design – HCI and Wearable Computing**	**07 Hours**
Introduction of Interaction Design, Basics of Interaction Design and its Concepts, Importance of Interaction Design, Difference between Interaction Design and UX. What is HCI? Importance of HCI, Advantages and Disadvantages of HCI, Elements of HCI, HCI Design and Architecture,Define Wearable Computing, Importance of Wearable Computing, Security issues in Wearable Computing, Wearable Computing Architecture and Applications, Wearable Computing Challenges and Opportunities for Privacy Protection		
#Exemplar/Case Studies	Smart Fabric/ Textile, Sensory Fabric for Ubiquitous interfaces	
***Mapping of Course Outcomes for Unit V**	**CO5**	
Unit VI	**Security Challenges & Ethics in Pervasive Computing**	**07 Hours**
Security issues in Pervasive Computing: security model, authentication & authorization, access control, secure resource discovery, open issues.Pervasive computing security challenges & requirements: Privacy & trust issues, social & user interaction issues, solution for pervasive computing challenges, Role of Ethics in pervasive computing security: Autonomy and Self-determination, Responsibility: legal, moral & social, distributive justice, digital divide and sustainable development		
#Exemplar/Case Studies	Pervasive Computing Security Gaia Project	
***Mapping of Course Outcomes for Unit VI**	**CO6**	
Learning Resources		

Text Books:

1. Stefan Poslad, "Ubiquitous Computing: Smart Devices: Environments and Interactions", Wiley Publication, Student Edition, ISBN 9788126527335.
2. Jochen Burkhardt, Horst Henn, Stefan Hepper, Klaus Rindtroff, Thomas Schack, " Pervasive Computing: Technology and Architecture of Mobile Internet Applications", Pearson Education, ISBN 9788177582802
3. Frank Adelstein, Sandeep K. S. Gupta, Golden G. Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing" McGraw Hill Education, Indian Edition, ISBN 9780070603646

Reference Books:

1. Sen Loke, "Context Aware Pervasive Systems; Architectures for new Breed of applications",Taylor and Fransis, ISBN 0-8493-7255-0
2. LaurnceYang, Evi Syukur, Seng Loke, "Handbook on Mobile and Ubiquitous Computing : Status and Perspective‖", CRC Press, 2013 ISBN 978-1-4398-4811-1
3. M. Haque and S. I. Ahamed, "Security in pervasive computing: Current status and open issues",
Int. J. Netw. Secur., vol. 3, no. 3, pp. 203–214, 2006.

e-Books :

1. M. Hilty, –Ubiquitous Computing in the Workplace: What Ethical Issues?‖ no. August, pp. 1–16, 2014, [Online].http://link.springer.com/bookseries/11156L.
2. https://web.uettaxila.edu.pk/CMS/SP2014/teMPCms/tutorial%5CFundamentalsOfMobilePervasiveComputing.pdf
3. http://pervasivecomputing.se/M7012E_2014/material/Wiley.Ubiquitous.Computing.Smart.Devices.Environments.And.Interactions.May.2009.eBook.pdf
4. http://media.techtarget.com/searchMobileComputing/downloads/Mobile_and_pervasive_computing_Ch06.pdf

MOOC Courses Links:

https://www.georgiancollege.ca/academics/part-time-studies/courses/mobile-and-pervasive-computing-comp-3025/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	--	--	--	--	--	--	--	--	--	--
CO2	2	3	2	2	--	--	--	--	--	--	--	--
CO3	3	3	3	3	--	--	--	--	--	--	--	--
CO4	3	2	3	3	--	--	--	--	--	--	--	--
CO5	3	3	3	3	--	--	--	--	--	--	--	--
CO6	1	2	-	3	--	--	--	--	--	--	--	--

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(B): Multimedia Techniques

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Graphics (210241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To understand input and output devices, device drivers, control signals and protocols, DSPs
- To study and use standards (e.g., audio, graphics, video)
- To implement applications, media editors, authoring systems, and authoring by studying streams/structures, capture/represent/transform, spaces/domains, compression/coding
- To design and develop content-based analysis, indexing, and retrieval of audio, images, animation, andvideo
- To demonstrate presentation, rendering, synchronization, multi-modal integration/interfaces
- To Understand IoT architecture's and Multimedia Internet of things

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the media and supporting devices commonly associated with multimedia information andsystems.

CO2: Demonstrate the use of content-based information analysis in a multimedia information system.

CO3: Critique multimedia presentations in terms of their appropriate use of audio, video, graphics, color,and other information presentation concepts.

CO4: Implement a multimedia application using an authoring system.

CO5: Understanding of technologies for tracking, navigation and gestural control.

CO6: Implement Multimedia Internet of Things Architectures.

Course Contents

Unit I	Introduction to multimedia	07 Hours

What is Multimedia and their Components, History of Multimedia; Hypermedia, WWW, and Internet; Multimedia Tools: Static (text, graphics, and still images), Active (sound, animation, and video, etc.); Multimedia Sharing and Distribution; Multimedia Authoring Tools: Adobe Premiere, Adobe Director, Adobe Flash.

#Exemplar/Case Studies	To study and install open-source multimedia Tools
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Graphics and Data Representation Techniques	07 Hours

What are Graphics data types, 1-bit Images, 8 –bit grey level ,16-bit grey level images, Image data type, Image data type:8 bit & 24-bit color images, Higher bit depth images, Color Lookup tables.
File Formats: GIF, JPEG, PNG, TIFF, PSD, APS, AI, INDD, RAW, Windows BMP, Windows WMF,

Netpbm format, EXIF, PTM, Text file format: RTF, TGA Applications/Use of text in Multimedia		
#Exemplar/CaseStudies	To study conversion of image file formats from one to Other.	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Multimedia Representations Techniques**	**07 Hours**
Principal concepts for the analog video: CRT, NTSC Video (National Television System Committee), PAL Video (Phase Alternating Line), SECAM Video (System Electronic Couleur Avec Memoire), Digital Video: Chroma Subsampling, High-Definition TV, Ultra High Definition TV (UHDTV), Component Video: High-Definition Multimedia Interface (HDMI),3D Video and TV: various cues, Basics of Digital Audio: What is Sound?, Nyquist Theorem, SNR, SQNR, Audio Filtering, Synthetic Sounds, MIDI Overview: Hardware, Structure, Conversion to WAV, Coding of Audio: PCM, DPCM, DM (Delta Modulation)		
#Exemplar/Case Studies	Install and use Handbrake (link is https://handbrake.fr) software to understand the concept of interlaced, deinterlace, noise filters, bitrate, and frame rate for any sample 30 min video, and note down the observations from the output video.	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Compression Algorithms**	**07 Hours**
Introduction to multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Types of compression algorithms- lossless compression algorithms RLC, VLC, DBC, AC, lossless image compression, differential coding of Images, lossy compression algorithms-Rate distortion theory, Quantization ,Transform coding, wavelet based coding, embedded Zerotress of wavelet coefficients . Image compression standard -JPEG standard, JPEG 2000 standard, LS standard, Bilevel image compression standard. Introduction to video compression - video compression based on motion compensation, Search for motion vectors, MPEG Video coding I , MPEG 1,2,4,7 onwards. Basic Audio Compression Techniques -ADPCM in speech coding, Vocoders, MPEG audio compression		
#Exemplar/Case Studies	Implementation of compression algorithms	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**Augmented Reality(AR), Virtual Reality (VR) and Mixed Reality (MR)**	**07 Hours**
Basics of Virtual Reality, difference between Virtual Reality and Augmented Reality, Requirement of Augmented Reality, Components and Performance issues in AR, Design and Technological foundations for Immersive Experiences. Input devices – controllers, motion trackers and motion capture technologies for tracking, navigation and gestural control. Output devices – Head Mounted VR Displays, Augmented and Mixed reality glasses. 3D interactive and procedural graphics. Immersive surround sound. Haptic and vibrotactile devices. Best practices in VR, AR and MR Future applications of Immersive Technologies. VRML Programming Modeling objects and virtual environments Domain Dependent applications: Medical, Visualization, Entertainment, etc.		
#Exemplar/Case Studies	Navigation Assistance System	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Multimedia Internet of Things**	**07 Hours**

IoT and Multimedia IoT Architecture: IoT Architecture; M-IoT Architectures: Multi-Agent Based, AI-Based Software-Defined, Big Data Layered; Applications of M-IoT: Road Management System, Multimedia IoT in Industrial Applications, Health Monitoring

#Exemplar/Case Studies	Traffic Monitoring System
***Mapping of Course Outcomes for Unit VI**	**CO6**

Learning Resources

Text Books:

1. Tay Vaughan, "Multimedia making it work", Tata McGraw-Hill, 2011, ISBN: 978-0-07-174850-6 MHID: 0-07-174850-4, eBook print version of this title: ISBN: 978-0-07-174846-9, MHID: 0-07-174846-6
2. Ze-Nian Li, Mark S. Drew and Jiang chuan Liu, "Fundamentals of Multimedia", Second Edition, Springer, 2011, ISSN 1868-0941 ISSN 1868-095X (electronic), ISBN 978-3-319-05289-2 ISBN 978-3-319-05290-8 (eBook), DOI 10.1007/978-3-319-05290-8, Pearson Education, 2009.

Reference Books:

1. Ali Nauman et al. "Multimedia Internet of Things: A Comprehensive Survey", Special Section on Mobile Multimedia: Methodology and Applications, IEEE Access, Volume 8, 2020

2. Kelly S. Hale (Editor), Kay M. Stanney (Editor). 2014. Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics) ISBN-13: 978-1466511842. Amazon

e-Books :

1. https://users.dimi.uniud.it/~antonio.dangelo/MMS/materials/Fundamentals_of_Multimedia.pdf
2. https://mu.ac.in/wp-content/uploads/2021/04/Multimedia.pdf
3. https://www.baschools.org/pages/uploaded_files/chap13.pdf

MOOC Courses Links:

- https://nptel.ac.in/courses/117105083

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-
CO3	2	1	-	2	3	-	-	-	-	1	-	-
CO4	3	3	2	2	1	1	1	1	1	1	1	1
CO5	2	1	2	-	-	-	-	-	-	-	-	-
CO6	3	3	2	1	2	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(C): Cyber Security and Digital Forensics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Networks and Security(310244), Information Security(310254(A))

Companion Course: 410246: Laboratory Practice IV

Course Objectives:

- To enhance awareness cyber forensics.
- To understand issues in cyber crime and different attacks
- To understand underlying principles and many of the techniques associated with the digital forensic practices
- To know the process and methods of evidence collection
- To analyze and validate forensic data collected.
- To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Outcomes: At the end of the course, the student should be able to:

CO1: Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
CO2: Build appropriate security solutions against cyber-attacks.
CO3:Underline the need of digital forensic and role of digital evidences.
CO4: Explain rules and types of evidence collection
CO5: Analyze, validate and process crime scenes
CO6: Identify the methods to generate legal evidence and supporting investigation reports.

Course Contents

Unit 1	Introduction to Cyber Security	06 Hours

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: crime against an individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism. Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.

#Exemplar/Case Studies	Data Breach Digest – Perspective & Reality : http://verizonenterprise.com/databreachdigest
***Mapping of Course Outcome for Unit I**	CO1

Unit 2	Cyber Crime Issues and Cyber attacks	06 Hours

Unauthorized Access to Computers, Computer Intrusions, Viruses, and Malicious Code, Internet Hacking and Cracking, Virus and worms, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Cybercrime prevention methods, Application security (Database, E-mail, and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Hardware protection mechanisms, OS Security

#Exemplar/Case Studies	Cyber Stalking types & their cases respectively
***Mapping of Course Outcome for Unit II**	CO2

Unit 3	Introduction to Digital Forensics	06 Hours

What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer

Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology, Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution.		
#Exemplar/Case Studies	Demonstrate practice Linux networking security recovery commands.& Study Tools viz; FTK & The Sleuth Kit	
***Mapping of Course Outcome for Unit III**	CO3	
Unit 4	**Evidence Collection and Data Seizure**	**06 Hours**
Why Collect Evidence? Collection Options ,Obstacles, Types of Evidence — The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.		
#Exemplar/Case Studies	Understand how computer forensics works by visiting: http://computer.howstuffworks.com/computer-forensic.htm/printable(23 December 2010)	
***Mapping of Course Outcome for Unit IV**	CO4	
Unit 5	**Computer Forensics analysis and validation**	**06 Hours**
Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, and performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case		
#Exemplar/Case Studies	Discuss cases under Financial Frauds, Matrimonial Frauds, Job Frauds, Spoofing, and Social media. Then write down safety tips, precautionary measures for the discussed fraud cases.	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit 6	**Current Computer Forensic tools**	**06 Hours**
Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.		
#Exemplar/Case Studies	Install Kali Linux & practice following examples: 1. https://www.youtube.com/watch?time_continue=6&v=MZXZctqIU-w&feature=emb_logo	
***Mapping of Course Outcome for Unit VI**	CO6	
Learning Resources		

Text Books:

1. John R. Vacca, “Computer Forensics”, Computer Crime Investigation Firewall Media, New Delhi.
2. Nelson, Phillips Enfinger, Steuart, “Computer Forensics and Investigations”, CENGAGE Learning

Reference Books:

1. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, “Real Digital Forensics”, Addison-

Wesley Pearson Education

2. Tony Sammes and Brian Jenkinson, “Forensic Compiling”, A Tractitioneris Guide, Springer International edition.

3. Christopher L.T. Brown, “Computer Evidence Collection & Presentation”, Firewall Media.

4. Jesus Mena, “Homeland Security, Techniques & Technologies”, Firewall Media.

e books:

1.**https://www.pdfdrive.com/computer-forensics-investigating-network-intrusions-and-cyber-crime-e15858265.html**

2.**https://dokumen.pub/handbook-of-computer-crime-investigation-forensic-tools-and-technology-1stnbsped-0121631036-9780121631031.html**

3.Massachusetts Institute of Technology Open Courseware: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/

MOOC Courses Links:

- **MIT Open CourseWare: https://ocw.mit.edu/courses/**

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	-	-	-	-	-	-	2
CO2	1	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	-	-	-	-	-	-	-	-	3
CO4	2	3	3	-	-	-	-	-	-	-	-	3
CO5	2	2	2	2	-	-	-	-	-	-	-	3
CO6	2	3	2	3	-	-	-	-	-	-	-	3

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) 410244(D): Object oriented Modeling and Design		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme: In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Software Engineering (210245)

Companion Course: Laboratory Practice IV (410247)

Course Objectives:

- Describe the concepts involved in Object-Oriented modelling and their benefits.
- Demonstrate concept of use-case model, sequence model and state chart model for a given problem.
- Explain the facets of the unified process approach to design and build a Software system.
- Translate the requirements into implementation for Object Oriented design.
- Choose an appropriate design pattern to facilitate development procedure. Select suitable design pattern depending on nature of application.
- To describe Designing and Management of Patterns.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the concepts of object-oriented and basic class modelling.
CO2: Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
CO3: Choose and apply a befitting design pattern for the given problem
CO4: To Analyze applications, architectural Styles & software control strategies
CO5: To develop Class design Models & choose Legacy Systems.
CO6:To Understand Design Patterns

Course Contents

Unit I	Introduction To Modeling	06 Hours

What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

#Exemplar/Case Studies	Case Study of ATM System
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Advanced Class Modeling and State Modeling	06 Hours

Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.

#Exemplar/CaseStudies	Case Study of Train Reservation System
*Mapping of Course Outcomes for Unit II	CO2

Unit III	Advanced State Modeling and Interaction Modeling	06 Hours

Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips.Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.

#Exemplar/Case Studies	Case Study of Coffee Vending Machine
*Mapping of Course Outcomes for Unit III	CO2, C03

Unit IV	User Application Analysis : System Design	06 Hours

Application Analysis: Application interaction model; Application class model; Application state model; Adding operations. Overview of system design; Estimating performance; Making a reuse plan; Breaking asystem in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of datastorage; Handling global resources;

Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example

#Exemplar/Case Studies	Case System of ATM System
*Mapping of Course Outcomes for Unit IV	CO3, CO4

Unit V	Class Design ,Implementation Modeling, Legacy Systems	06 Hours

Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example. Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing. Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance

#Exemplar/Case Studies	Case study of College Library System
*Mapping of Course Outcomes for Unit V	CO4, CO5

Unit VI	Design Pattern	06 Hours

What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Patterndescription Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber.

Management Patterns: Command processor; View handler. Idioms: Introduction; what can idioms provide? Idiomsand style; Where to find idioms; Counted Pointer example

#Exemplar/Case Studies	Design Pattern for Any suitable System
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Michael Blaha, James Rumbaugh, "Object-Oriented Modeling and Design with UML", 2 nd Edition, Pearson Education, 2005.
2. Frank Buchmann, Regine Meunier, Hans Rohnert, Peter Sommer lad, Michael Stal, "Pattern-Oriented Software Architecture, A System of Patterns", Volume 1, John Wiley and Sons, 2007

Reference Books:

1. Grady Booch et al, "Object-Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 2007

2. Brahma Dathan, Sarnath Ramnath, "Object-Oriented Analysis, Design, and Implementation", UniversitiesPress, 2009

3. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado, " UML 2 Toolkit", Wiley-Dreamtech India, 2004

4. Simon Bennett, Steve McRobb and Ray Farmer, " UML 2 Toolkit, Object- Oriented Systems Analysis and Design Using UML, 2 nd Edition, Tata McGraw-Hill, 2002

e-Books :

1. Object Oriented Modeling and Design - https://www.pdfdrive.com/object-oriented-design-and-modeling-d10014860.html
2. https://www.gopalancolleges.com/gcem/course-material/computer-science/course-plan/sem-Vll/object-oriented-modeling-and-design-10CS71.pdf

MOOC Lectures Links:

- https://nptel.ac.in/courses/106105153

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	--	--	--	--	--	--
CO2	2	2	2	2	2	2	--	--	--	--	--	--
CO3	2	2	2	2	2	2	--	--	--	--	--	--
CO4	2	2	2	2	2	2	--	--	--	--	--	--
CO5	2	2	2	2	2	2	--	--	--	--	--	--
CO6	2	2	2	2	2	2	--	--	--	--	--	--

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410244(E): Digital Signal Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Engineering Mathematics III(207003)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand Design of filters as DT systems
- To get acquainted with the DSP Processors and DSP applications

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand the mathematical models and representations of DT Signals and Systems

CO2: Apply different transforms like Fourier and Z-Transform from applications point of view.

CO3: Understand the design and implementation of DT systems as DT filters with filter structuresand different transforms.

CO4: Demonstrate the knowledge of signals and systems for design and analysis of systems

CO5: Apply knowledge and use the signal transforms for digital processing applications

CO6:To understand Filtering and Different Filter Structures

Course Contents

Unit I	Signals and Systems	08 Hours

Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding

#Exemplar/Case Studies	Audio/Music Sampling
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Frequency Domain Representation of Signal	08 Hours

Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral

leakage	
#Exemplar/Case Studies	Spectral Analysis using FFT
***Mapping of Course Outcomes for Unit II**	CO1

Unit III	**Fast Fourier Transform (FFT) and Z-Transform(ZT)**	**08 Hours**

Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method.

#Exemplar/Case Studies	Discrete Hilbert Algorithm
***Mapping of Course Outcomes for Unit III**	CO2

Unit IV	**Analysis of DT - LTI Systems**	**08 Hours**

System function H(z), H(z) in terms of Nth order general difference equation, all poll and all zero systems, Analysis of LTI system using H(Z), Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of H(Z) and difference equation, Frequency response of system, Frequency response from pole-zero plot using Simple geometric construction.

#Exemplar/Case Studies	Schur Algorithm
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Digital Filter Design**	**08 Hours**

Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, Linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, Frequency Warping, Pre-warping, Design examples, Comparison of IIR and FIR Filters.

#Exemplar/Case Studies	Realization of an Analogue Second-order Differentiator
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Filter Structures and DSP Processors**	**08 Hours**

Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).

#Exemplar/Case Studies	Architectures and Design techniques for energy efficient embedded DSP

	and multimedia processing
***Mapping of Course Outcomes for Unit VI**	**CO6**

Learning Resources

Text Books:

1. Proakis J, Manolakis D, "Digital Signal Processing", 4th Edition, Pearson Education, ISBN9788131710005
2. Oppenheium A, Schafer R, Buck J, "Discrete time Signal Processing", 2nd Edition, PearsonEducation, ISBN 9788131704929

Reference Books:

1. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill,1998, ISBN 0-07-044705-5
2. Ifleachor E. C., Jervis B. W., "Digital Signal Processing: A Practical Approach ", Pearson-Education, 2002, , ISBN-13: 978-0201596199,ISBN-10: 0201596199
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw-Hill,ISBN 0-07-463996-X
4. S. Poornachandra, B. Sasikala, "Digital Signal Processing",3rd Edition, McGraw-Hill, ISBN-13:978-07- 067279-6

e-Books :

1. An Introduction to Digital Signal Processing: A Focus on Implementation https://www.riverpublishers.com/pdf/ebook/RP_E9788792982032.pdf

MOOC Courses Links:

- **Digital signal Processing Introduction- https://nptel.ac.in/courses/117102060**

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	-	-	-	-	-
CO2	3	3	2	2	3	-	-	-	-	-	-	-
CO3	1	2	2	2	1	-	-	-	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	-
CO5	3	2	3	2	2	-	-	-	-	-	-	-
CO6	2	2	2	2	2	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410245(A): Information Retrieval

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Database Management Systems(310241)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To study basic concepts of Information Retrieval.
- To study concepts of Indexing for Information Retrieval.
- To analyze the performance of information retrieval using advanced techniques such asclassification, clustering, and filtering over multimedia.
- To provide comprehensive details about various Evaluation methods.
- To understand the changes necessary to transfer a Basic IR system into large scale search service system.
- To understand Parallel Information retrieval and Web structures .

Course Outcomes:

On completion of the course, student will be able to–

CO1:Implement the concept of Information Retrieval
CO2:Generate quality information out of retrieved information
CO3:Apply techniques such as classification, clustering, and filtering over multimedia to analyzethe information
CO4:Evaluate and analyze retrieved information
CO5:Understand the data in various Application and Extensions of information retrieval
CO6: Understand Parallel information retrieving and web structure.

Course Contents

Unit I	Introduction , Basic techniques, &Token	07 Hours

Introduction: The IR System, The Software Architecture Of The IR System.
Basic IR Models: Boolean Model, TF-IDF (Term Frequency/Inverse Document Frequency) Weighting, Vector Model, Probabilistic Model and Latent Semantic Indexing Model.
Basic Tokenizing: Simple Tokenizing, Stop-Word Removal and Stemming.

#Exemplar/Case Studies	A Case Study Of Onitsha Divisional Library Which Aims At Finding TheCauses And Solutions To The Problems Of Information Retrieval Methods By The Library.
*Mapping of Course Outcomes for Unit I	CO 1

Unit II	Static Inverted Indices and Query Processing	07 Hours

Static Inverted Indices :Inverted Index Construction, **Index Components and Index Life Cycle, The Dictionary** : Sort-based dictionary ,Hash-based dictionary, Interleaving Dictionary and Postings Lists,

Index Construction: Different types of Index Construction, In-Memory Index Construction, Sort-Based Index Construction, Merge-Based Index Construction, Disk-Based Index Construction),

Other types of Indices.

Query Processing : Query Processing for Ranked Retrieval , Document-at-a-Time QueryProcessing, Term-at-a-Time Query Processing, Pre-computing Score Contributions, Impact Ordering)

Query optimization, Lightweight Structure : Generalized Concordance Lists, Operators, Implementation & Examples

#Exemplar/CaseStudies	Match the search statement with the stored database
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Index Compression and Dynamic Inverted Indices	07 Hours

General-Purpose Data Compression,

Data Compression : Modeling and Coding, Huffman Coding, Arithmetic Coding, Symbolwise Text Compression

Compressing Postings Lists:

Nonparametric Gap Compression, Parametric Gap Compression, Context-Aware Compression Methods, Index Compression for High Query Performance, Compression Effectiveness, DecodingPerformance, Document Reordering.

Dynamic Inverted Indices:

Incremental Index Updates, Contiguous Inverted Lists, Noncontiguous Inverted,

Document Deletions: Invalidation List, Garbage Collection, Document Modifications,

#Exemplar/Case Studies	Translating Short Segments with NMT: A Case Study in English-to-Hindi
***Mapping of Course Outcomes for Unit III**	CO2

Unit IV	Probabilistic Retrieval and Language Modeling & Related Methods , Categorization & Filtering	07 Hours

Probabilistic Retrieval: Mdeling Relevance, The Binary Independence Model, Term Frequency, Document Length:BM25, Relevance Feedback, Field Weights

Language Modeling and Related Methods: Generating Queries from Documents, Language Models and Smoothing, Ranking with Language Models, Divergence from Randomness, PassageRetrieval and Ranking

Categorization and Filtering: Detailed Examples, Classification, Linear, Similarity- Based, Probabilistic Classifiers, Generalized Linear Models. Information-Theoretic Model.

E-Mail on the Move: Categorization, Filtering, and Alerting on Mobile Devices with the if Mail Prototype

#Exemplar/Case Studies	E-Mail on the Move: Study of E-mail Categorization, Filtering, and Alerting on Mobile Devices

***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Measuring Effectiveness and Measuring Efficiency**	**07 Hours**

Measuring Effectiveness - Traditional effectiveness measure, The Text Retrieval Conference (TREC), Using statistics in evaluation, Minimizing adjudication Effort, Nontraditional effectiveness measures

Measuring Efficiency – Efficiency criteria, Query Scheduling, Caching, Introduction to Redisand Memcached

#Exemplar/Case Studies	Study of API Handling
***Mapping of Course Outcomes for Unit V**	CO 4

Unit VI	**Parallel Information retrieval , Web Search**	**07 Hours**

Parallel Information retrieval - Parallel Query Processing, MapReduce

Web Search- The structure of the web, Quires and Users, Static ranking, Dynamic ranking, Evaluation web search, Web Crawlers, Web crawler libraries, Python Scrapy, BeautifulSoup

#Exemplar/Case Studies	Study of Google Map / Facebook information retrieval
***Mapping of Course Outcomes for Unit VI**	**CO 5 , CO6**

Learning Resources

Text Books:

1. S. Buttcher, C. Clarke and G. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines" MIT Press, 2010, ISBN: 0-408-70929-4.
2. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008, -13: 9780521865715
3. Ricardo Baeza , Yates and Berthier Ribeiro Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", 2nd Edition, ACM Press Books 2011.
4. Bruce Croft, Donald Metzler and Trevor Strohman, "Search Engines: Information Retrieval in Practice", 1st Edition Addison Wesley, 2009, ISBN: 9780135756324

Reference Books:

1. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html)
2. W.R. Hersh, "Information Retrieval: A Health and Biomedical Perspective", Springer, 2002.
3. G. Kowalski, M.T. Maybury. "Information storage and Retrieval System" , Springer, 2005
4. W.B. Croft, J. Lafferty, "Language Modeling for Information Retrieval", Springer, 2003

e-Books :

1. Information Retrieval- www.informationretrieval.org

MOOC Courses Links:

- https://nptel.ac.in/courses/117102060

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	1	-	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-
CO4	1	1	2	1	-	-	-	-	-	-	-	-
CO5	1	1	2	3	2	-	-	-	-	-	-	-
CO6	1	2	2	2	1	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course) Home
Elective V
410245(B): GPU Programming and Architecture

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Graphics(210244)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To Understand Graphics Processing Unit (GPU) Concepts.
- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models
- To examine the architecture and capabilities of modern GPUs.

Course Outcomes:

After completion of the course, students should be able to-

CO1: Describe GPU architecture

CO2: Write programs using CUDA, identify issues and debug them.

CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication

CO4: Write simple programs using OpenCL

CO5: Identify efficient parallel programming patterns to solve problems

CO6: Explore the modern GPUs architecture and it's Applications.

Course Contents

Unit I	Introduction to Graphics Processing Unit (GPU)	07 Hours

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

#Exemplar/Case Studies	Review of traditional Computer Architecture
***Mapping of Course Outcomes for Unit I**	CO 1

Unit II	Cuda Programming	07 Hours

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

#Exemplar/Case Studies	Write basic CUDA programs.
***Mapping of Course Outcomes for Unit II**	CO 2

Unit III	Programming Issues	07 Hours

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.		
#Exemplar/Case Studies	Study of various CUDA errors	
***Mapping of Course Outcomes for Unit III**	CO 3	
Unit IV	**Opencl Basics**	**07 Hours**
OpenCL Standard, Kernels, Host Device Interaction, Execution Environment, Memory Model, Basic OpenCL Examples.		
#Exemplar/Case Studies	Write OpenCL basic program	
***Mapping of Course Outcomes for Unit IV**	CO 4	
Unit V	**Algorithms on GPU**	**07 Hours**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster		
#Exemplar/Case Studies	Describe multi-dimensional mapping of dataspace.	
***Mapping of Course Outcomes for Unit V**	CO 5	
Unit VI	**OpenCL and Application Design**	**07 Hours**
OpenCL for Heterogeneous Computing, Application Design : Efficient Neural Network Training/Inferencing		
#Exemplar/Case Studies	Describe OpenCL for Heterogeneous computing	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3rd Edition, Morgan Kauffman, 2015.
3. Benedict Gaster,Lee Howes, David R. Kaeli, "Heterogeneous Computing with OpenCL"

Reference Books :

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", Addison –Wesley, 2013.
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPUProgramming", Addison – Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors ", A Hands-onApproach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

e-B ooks :

1. https://www.perlego.com/book/1418742/cuda-handbook-a-comprehensive-guide-to- gpu-programming-the-pdf

NPTEL/YouTube video lecture link

- https://onlinecourses.nptel.ac.in/noc20_cs41/preview

@The CO-PO Mapping Matrix

CO/ PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO1 1	PO1 2
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-
CO3	1	2	2	2	2	-	-	-	-	-	-	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-
CO5	1	2	2	2	2	-	-	-	-	-	-	-
CO6	1	2	2	1	2	-	-	-	-	-	-	-

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410245(C): Mobile Computing

Teaching Scheme:	Credit	Examination Scheme:100
TH: 3 Hours/Week	3	Mid-Semester (TH) : 30 End- Sem (TH): 70

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To introduce the basic concepts and principles in mobile computing. This includes major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications
- To demonstrate the protocols of mobile communication.
- To know GSM architecture and support services
- To Study on location, handoff management and wireless fundamentals.
- To summarize VLR and HLR identification algorithms
- To learn current technologies being used on field and design and development of various network protocol using simulation tools.

Course Outcomes:

CO1: Develop a strong grounding in the fundamentals of mobile Networks

CO2: Apply knowledge in MAC, Network, and Transport Layer protocols ofWireless Network

CO3: Illustrate Global System for Mobile Communications

CO4: Use the 3G/4G technology based network with bandwidth capacity planning,VLR and HLR identification algorithms

CO5: Classify network and transport layer of mobile communication

CO6: Design & development of various wireless network protocols using simulationtools

Course Contents

Unit I	Introduction to Mobile Computing	07 Hours

Introduction to Mobile computing, Constraints in mobile computing, Application of mobile computing, Generations of mobile wireless 1G to 5G, Future of mobile computing, Radio frequency Technology, Public Switched Telephone network, (PSTN), Public Communication service (PCS), PCS Architecture, , Blue tooth, Ad-hoc Networks.

#Exemplar/Case Studies	5G Network , Spectrum sharing for D2D communication in 5G cellular networks
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Mobile Wireless protocols	07 Hours

Introduction of WAP, WAP applications, WAP Architecture, WAP Protocol Stack, Challenges in WAP . Introduction, Benefits, Difference, Routing protocols for ad hoc wireless networks: DSDV and AODV,

Wireless Application protocols: MAC, SDMA, FDMA,TDMA,CDMA, Cellular Wireless Networks. Wireless Communication: Cellular systems, Frequency Management and Channel Assignment Types of handoff

and their characteristics.	
#Exemplar/Case Studies	IPoC: A New Core Networking Protocol for 5G Networks.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Global System for Mobile Communication**	**07 Hours**
Global System for Mobile Communications (GSM) architecture , Mobile Station, Base Station System, Switching subsystem, Security, Data Services, HSCSD, GPRS - GPRS system and protocol architecture 2.3 UTRAN, UMTS core network; Improvements on Core Network, 802.11 Architecture 802.11a, 802.11b standard		
#Exemplar/Case Studies	5G mobile communications	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**GSM Networking Signaling and Mobile Management**	**07 Hours**
GSM MAP Service framework, MAP protocol machine, GSM location management, Transaction management, Mobile database, Introduction to location management HLR andLR VLR and HLR Failure restoration, VLR identification algorithm, O-I, O-II algorithm etc. Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical).		
#Exemplar/Case Studies	5G Mobility Management , Micro Mobility: CellularIP, HAWAII, HMIPv6	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Mobile Network and Transport Layers**	**07 Hours**
Mobile IP , IP packet delivery, Tunnelling and encapsulation, IPv6, DHCP, Vehicular Ad Hoc networks (VANET), MANET , Traditional TCP, Snooping TCP, Mobile TCP, 3G wireless network, Wireless Application Protocol, WDP WTP, WML, WTA architecture, Cellular IP		
#Exemplar/Case Studies	5G Network and Transport Layers	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Wireless Application Protocol (WAP) and current trends**	**07 Hours**
WAP model, WAP Gateway, WAP protocol, WAP UAProf and Caching, Wireless Bearer for WAP, WAP Developer Toolkits, Introduction to D2D communications; High level requirements for 5G architecture; Introduction to the radio resource management, power control and mode selection problems; Millimeter wave communication in 5G, Introduction to mobile cloud computing and its Applications		

#Exemplar/Case Studies	Long-Term Evolution (LTE) of 3GPP
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Jochen Schiller, "Mobile Communications", Pearson Education, 2009.
2. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together", 2012, ISBN-13: 978-1118341483
3. Raj Kamal, "Mobile Computing", 2/e, Oxford University Press

Reference Books :

1. William Stallings, ""Wireless Communications & Networks", Second Edition, Pearson Education
2. Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G MobileCommunications", Wiley publications
3. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2012.

e-Books :

1. http://www.dauniv.ac.in/downloads/Mobilecomputing/Microsoft%20%20MobileCompChap02L02HandhelCompandMobileOSes.pdf

MOOC Courses Links :

- https://nptel.ac.in/courses/106106147

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	1	2	-	2	-	-	-	-	-	-	-	1
CO6	2	2	-	2	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410245 (D): Software Testing and Quality Assurance

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Software Engineering (210253), Software Project Management(310245(D))

Companion Course: **Lab Practice IV**

Course Objectives:

- Introduce basic concepts of software testing.
- Understand the best way to increase the effectiveness, test coverage, and execution speed in software testing.
- Understand white box, block box, object oriented, web based and cloud testing.
- Understand the importance of software quality and assurance software systems development.
- Know in details automation testing and tools used for automation testing.
- To learn and understand the combination of practices and tools that are designed to help QA professionals test more efficiently.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.

CO2: Design and Develop project test plan, design test cases, test data, and conduct test operations.

CO3: Apply recent automation tool for various software testing for testing software.

CO4: Apply different approaches of quality management, assurance, and quality standard to software system.

CO5: Apply and analyze effectiveness Software Quality Tools.

CO6: Apply tools necessary for efficient testing framework.

Course Contents

Unit I	Introduction to Software Testing	07 Hours

Introduction: historical perspective, Definition, Core Components, Customers suppliers and process, Objectives of Testing, Testing and Debugging, Need of Testing, Quality Assurance and Testing, Why Software has Errors, Defects and Failures and its Causes and Effects, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, Benchmarking and metrics, Problem Solving Techniques and Software Tools. Software Quality, Constraints of Software product Quality assessment, Quality and Productivity Relationship, Requirements of Product, Software Development Process, Types of Products, Software Development Lifecycle Models, Software Quality Management, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

#Exemplar/Case Studies	1. Offshore delivery model for an Airline Company. 2. SAP test automation CoE for Financial Service Provider.

***Mapping of Course Outcomes for Unit I**	CO1

Unit II — Test Planning and Quality Management — 07 Hours

Test Planning –Artifacts & Strategy, Test Organization –Test Manager & Tester Role, Test plan purpose & contents, Test Strategy and Approach, Test cases & Test Data, Test Entry-Exit criteria, Test Execution Schedule, Use case Testing, Scenario Testing, Test Monitoring & Control- Test Metrics –Test Case Productivity, Test case Coverage, Defect Acceptance & Rejection, Test Efficiency, Efforts and Schedule Variance, Test Efforts biasing Factors, Test Report & configuration Management, Quality Assurance Process, Documentation Risk & Issues. Software Quality, Quality Management Importance, Quality Best practices.

#Exemplar/CaseStudies	1. Online Recommendation System 2. Quality Engineering services for Medical Devices company | CaseStudy (cigniti.com)
***Mapping of Course Outcomes for Unit II**	CO2

Unit III — Test Case Design Techniques — 07 Hours

Software Testing Methodologies: White Box Testing, Black Box Testing, Grey Box Testing. Test Case Design Techniques: Static Techniques: Informal Reviews, Walkthroughs, Technical Reviews, Inspection. Dynamic Techniques: Structural Techniques: Statement Coverage Testing, Branch Coverage Testing, Path Coverage Testing, Conditional Coverage Testing, Loop Coverage Testing Black Box Techniques: Boundary Value Analysis, Equivalence Class Partition, State Transition Technique, Cause Effective Graph, Decision Table, Use Case Testing, Experienced Based Techniques: Error guessing, Exploratory testing

Levels of Testing: Functional Testing: Unit Testing, Integration Testing, System Testing, User Acceptance Testing, Sanity/Smoke Testing, Regression Test, Retest. Non-Functional Testing: Performance Testing, Memory Test, Scalability Testing, Compatibility Testing, Security Testing, Cookies Testing, Session Testing, Recovery Testing, Installation Testing, Adhoc Testing, Risk Based Testing, I18N Testing, L1ON Testing, Compliance Testing.

Link:https://www.besanttechnologies.com/training-courses/software-testing-training/manual-testing-training-institute-in-chennai

#Exemplar/Case Studies	1. Case Study: Manual Testing (Online Marketing SoftwarePlatform) Link: https://www.360logica.com/blog/case-study-manual-testing-online-marketing-software-platform/ 2. Case Study: Decision Table Testing (transferring money online to an account which is already added and approved.)
***Mapping of Course Outcomes for Unit III**	**CO3**

Unit IV — Software Quality Assurance and Quality Control — 07 Hours

Software Quality Assurance: Introduction, Constraints of Software Product Quality Assessment, Quality and Productivity Relationship, Requirements of a Product, Characteristics of Software,

Software Development Process, Types of Products, Schemes of Criticality Definitions, Software Quality Management, Why Software Has Defects? Processes Related to Software Quality, Quality Management System Structure, Pillars of Quality Management System, Important Aspects ofQualityManagement. **Software Quality Control**: Software quality models, Quality measurement and metrics, Quality plan, implementation and documentation, Quality tools including CASE tools, Quality control and reliability of quality process, Quality management system models, Complexity metrics and Customer Satisfaction, International quality standards – ISO, CMM	
#Exemplar/Case Studies	1. Case Study #1 – Android Application Acceptance Test Suite 2. Case Study #2 – API Acceptance Test Suite Link for above case studies - Software Quality Assurance Case Studies - Beta Breakers
***Mapping of Course Outcomes for Unit IV**	**CO4**
Unit V	**Automation Testing Tools / Performance Testing Tools** — **07 Hours**
Automation Testing: What is automation testing, Automated Testing Process, Automation Frameworks, Benefits of automation testing, how to choose automation testing tools. Selenium Automation Tools: Selenium's Tool Suite- Selenium IDE, Selenium RC, Selenium Web driver, Selenium Grid. Automation Tools: SoapUI, Robotic Process Automation (RPA), Tosca, Appium. Performance Testing : What is Performance Testing what is use of it? Tools used for performance testing - Apache Jmeter.	
#Exemplar/Case Studies	**1.** Case Study: Cucumber open-source automation testingframework. **2.** Case Study: (PDF) Automated Software Testing—A Case Study(researchgate.net)
***Mapping of Course Outcomes for Unit V**	**CO5**
Unit VI	**Testing Framework** — **07 Hours**
Testing Framework: Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance Elements of SQA, SQA Tasks, Goals and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan, Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Flow Chart, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process.	
#Exemplar/Case Studies	1. Case study: Software Quality In AcademicCurriculum. 2. Case study: Evaluation of an Automated Testing Framework: ACase Study (scielo.sa.cr)
***Mapping of Course Outcomes for Unit VI**	**CO6**
Learning Resources	

Text Books:

1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata McGraw Hill, ISBN:9780070139909 0070139903
2. Srinivasan Desikan, Gopal Swamy Ramesh, "Software Testing Principles and Practices", Pearson,ISBN-10: 817758121X

Reference Books:

1. Naresh Chauhan, "Software Testing Principles and Practices", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

e-Books :

1. M G Limaye, "Software Testing Principles, Techniques and Tools"
https://books.google.co.in/books?id=zUm8My7SiakC&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices"
https://kupdf.net/queue/software-testing-principles-and-practices-by-srinivasan_5b0ae8eae2b6f51f7d862d26_pdf?queue_id=-1&x=1656562364&z=MTE1LjI0Mi4yNDIuNzA=
3. Naresh Chauhan, "Software Testing Principles and Practice"
. https://pdfcoffee.com/download/se-4-pdf-free.html

MOOC Courses Links:

- https://nptel.ac.in/courses/106105150
- NPTEL : NOC: Software Testing (2017) (Computer Science and Engineering) (digimat.in)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	2	-	-	1	2	1	2	1
CO2	1	3	3	2	1	-	-	1	2	1	2	-
CO3	1	-	1	2	3	-	-	-	2	1	1	-
CO4	1	1	2	3	1	1	1	2	2	2	2	-
CO5	1	2	1	2	3	1	-	-	1	1	2	-
CO6	1	2	3	2	3	1	-	-	2	1	1	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective V 410252(E): Compilers		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

Prerequisite Courses: Theory of Computation(310241), Systems Programming and Operating System310251

Companion Course : Laboratory Practice IV (410247)-

Course Objectives:

- To aware about language translation theories and compiler design stages
- To illustrate the various parser configurations
- To exemplify the use of syntax directed translation in intermediate code
- To Understand Storage Management and Control Structure Environment .
- Learn to develop a Code generator
- To demonstrate the numerous optimization methods used in the creation of different optimizing compilers

Course Outcomes:

On completion of the course, student will be able to–

CO1: **Design** and **implement** a lexical analyzer using LEX tools

CO2: **Design** and **implement** a syntax analyzer using YACC tools

CO3:**Understand** syntax-directed translation and run-time environment

CO4 : **Generate** intermediate codes for high-level statements.

CO5 :**Construct** algorithms to produce computer code.

CO6: **Analyze and transform** programs to improve their time and memory efficiency

Course Contents

Unit I	Notion and Concepts	08 Hours

Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.

#Exemplar/Case Studies	Study of LEX Compiler
*Mapping of Course Outcomes for Unit	CO1

Unit II	Parsing	08 Hours

Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.			
#Exemplar/Case Studies	Study of YAAC		
***Mapping of Course Outcomes for Unit II**	CO2		
Unit III	**Syntax Translation Schemes**		**08 Hours**
Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.			
#Exemplar/Case Studies	Applications of Syntax Directed Translation		
***Mapping of Course Outcomes for Unit III**	CO3		
Unit IV	**Run-time Storage Management**		**08 Hours**
Storage Management – Static, Stack and Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do -while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.			
#Exemplar/Case Studies	CARAT - Compiler and runtime based address translation model		
***Mapping of Course Outcomes for Unit IV**	CO4		
Unit V	**Code Generation**		**07 Hours**
Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.			
#Exemplar/Case Studies	Code Generator for a Virtual Machine Code based JavaScript Compiler (http://article.nadiapub.com/IJAST/vol119/11.pdf)		
***Mapping of Course Outcomes for Unit V**	CO5		
Unit VI	**Code Optimization**		**07 Hours**
Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.			

#Exemplar/Case Studies	Execution of super-scalar processors
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. V Aho, R Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8
2. Dick Grune, Bal, Jacobs, Langendoen, " Modern Compiler Design", Wiley, ISBN 81-265-0418-8

Reference Books:

1. Anthony J. Dos Reis, "Compiler Construction Using Java", JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7
2. K Muneeswaran, "Compiler Design", Oxford University press, ISBN 0-19-806664-3
3. J R Levin, T Mason, D Brown, "Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X

eBooks:

1. **Basics of Compiler Design**
   http://hjemmesider.diku.dk/~torbenm/Basics/basics_lulu2.pdf
2. **Modern Compiler Design**
   http://160592857366.free.fr/joe/ebooks/ShareData/Modern%20Compiler%20Design%202e.pdf

MOOC Courses Links:

- **https://nptel.ac.in/courses/106105190**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	2	-
CO3	1	2	1	1	1	-	-	-	-	-	-	-
CO4	1	2	1	1	1	-	-	-	-	-	-	-
CO5	1	2	2	2	-	-	-	-	-	-	-	-
CO6	1	2	2	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410246: Laboratory Practice III

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hours/Week	02	Term work: 50 Marks Practical: 50 Marks

Companion Course: Design and Analysis of Algorithms (410241), Machine Learning(410242), Blockchain Technology(410243)

Course Objectives:

- Learn effect of data preprocessing on the performance of machine learning algorithms
- Develop in depth understanding for implementation of the regression models.
- Implement and evaluate supervised and unsupervised machine learning algorithms.
- Analyze performance of an algorithm.
- Learn how to implement algorithms that follow algorithm design strategies namely divide and conquer, greedy, dynamic programming, backtracking, branch and bound.
- Understand and explore the working of Blockchain technology and its applications.

Course Outcomes:

After completion of the course, students will be able to

CO1: Apply preprocessing techniques on datasets.

CO2: Implement and evaluate linear regression and random forest regression models.

CO3: Apply and evaluate classification and clustering techniques.

CO4: Analyze performance of an algorithm.

CO5: Implement an algorithm that follows one of the following algorithm design strategies: divide and conquer, greedy, dynamic programming, backtracking, branch and bound.

CO6: Interpret the basic concepts in Blockchain technology and its applications

Guidelines for Instructor's Manual

The instructor’s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as a softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to a journal must be avoided. Use of DVD containing student programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Assessment of each Laboratory assignment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality, documentation and neatness.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy needs to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructors may also set one assignment or mini-project that is suitable to each branch beyond the scope of the syllabus.
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - C++, Java, Python, Solidity, etc.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/
- http://vlabs.iitb.ac.in/vlabs-dev/labs/blockchain/labs/index.php
- http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Suggested List of Laboratory Experiments/Assignments.
Assignments from all the Groups (A, B, C) are compulsory.

Course Contents

Group A: Design and Analysis of Algorithms

Any 4 assignments and 1 mini project are mandatory.

1.	Write a program to calculate Fibonacci numbers and find its step count.
2.	Implement job sequencing with deadlines using a greedy method.
3.	Write a program to solve a fractional Knapsack problem using a greedy method.
4.	Write a program to solve a 0-1 Knapsack problem using dynamic programming or branch and bound strategy.
5.	Write a program to generate binomial coefficients using dynamic programming.
6.	Design 8-Queens matrix having first Queen placed. Use backtracking to place remaining Queens to generate the final 8-queen's matrix.

7.	**Mini Project** Write a program to implement matrix multiplication. Also implement multithreaded matrix multiplication with either one thread per row or one thread per cell. Analyze and compare their performance. OR Implement merge sort and multithreaded merge sort. Compare time required by both the algorithms. Also analyze the performance of each algorithm for the best case and the worst case. OR Implement the Naive string matching algorithm and Rabin-Karp algorithm for string matching. Observe difference in working of both the algorithms for the same input.

Group B: Machine Learning

Any 4 assignments and 1 Mini project are mandatory.

1.	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks: 1. Pre-process the dataset. 2. Identify outliers. 3. Check the correlation. 4. Implement linear regression and random forest regression models. 5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2.	Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3.	Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling Perform following steps: 1. Read the dataset. 2. Distinguish the feature and target set and divide the data set into training and test sets. 3. Normalize the train and test data. 4. Initialize and build the model. Identify the points of improvement and implement the same. 5. Print the accuracy score and confusion matrix (5 points).
4.	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point $x=2$.
5.	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes

6. Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method.

   Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data

7. **Mini Project**

   Use the following dataset to analyze ups and downs in the market and predict future stock price returns based on Indian Market data from 2000 to 2020.

   Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data

   OR

   Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.).
   Dataset Link: https://www.kaggle.com/competitions/titanic/data

Group C: Blockchain Technology

Any 4 assignments and a Mini project are mandatory.

1. Installation of Metamask and study spending Ether per transaction.
2. Create your own wallet using Metamask for crypto transactions.
3. Write a smart contract on a test network, for Bank account of a customer for following operations:
   - Deposit money
   - Withdraw Money
   - Show balance
4. Write a program in solidity to create Student data. Use the following constructs:
   - Structures
   - Arrays
   - Fallback

   Deploy this as smart contract on Ethereum and Observe the transaction fee and Gas values.
5. Write a survey report on types of Blockchains and its real time use cases.
6. **Mini Project:** Create a dApp (de-centralized app) for e-voting system.

@The CO-PO Mapping Matrix

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CO4	3	2	2	-	1	-	-	1	2	-	2	2
CO5	3	2	3	-	1	-	-	1	2	-	-	2
CO6	3	3	2	2	2	-	-	1	2	-	-	2

Savitribai Phule Pune University
Fourth Year of Computer Engineering(2019Course)
410247:Laboratory Practice IV

Teaching Scheme	Credit	Examination Scheme and Marks
Practical:04 Hours/Week	01	Term Work: 50 Marks

Companion Course: Elective III(410244), Elective IV(410245)

Course Objectives:

- Learn android application development related to pervasive computing
- Understand various multimedia file formats
- Understand various vulnerabilities and use of various tools for assessment of vulnerabilities
- Understand information retrieval process using standard tools available
- Learn GPU programming and implementation of same using open source libraries
- Learn installation and use of open source software testing tools

Course Outcomes:

After completion of the course, students will be able to

CO1: Apply android application development for solving real life problems

CO2: Design and develop system using various multimedia components.

CO3: Identify various vulnerabilities and demonstrate using various tools.

CO4: Apply information retrieval tools for natural language processing

CO5: Develop an application using open source GPU programming languages

CO6: Apply software testing tools to perform automated testing

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Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

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The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Virtual Laboratory: 1. **https://hci-iitg.vlabs.ac.in/**
2. **http://vlabs.iitkgp.ernet.in/se/**
3. **https://vlab.amrita.edu/?sub=3&brch=179&sim=1293&cnt=2**

410244(A) Pervasive Computing

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1.	Develop an indoor location system to Library guide system where it can direct a user to the bookshelf from a mobile device.
2.	Design a pervasive application in which remote computer monitors our health statistics & will determine when one is in trouble & will take appropriate action for rescue.
3.	Develop an Android application in which car will use the Internet to find nearby open parking space.
4.	Android User Activity Recognition – Still, Walking, Running, Driving etc.
5.	Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
6.	Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device.

Group 2.

7.	**Mini project:** Develop Food Ordering System which uses the GPS of an Android-based Smartphone to record and analyze various locations that could give alert to the user, then asking the user to select particular food from given hotel list and place an order.
8.	**Mini Project :** Design a mobile sensing platform mounted on a glove that integrates several sensors, such as touch pressure, imaging, inertial measurements, localization and a Radio Frequency Identification (RFID) reader for fruit classification and grading system.

9. **Mini Project :** Sensor-Based Assistive Devices for Visually Impaired People. It should cover following points:
   - Determining obstacles around the user body from the ground to the head;
   - Affording some instructions to the user about the movement surface consists of gaps or textures;
   - Finding items surrounding the obstacles;
   - Providing information about the distance between the user and the obstacle with essential direction instructions.

10. **Mini Project:** Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

410244(B) Multimedia Techniques

Group 1

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

1. To study and install open-source multimedia tools and create an application using appropriate tool to design the college webpage
2. To create JPEG Image that demonstrate various features of an Image editing tool.
3. Create or play a sample MIDI format sound file using LMMS / MuseScore / Tuxguitar software tool. Edit the sample file by applying effects like bend, slide, vibrato, and hammer-on/pull-off. Export / Convert final MIDI to WAV file format.
4. Implement transform coding, quantization, and hierarchical coding for the encoder and decoder of three-level Hierarchical JPEG.
5. Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
6. Create a web page for a clothing company which contains all the details of that company and atleast five links to other web pages.

Group2

7. Mini Project: Design and develop a Navigation Assistance System.
8. Mini Project: Design and Develop a Traffic Monitoring System.

410244(C) Cyber Security and Digital Forensics

Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.

Group 1

1. Write a program for Tracking Emails & Investigating Email Crimes. i.e. Write a program to analyze e–mail header
2. Implement a program to generate & verify CAPTCHA image
3. A person on a nearby road is trying to enter into a WiFi network by trying to crack the Password to use the IP Printer resource; write a program detect such attempt and prohibit the

	access. Develop the necessary scenario by Using an IEEE 802.11, configure a Wi-Fi adapter and Access Point
4.	Write a computer forensic application program for Recovering permanent Deleted Files and Deleted Partitions
5.	Write a program for Log Capturing and Event Correlation
6.	Configure and demonstrate use of vulnerability assessment tool like Wireshark or SNORT
7.	Study of Honeypot
Group 2	
1.	Mini–project: Perform the following steps: • Go to the National Child Exploitation Coordination Centre (NCECC) Web site at http:// www.ncecc.ca • Click on the Reporting child exploitation link. • c. Read "How to Report Internet Pornography or Internet Luring Related to Children."
2.	Mini- Project: Perform the following steps: • Go to http://www.usdoj.gov/criminal/cybercrime/cyberstalking.htm. • b. Read the 1999 report on cyber stalking.
410244(D) Object Oriented Modeling and Design	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory.	
Group 1	
1.	Draw state model for telephone line, with various activities.
2.	Draw basic class diagrams to identify and describe key concepts like classes, types in your system and their relationships.
3.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
4.	Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include template showing description and steps of the Use Case for various scenarios.
5.	Draw activity diagrams to display either business flows or like flow charts
6.	Draw component diagrams assuming that you will build your system reusing existing components along with a few new ones
7.	Draw deployment diagrams to model the runtime architecture of your system.
Group 1	
8.	Mini Project: Draw all UML diagrams for your project work.
9.	Mini Project: Draw following UML Diagrams for Bank Management application a. Class Diagram b. Object Diagram c. ER Diagram d. Component Diagram
410244(E) Digital Signal Processing	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	

1.	Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and sampling frequency (Fs)). 23. 4. 5. 6. 7.
2.	Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence x(n). Observe the response by considering system as FIR and IIR system).
3.	Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity).
4.	Find the N point DFT / IDFT of the given sequence x (n). Plot the magnitude spectrum |X(K)| Vs K. (Analyze the output for different N and the same input sequence x(n). Also observe the periodicity and symmetry property).
5.	Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6.	Develop a program to plot the magnitude and phase response of a given system (given: h(n): impulse response of system S) (Observe the frequency response for different systems. Compare the frequency response of a system (filter) for different length h(n) i.e filter coefficients).
Group 2:	
7.	**Mini-Project:** Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence x (n). (Analyze the output for different N. Program should work for any value of N and output should be generated for all intermediate stages.) 8 9.
8.	**Mini-Project:** Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Henning, Kaiser. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes).
9.	**Mini-Project:** Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency). 10.
10	**Mini-Project:** Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function H(Z). Application should work for different types of filter specifications that is LPF, HPF, BPF etc. and for different transfer functions of an analog filter).
410245(A) Information Retrieval	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	Write a program to Compute Similarity between two text documents.
2.	Implement Page Rank Algorithm.
3.	Write a program for Pre-processing of a Text Document: stop word removal.
4.	Write a map-reduce program to count the number of occurrences of each alphabetic character in the given dataset. The count for each letter should be case-insensitive (i.e., include both upper-case and lower-case versions of the letter; Ignore non-alphabetic characters).
5.	Write a program to implement simple web crawler.
6.	Write a program to parse XML text, generate Web graph and compute topic specific page
Group 2:	
7.	Mini project: Develop Document summarization system

8.	Mini Project: Develop Tweet sentiment analysis system
9.	Mini Project:Develop Fake news detection system
410245(B) GPU Programming and Architecture	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	Write program using OpenCL for Heterogeneous computing
2.	Write CUDA programming with some simple things such as dot product, calculation of pi using integration method etc.
3.	Write CUDA programming for matrix transpose and matrix multiplication
4.	Write OpenCL "Hello World" basic program
5.	Develop program using combining abilities of OpenGL and CUDA to accelerate the performance of simple graphics.
6.	Case study on "Review of traditional Computer Architecture
Group 2:	
	Mini Project : huge data computation
	Mini Project : Visualization to develop project for image processing and then video processing
	Mini Project : Parallel programming
	410245(C) Mobile Computing
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	To implement a basic function of Code Division Multiple Access (CDMA) to test the orthogonally and autocorrelation of a code to be used for CDMA operation. Write an application based on the above concept.
2.	Implementation of GSM security algorithms (A3/A5/A8)
3.	Write an application that draws basic graphical primitives on the screen.
4.	Develop a native application that uses GPS location information.
5.	Design an android Application for Frame Animation
Group 2:	
6.	**Mini Project:** Create an application for Bank using spinner, intent a) Form 1: Create a new account for customer b) Form 2: Deposit money in customer account. c) Link both forms, after completing of first form the user should be directed to the second form

	d) Provide different menu options
7.	**Mini Project:** Create the module for collecting cellular mobile network performance parameters using telephony API Manager i) Nearest Base Station ii) Signal Strengths iii) SIM Module Details iv) Mobility Management Information
8.	**Mini Project:** Create the module for payment of fees for College by demonstrating the following methods. i) FeesMethod()- for calculation of fees ii) Use customized Toast for successful payment of fees iii) Implement an alarm in case someone misses out on the fee submission deadline iv) Demonstrate the online payment gateway
9.	**Mini Project:** Create an app to add of a product to SQLite database and make sure to add following features i) SMS messaging and email provision ii) Bluetooth options iii) Accessing Web services iv) Asynchronous remote method call v) Use Alert box for user notification
410245(D)Software Testing and Quality Assurance	
Any 5 assignments from group 1 and 1 Mini project from group 2 is mandatory	
Group 1:	
1.	Write TEST Scenario for Gmail Login Page
2.	TEST Scenario for Gmail Login Page
3.	Write Test cases in excel sheet for Social Media application or website
4.	Create Defect Report for Any application or web application
5.	Installation of Selenium grid and selenium Webdriver & java eclipse (automation tools).
6.	Prepare Software requirement specification for any project or problem statement
Group 2:	
7.	**Mini Project :**Software Testing and Quality Assurance Mini Project Dynamic webside of covid-19 information using HTML, CSS, JAVASCRIPT And PHP, MySQL database used to store user account, comment, and registration form details. Regular Expression testcases for testing purpose
8.	**Mini Project :**Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective Black-box and White-box testing covering Unit and Integration test by using

	suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed
9.	**Mini Project :** Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDE and generate test reports encompassing exploratory testing.
	410245(E) Quantum Computing
1.	Analyze simple states of superposition and the effect of doing the measurement in different basis states .
2.	Build simple quantum circuits with single and two-qubit gates
3.	Install Setup for running quantum programs on IBM machines.
4.	Analyze the effectiveness of simple error correction scheme
5.	Implement quantum programs in NISQ model of computing

@TheCO-POMappingMatrix

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CO4	1	-	2	-	3	-	-	2	2	2	2	2
CO5	1	-	2	-	3	-	-	2	2	2	2	2
CO6	1	-	2	-	3	-	-	2	2	2	2	2

SavitribaiPhulePuneUniversity
Fourth Year of Computer Engineering (2019 Course)
410248: Project Work Stage I

TeachingScheme:	Credit	ExaminationScheme:
Practical:02Hours/Week	02	Presentation:50Marks

CourseObjectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods
- To Reflect upon the experience gained and lessons learned
- To Consider relevant social, ethical and legal issues
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in Team and learn professionalism

Course Outcomes:

On completion of the course, student will be able to–

- Solve real life problems by applying knowledge.
- Analyze alternative approaches, apply and use most appropriate one for feasible solution.
- Write precise reports and technical documents in a nutshell.
- Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work
- Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
AC7-I	MOOC- Learn New Skills
AC7-II	Entrepreneurship Development
AC7-III	Botnet of Things
AC7-IV	3D Printing
AC7-V	Industrial Safety and Environment Consciousness

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AC7 – I: MOOC-learn New Skill

This course aims to create awareness among the students regarding various courses available under MOOC and learn new skills through these courses.

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, , students will be able to

CO1: To acquire additional knowledge and skill.

About Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you'reinterested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effortis to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/
3. https://www.edx.org

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – II: Entrepreneurship Development

This Course aims at instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur

Course Objectives:

- To introduce the aspects of Entrepreneurship
- To acquaint with legalities in product development
- To understand IPR, Trademarks, Copyright and patenting
- To know the facets of functional plans, Entrepreneurial Finance and Enterprise Management

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the legalities in product development
CO2: Undertake the process of IPR, Trademarks, Copyright and patenting
CO3: Understand and apply functional plans
CO4: Manage Entrepreneurial Finance
CO5: Inculcate managerial skill as an entrepreneur

Course Contents

1. Introduction: Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.

2. Creating Entrepreneurial Venture : Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights.

3. Functional plans: Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, Ratio Analysis.

4. Entrepreneurial Finance: Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India. 5. Enterprise Management: Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers and acquisition

Books:

1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization‟‟‟, Pearson ISBN-10: 8131765784; ISBN-13: 978-8131765784

2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise‟‟‟, ISBN 0-256-14147- 9

3. Irwin Taneja, ``Entrepreneurship,‟‟‟ Galgotia Publishers. ISBN: 978-93-84044-82-4

4.Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,‟‟‟ Pearson Education, ISBN, 8177582607, 9788177582604.

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – III: Botnet of Things

This course aims to provide an understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities. It gives an outline of the techniques for developing a secure application.

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To learn the concept of Botnet

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Implement security as a culture and show mistakes that make applications vulnerable to attacks.

CO2: Understand various attacks like DoS, buffer overflow, web specific, database specific, web -spoofing attacks.

CO3: Demonstrate skills needed to deal with common programming errors that lead to most securityproblems and to learn how to develop secure applications

Course Contents

1. Introduction

2. IRC-Based Bot Networks

3. Anatomy of a Botnet: The Gaobot Worm

4. IoT Senosors and Security : Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots and Botnet

5. Service Layer Protocols and Security : Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport and Session layer protocols-transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) –

Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

1. Bernd Scholz - Reiter, Florian Michahelles, "Architecting the Internet of Things", Springer ISBN 978 –3 – 642 – 19156 - 5 e - ISBN 978 – 3 -642 - 19157 - 2,
2. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1 st Edition 2004
3. Gunter Ollmann 2007. The Phishing Guide Understanding and Preventing Phishing Attacks. IBM Internet Security Systems.
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978 – 1 – 118 – 47347 - 4, Willy Publications
5. White Papers :- https://www.sans.org/reading-room/whitepapers/malicious/bots-botnet-overview-1299
6. https://www-01.ibm.com/marketing/iwm/dre

Mike Kuniavsky, "Smart Things: Ubiquitous Computing User Experience Design," Morgan Kaufmann Publishers.

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410249: Audit Course 7
AC7 – IV: 3D Printing

This course aims to provide knowledge of 3D printing devices and explore the business side of 3D printing.

Course Objectives:

- To **acquire** basic knowledge of drafting terminology and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003
- To **inculcate** skill of technical sketching, multi-view drawings, Lettering, tolerance, and metricconstruction
- To **impart** practical aspects to generate detailed and assembly views with dimensions, annotations,in 3D Modeling software.
- To **develop** prototype/ end use product for 3D Printing

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the basic knowledge of Shop Floor Safety rules and regulations basics of Machinetools and 3D printing machines

CO2: Understand the concept of concept of technical sketching, multi-view drawings, Lettering,tolerance, and metric construction

CO3:Identify and Distinguish drafting terminologies and construction of geometrical figures using drawing instruments, procedure to prepare a drawing sheet as per SP-46:2003

CO4:Describe and Explain practical aspects to generate detailed and assembly views with dimensions,annotations, in 3D Modeling software.

CO5: Apply concepts and **Fabricate** the simple mechanical parts, prototype/ end use product for 3D Printing

Course Contents

1. Getting Started with 3D Printing: How 3D Printers Fit into Modern Manufacturing, Exploring theTypes of 3D Printing, Exploring Applications of 3D Printing.

2. Outlining 3D Printing Resources: Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.

3. Exploring the Business Side of 3D Printing: Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.

4. Employing Personal 3D printing Devices: Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, “ 3D Printing for Dummies”, Taschenbuch, ISBN: 9781119386315

2. Greg Norton, “3D Printing Business - 3D Printing for Beginners - How to 3D Print”,ISBN:9781514785669

2. Liza Wallach Kloski and Nick Kloski, “ Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution”, Maker Media, ISBN: 1680450204

4.Jeff Heldrich , “3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410249: Audit Course 7
AC7 – V: Industrial Safety and Environment Consciousness

This course aims to provide knowledge of industrial safety performance planning and accident prevention.

Course Objectives:

- To understand Industrial hazards and Safety requirements with norms
- To learn the basics of Safety performance planning
- To know the means of accident prevention
- To understand the impact of industrialization on environment
- To know the diversified industrial requirements of safety and security

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Develop the plan for Safety performance
CO2: Demonstrate the action plan for accidents and hazards
CO3: Apply the safety and security norms in the industry
CO4: Evaluate the environmental issues of Industrialization

Course Contents

1. Introduction: Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

2. Safety Performance Planning

Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.

3. Accident Prevention

What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.

4. Organization Safety

Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.

5. Industrial Pollution

Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers,

6. Industrial Security(Industry wise)

General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments.

Books :

1. Basudev Panda ,"Industrial Safety, Health Environment and Security",Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439

2. L.M. Deshmukh, "Industrial Safety Management", TMH , ISBN: 9780070617681

SEMESTER VIII

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410250: High Performance Computing

Teaching Scheme:	Credit	Examination Scheme:100
TH: 4 Hours/Week	3	Mid-Semester (TH) : 30 End- Sem (TH): 70

Prerequisites Courses: -Microprocessor (210254), Principles of Programming Languages(210255), Computer Networks and Security(310244)

Companion Course: Laboratory Practice V(410254)

Course Objectives:

- To understand different parallel programming models
- To analyze the performance and modeling of parallel programs
- To illustrate the various techniques to parallelize the algorithm
- To implement parallel communication operations.
- To discriminate CUDA Architecture and its components.
- To Understand Scope of Parallel Computing and its search algorithms.

Course Outcomes:

CO1: **Understand** various Parallel Paradigm
CO2: **Design and Develop** an efficient parallel algorithm to solve given problem
CO3: **Illustrate** data communication operations on various parallel architecture
CO4: **Analyze** and measure performance of modern parallel computing systems
CO5: **Apply** CUDA architecture for parallel programming
CO6: **Analyze** the performance of HPC applications

Course Contents

Unit I	Introduction to Parallel Computing	09 Hours

Introduction to Parallel Computing: Motivating Parallelism, **Modern Processor:** Stored-program computer architecture, General-purpose Cache-based Microprocessor architecture. **Parallel Programming Platforms:** Implicit Parallelism, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines. Levels of parallelism, **Models:** SIMD, MIMD, SIMT, SPMD, Data Flow Models, Demand-driven Computation, **Architectures:** N-wide superscalar architectures, multi-core, multi-threaded.

#Exemplar/Case Studies	Case study: Multi-core System
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Parallel Algorithm Design	09 Hours

Global System for Mobile Communications (GSM) architecture , Mobile Station, Base Station System, Switching subsystem, Security, Data Services, HSCSD, GPRS - GPRS system and protocol architecture 2.3 UTRAN, UMTS core network; Improvements on Core Network, 802.11 Architecture 802.11a, 802.11b standard

#Exemplar/Case Studies	**IPoC**: A New Core Networking Protocol for 5G Networks.

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Parallel Communication**	**09 Hours**
Basic Communication: One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Collective **Communication using MPI:** Scatter, Gather, Broadcast, Blocking and non blocking MPI, All-to-All Personalized Communication, Circular Shift, Improving the speed of some communication operations.		
#Exemplar/Case Studies	Case study: Monte-Carlo Pi computing using MPI	
***Mapping of Course Outcomes for UnitIII**	CO3	
Unit IV	**Analytical Modeling of Parallel Programs**	**09 Hours**
Sources of Overhead in Parallel Programs, **Performance Measures and Analysis:** Amdahl's and Gustafson's Laws, Speedup Factor and Efficiency, Cost and Utilization, Execution Rate and Redundancy, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost, Optimal Execution Time, Asymptotic Analysis of Parallel Programs. **Matrix Computation:** Matrix-Vector Multiplication, Matrix-Matrix Multiplication.		
#Exemplar/Case Studies	Case study: The DAG Model of parallel computation	
***Mapping of Course Outcomes for UnitIV**	**CO4**	
Unit V	**CUDA Architecture**	**09 Hours**
Introduction to GPU: Introduction to GPU Architecture overview, Introduction to CUDA C- CUDA programming model, write and launch a CUDA kernel, Handling Errors, CUDA memory model, Manage communication and synchronization, Parallel programming in CUDA- C.		
#Exemplar/Case Studies	Case study: GPU applications using SYCL and CUDA on NVIDIA	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**High Performance Computing Applications**	**09 Hours**
Scope of Parallel Computing, **Parallel Search Algorithms:** Depth First Search(DFS), Breadth First Search(BFS), **Parallel Sorting:** Bubble and Merge, **Distributed Computing:** Document classification, Frameworks – Kuberbets, GPU Applications, Parallel Computing for AI/ ML		
#Exemplar/Case Studies	Case study: Disaster detection and management/ Smart Mobility/Urban planning	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction toParallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Seyed H. Roosta, "Parallel Processing and Parallel Algorithms Theory and Computation‖", Springer-Verlag 2000 ,ISBN 978-1-4612-7048-5 ISBN 978-1-4612-1220-1
3. John Cheng, Max Grossman, and Ty McKercher, "Professional CUDA C Programming", John Wiley & Sons, Inc., ISBN: 978-1-118-73932-7

Reference Books :

1. Kai Hwang,, "Scalable Parallel Computing", McGraw Hill 1998.
2. George S. Almasi and Alan Gottlieb, "Highly Parallel Computing", The Benjamin and Cummings Pub. Co., Inc
3. Jason sanders, Edward Kandrot, "CUDA by Example'', Addison-Wesley, ISBN-13: 978-0-13-138768-3
4. Pacheco, Peter S., "An Introduction to Parallel Programming", Morgan Kaufmann Publishers ISBN 978-0-12-374260-5
5. Rieffel WH.EG, Polak, "Quantum Computing: A gentle introduction", MIT Press, 2011,ISBN 978-0-262-01506-6
6. Ajay D. Kshemkalyani , Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge March 2011, ISBN: 9780521189842

e Books :

1. http://prdrklaina.weebly.com/uploads/5/7/7/3/5773421/introduction_to_high_performance_computing_for_scientists_and_engineers.pdf

2. https://www.vssut.ac.in/lecture_notes/lecture1428643084.pdf

NPTEL/YouTube video lecture link

- https://nptel.ac.in/courses/106108055
- https://www.digimat.in/nptel/courses/video/106104120/L01.html

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	1	2	-	2	-	-	-	-	-	-	-	1
CO6	2	2	-	2	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410251: Deep Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Machine Learning (410242)

Companion Course: Laboratory Practice V(410254)

Course Objectives:

- To understand the basics of neural networks.
- Comparing different deep learning models.
- To understand the Recurrent and Recursive nets in Deep Learning
- To understand the basics of deep reinforcement Learning models.
- To analyze Types of Networks.
- To Describe Reinforcement Learning.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand the basics of Deep Learning and apply the tools to implement deep learningapplications

CO2: Evaluate the performance of deep learning models (e.g., with respect to the bias-variance trade-off, overfitting and underfitting, estimation of test error).

CO3: To apply the technique of Convolution (CNN) and Recurrent Neural Network (RNN) forimplementing Deep Learning models

CO4: To implement and apply deep generative models.

CO5: Construct and apply on-policy reinforcement learning algorithms

CO6:To Understand Reinforcement Learning Process

Course Contents

Unit I	Foundations of Deep learning	07 Hours

What is machine learning and deep learning?,Supervised and Unsupervised Learning, bias variance tradeoff, hyper parameters, under/over fitting regularization, Limitations of machine learning, History of deep learning, Advantage and challenges of deep learning. Learning representations from data , Understanding how deep learning works in three figures, Common Architectural Principles of Deep Network, Architecture Design, Applications of Deep learning, Introduction and use of popular industry tools such as TensorFLow,
Keras, PyTorch, Caffe, Shogun.

#Exemplar/Case Studies	Deep Mind, AlphaGo, Boston Dynamics
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Deep Neural Networks(DNNs)	07 Hours

Introduction to Neural Networks :The Biological Neuron, The Perceptron, Multilayer Feed-Forward Networks , **Training Neural Networks** :Backpropagation and Forward propagation **Activation Functions** :Linear ,Sigmoid, Tannh, Hard Tanh, Softmax, Rectified Linear, **Loss Functions** :Loss Function Notation , Loss Functions for Regression , Loss Functions for Classification, Loss Functions for Reconstruction, **Hyperparameters** : Learning Rate, Regularization, Momentum, Sparsity, Deep Feedforward Networks – Example of Ex OR, Hidden Units, cost functions, error backpropagation, Gradient-Based Learning, Implementing Gradient Descent, vanishing and Exploding gradient descent, Sentiment Analysis, Deep Learning with Pytorch, Jupyter, colab.

#Exemplar/CaseStudies	A Case Study for Music Genre Classification
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Convolution Neural Network(CNN)**	**07 Hours**

Introduction, CNN architecture overview, The Basic Structure of a Convolutional Network- Padding, Strides, Typical Settings, the ReLU layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network

#Exemplar/Case Studies	AlexNet, VGG
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Convolution Neural Network(CNN)**	**07 Hours**

Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory. **Practical Methodology**: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyper parameters.

#Exemplar/Case Studies	Multi-Digit Number Recognition
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Deep Generative Models**	**08 Hours**

Introduction to deep generative model, Boltzmann Machine, Deep Belief Networks, Generative adversarial network (GAN), discriminator network, generator network, types of GAN, Applications of GAN networks

#Exemplar/Case Studies	GAN for detection of real or fake images
***Mapping of Course Outcomes for Unit V**	CO4

Unit VI	**Reinforcement Learning**	**07 Hours**

Introduction of deep reinforcement learning, Markov Decision Process, basic framework of reinforcement learning, challenges of reinforcement learning, Dynamic programming algorithms for reinforcement learning,Q Learning and Deep Q-Networks, Deep Q recurrent networks, Simple reinforcement learning for Tic-Tac-Toe.

#Exemplar/Case Studies	Self driving cars, Deep learning for chatbots
*Mapping of Course Outcomes for Unit VI	CO5

Learning Resources

Text Books:

1. Goodfellow, I., Bengio, Y.,,Courville, A, "Deep Learning", MIT Press, 2016.
2. Josh Patterson & Adam Gibson, "Deep Learning"
3. Charu Agarwal, "Neural Networks and deep learning", A textbook
4. Nikhil Buduma, "Fundamentals of Deep Learning", SPD
5. Francois chollet, "Deep Learning with Python"

Reference Books:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction"
2. by SethWeidman, "Deep Learning from Scratch: Building with Python from First Principles"O'Reily
3. Francois Duval, "Deep Learning for Beginners, Practical Guide with Python and Tensorflow"

e-Books :

1. http://csis.pace.edu/ctappert/cs855-18fall/DeepLearningPractitionersApproach.pdf
2. https://www.dkriesel.com/_media/science/neuronalenetze-en-zeta2-1col-dkrieselcom.pdf

MOOC Courses Links:

- https://www.my-mooc.com/en/categorie/deep-learning

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3	-	-	-	-	-	-	2
CO2	3	2	2	2	1	-	-	-	-	-	-	1
CO3	3	2	2	2	2	-	1	-	-	-	-	1
CO4	1	2	1	1	2	-	1	-	-	-	-	1
CO5	2	2	3	2	2	-	-	-	-	-	-	1
CO6	1	2	2	2	2	-	-	-	-	-	2	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252(A): Natural Language Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Discrete Mathematics (210241), Theory of Computation (310242), Data Science and Big Data Analytics (310251)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To be familiar with fundamental concepts and techniques of natural language processing (NLP)
- To acquire the knowledge of various morphological, syntactic, and semantic NLP tasks
- To develop the various language modeling techniques for NLP
- To use appropriate tools and techniques for processing natural languages
- To comprehend the advance real world applications in NLP domain.
- To Describe Applications of NLP and Machine Translations.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Describe the fundamental concepts of NLP, challenges and issues in NLP

CO2: Analyze Natural languages morphologically, syntactical and semantically OR Describe the concepts of morphology, syntax, semantics of natural language

CO3: Illustrate various language modelling techniques

CO4: Integrate the NLP techniques for the information retrieval task

CO5: Demonstrate the use of NLP tools and techniques for text-based processing of natural languages

CO6: Develop real world NLP applications

Course Contents

Unit I	Introduction to Natural Language Processing	07 Hours

Introduction: Natural Language Processing, Why NLP is hard? Programming languages Vs Natural Languages, Are natural languages regular? Finite automata for NLP, Stages of NLP, Challenges and Issues(Open Problems) in NLP

Basics of text processing: Tokenization, Stemming, Lemmatization, Part of Speech Tagging

#Exemplar/Case Studies	Why English is not a regular language: http://cs.haifa.ac.il/~shuly/teaching/08/nlp/complexity.pdf#page=20
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Language Syntax and Semantics	07 Hours

Morphological Analysis: What is Morphology? Types of Morphemes, Inflectional morphology &Derivational morphology, Morphological parsing with Finite State Transducers (FST)
Syntactic Analysis: Syntactic Representations of Natural Language, Parsing Algorithms, Probabilistic context-free grammars, and Statistical parsing
Semantic Analysis: Lexical Semantic, Relations among lexemes & their senses – Homonymy,Polysemy, Synonymy, Hyponymy, WordNet, Word Sense Disambiguation (WSD), Dictionary
based approach, Latent Semantic Analysis

#Exemplar/CaseStudies	Study of Stanford Parser and POS Tagger https://nlp.stanford.edu/software/lex-parser.html https://nlp.stanford.edu/software/tagger.html
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Language Modelling	07 Hours

Probabilistic language modeling, Markov models, Generative models of language, Log-Liner Models, Graph-based Models
N-gram models: Simple n-gram models, Estimation parameters and smoothing, Evaluating language models, **Word Embeddings/ Vector Semantics:** Bag-of-words, TFIDF, word2vec, doc2vec, Contextualized representations (BERT)
Topic Modelling: Latent Dirichlet Allocation (LDA), Latent Semantic Analysis, Non Negative
Matrix Factorization

#Exemplar/Case Studies	Study of language modelling for Indian languages.
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	Information Retrieval using NLP	07 Hours

Information Retrieval: Introduction, Vector Space Model
Named Entity Recognition: NER System Building Process, Evaluating NER System
Entity Extraction, Relation Extraction, Reference Resolution, Coreference resolution, Cross Lingual Information Retrieval

#Exemplar/Case Studies	Natural Language Processing based Information Extraction & Retrieval: https://www.cdac.in/index.aspx?id=mc_cli_cross_lingual_info
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	NLP Tools and Techniques	08 Hours

Prominent NLP Libraries: Natural Language Tool Kit (NLTK), spaCy, TextBlob, Gensim etc.
Linguistic Resources: Lexical Knowledge Networks, WordNets, Indian Language WordNet (IndoWordnet), VerbNets, PropBank, Treebanks, Universal Dependency Treebanks
Word Sense Disambiguation: Lesk Algorithm Walker's algorithm, WordNets for Word Sense Disambiguation

#Exemplar/Case Studies	Hindi Wordnet: https://www.cfilt.iitb.ac.in/wordnet/webhwn/ Sanskrit WordNet: https://www.cfilt.iitb.ac.in/wordnet/webswn/ Indic Library: http://anoopkunchukuttan.github.io/indic_nlp_library/

***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Applications of NLP**	**07 Hours**

Machine Translation: Rule based techniques, Statistical Machine Translation (SMT), Cross Lingual Translation

Sentiment Analysis, Question Answering, Text Entailment, Discourse Processing, Dialog and Conversational Agents, Natural Language Generation

#Exemplar/Case Studies	Study working of Google Translate Study working of IBM Watson Natural Language Processing
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Jurafsky, David, and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing", Computational Linguistics and Speech Recognition‖, ,PEARSON Publication
2. Manning, Christopher D., and nrich Schütze , "Foundations of Statistical Natural Language Processing", Cambridge, MA: MIT Press

Reference Books:

1. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit", O'Reilly Publication
2. Dipanjan Sarkar , "Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from your Data", Apress Publication ISBN: 9781484223871
3. Alexander Clark, Chris Fox, and Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley Blackwell Publications
4. Jacob Eisenstein, "Natural Language Processing", MIT Press
5. Jacob Eisenstein, "An Introduction to Information Retrieval", Cambridge University Press

e-Books :

1. https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf
2. https://www3.cs.stonybrook.edu/~cse521/L16NLP.pdf

NPTEL Courses links:

- https://nptel.ac.in/courses/106101007
- https://nptel.ac.in/courses/106106211

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	1
CO3	2	3	3	2	2	-	-	-	-	-	-	2
CO4	2	2	3	3	3	-	2	2	-	-	-	3
CO5	2	2	3	3	3	-	-	-	-	-	-	3
CO6	3	3	3	3	3	2	1	1	-	-	-	3

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective V
410252 (B): Image Processing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: Laboratory Practice VI (410255)

Course Objectives:

- To Understand Digital Image Processing Concepts.
- To Study Various Methods for Image Enhancement using Spatial and Frequency Domain.
- To Learn Classification Techniques for Image Segmentation.
- To Understand Image Compression and Object Recognition.
- To Study Various Image Restoration Techniques.
- To Understand various Medical and Satellite Image Processing Applications.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Apply Relevant Mathematics Required for Digital Image Processing.

CO2: Apply Special and Frequency Domain Method for Image Enhancement.

CO3: Apply algorithmic approaches for Image segmentation.

CO4: Summarize the Concept of Image Compression and Object Recognition.

CO5: Explore the Image Restoration Techniques.

CO6: Explore the Medical and Satellite Image Processing Applications.

Course Contents

Unit I	Introduction to Digital Image Processing	07 Hours

Introduction, Fundamental steps in Digital Image Processing, Components, Elements of visual perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, different Color Models, Image Types, Image File Formats, Component Labeling algorithm.

Introduction to OpenCV tool to Open and Display Images using Python or Eclipse C/C++.

#Exemplar/Case Studies	Write a program to create a simple image file, save the same in .jpg, .tiff, .bmp format and display it.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Image Enhancement	08 Hours

. Introduction to Image Enhancement and its Importance, Types of Image Enhancement- **Spatial Domain Image Enhancement:** Intensity Transformations, Contrast Stretching, Histogram Equalization, Correlation and Convolution, Smoothing Filters, Sharpening Filters, Gradient and Laplacian

Frequency Domain Image Enhancement: Low Pass filtering in Frequency Domain (Ideal, Butterworth, Gaussian), High Pass filter in Frequency Domain (Ideal, Butterworth, Gaussian).

#Exemplar/Case Studies	Write a program for image enhancement using suitable algorithm forHistogram equalization, Local enhancement, Smoothing and Sharpening.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Image Segmentation and Analysis**	**08 Hours**

Introduction to Image Segmentation and its need. **Classification of Image Segmentation Techniques:** Threshold Based Image Segmentation, Edge Based Segmentation, Edge Detection, Edge Linking, Hough Transform, Watershed Transform, Clustering Techniques, region approach

#Exemplar/Case Studies	Study the different image segmentation techniques for image segmentation
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Image Compression and Object Recognition**	**06 Hours**

Image Compression: Introduction to Image Compression and its need, Classification of Image Compression Techniques- run-length coding, Shannon Fano coding, Huffman coding, Scalar and vector quantization, Compression Standards-JPEG/MPEG, Video compression.

Object Recognition: Introduction, Computer Vision, Tensor Methods in Computer Vision, Classifications Methods and Algorithm, Object Detection and Tracking, Object Recognition.

#Exemplar/Case Studies	Explain image compression and object recognition techniques.
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	**Image Restoration and Reconstruction**	**07 Hours**

Introduction, Model of Image degradation, Noise Models, Classification of image restoration techniques, Blind-deconvolution techniques, Lucy Richardson Filtering, Wiener Filtering

#Exemplar/Case Studies	Explain classification of image restoration techniques.
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	**Medical and Satellite Image Processing**	**07 Hours**

Medical Image Processing: Introduction, Medical Image Enhancement, Segmentation, MedicalImage Analysis (Images of Brain MRI or Cardiac MRI or Breast Cancer).

Satellite Image Processing: Concepts and Foundations of Remote Sensing, GPS, GIS, Elements of Photographic Systems, Basic Principles of Photogrammetry, Multispectral, Thermal, and Hyper spectral Sensing, Earth Resource Satellites Operating in the Optical Spectrum

#Exemplar/Case Studies	Implement application for medical image processing or satellite image processing using OpenCV or Python.

***Mapping of Course Outcomes for UnitVI**	CO6

Learning Resources

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image processing”, Pearson Education, Fourth Impression, 2008, ISBN: 978-81-7758-898- 9.
2. A. K. Jain, “Fundamentals of Digital Image Processing”, PHI, ISBN-978-81- 203- 0929-6.
3. S. Annadurai, R. Shanmugalakshmi, “Fundamentals of Digital Image Processing”, Pearson Education, First Edition, 2007, ISBN-8177584790.
4. Boguslaw Cyganek, “Object Detection and Recognition in Digital Images: Theory and Practice”, Wiley, First Edition, 2013, ISBN: 978-0-470-97637-1.
5. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, “Digital Watermarking and Steganography”, Morgan Kaufmann (MK), ISBN: 978-0-12- 372585-1.
6. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, “Remote Sensing and Image Interpretation”, Wiley, Seventh Edition, 2015, ISBN: 978-1-118-91947-7

Reference Books :

1. Isaac Bankman, “Handbook of Medical Imaging”, Academic Press, Second Edition, 2008, ISBN: 9780080559148.
2. Jayaraman, Esakkirajan,Veerakumar, “Digital image processing” , , Mc Graw Hill, Second reprint- 2010, ISBN(13): 978-0-07-01447-8, ISBN(10):0-07-014479-6.

e-Books :

- **https://bookboon.com/en/3d-video-processing-and-transmission-fundamentals-ebook**

MOOC Courses links :

- http://nptel.ac.in/courses/117105079.

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	-	-	-	-	1	-	-	-
CO2	1	2	2	2	2	1	-	-	1	-	-	1
CO3	1	2	2	2	2	1	-	-	1	-	-	1
CO4	1	1	2	2	2	1	-	-	1	-	-	1
CO5	1	1	1	2	2	1	-	-	1	-	-	1
CO6	1	2	3	2	2	1	1	-	1	-	1	1

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective V 410252(C): Software Defined Networks		
Teaching Scheme: **TH: 3 Hours/Week**	**Credit:** **3**	**Examination Scheme:** **Mid-Semester (TH) : 30** **End-Sem (TH): 70**

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To learn the fundamentals of software defined networks and understand Differentiation between traditional networks and software defined networks
- To gain conceptual understanding of Software Defined Networking (SDN) and its rolein Data Center.
- To study about the SDN Programming.
- To study industrial deployment use-cases of SDN.
- To study about the various applications of SDN
- To Describe SDN Framework.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Interpret the need of Software Defined networking solutions.

CO2: Analyze different methodologies for sustainable Software Defined Networkingsolutions.

CO3: Select best practices for design, deploy and troubleshoot of next generation networks.

CO4: Develop programmability of network elements.

CO5: Demonstrate virtualization and SDN Controllers using Open Flow protocol

CO6: Design and develop various applications of SDN

Course Contents

Unit I	Introduction	07 Hours
Challenges of traditional networks, History of Software Defined Networking (SDN), Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.		
#Exemplar/Case Studies	Video Streaming https://kempsdn.com/what-is-sdn-and-use-cases/video-streaming/	
***Mapping of Course Outcomes for Unit I**	CO1,CO2	
Unit II	**OPEN FLOW & SDN CONTROLLERS**	**07 Hours**
Open Flow Overview, The Open Flow Switch, The Open Flow Controller, Open Flow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, Open Flow Protocol, Proactive and Reactive Flow, Timers, Open Flow Limitations, Open Flow Advantages and Disadvantages, Open v Switch Features, Drawbacks of Open SDN, Introduction to SDN controller.		

#Exemplar/Case Studies	Behavior Anomaly Detection in SDN Control Plane: A Case Study of Topology Discovery Attacks https://www.hindawi.com/journals/wcmc/2020/8898949/	
***Mapping of Course Outcomes for Unit II**	CO2,CO3	
Unit III	**DATA CENTERS**	**07 Hours**
Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE		
#Exemplar/Case Studies	The World's Second Largest Tier IV Data Center A Yotta Infrastructure case study https://www.missioncriticalmagazine.com/articles/94105-the-worlds-seconzd-largest-tier-iv-data-center	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**SDN PROGRAMMING**	**07 Hours**
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Introduction of Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications		
#Exemplar/Case Studies	Case study: Ballarat Grammar uses SDN to fight malware https://www.zdnet.com/home-and-office/networking/case-study-ballarat-grammar-uses-sdn-to-fight-malware/	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Network Functions Virtualization (NFV)**	**07 Hours**
Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions		
Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.		
#Exemplar/Case Studies	NFV deployment case study failure migrate https://www.dell.com/en-us/blog/nfv-deployment-case-study-failure-migrate/	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**SDN Use Cases**	**07 Hours**
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration		
#Exemplar/Case Studies	CloudSeeds automate IaaS using SDN and a high-performance network from Juniper.	
***Mapping of Course Outcomes for Unit VI**	**CO6**	

Learning Resources

Text Books:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
2. Siamak Azodolmolky, "Software Defined Networking with Open Flow", Packt Publishing, 2013, ISBN: 9781849698726
3. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks", An Authoritative Review of Network Programmability Technologies‖, 2013, ISBN : 10:1-4493-4230-2, 9781-4493-4230-2

Reference Books :

1. Vivek Tiwari, "SDN and Open Flow for Beginners", Amazon Digital Services, Inc., 2013.
2. Fei Hu, Editor, "Network Innovation through Open Flow and SDN: Principles and Design", CRC Press, 2014.

e-Books :

1. https://ridhanegara.staff.telkomuniversity.ac.id/files/2017/04/Paul-Goransson-and-Chuck-Black-Auth.-Software-Defined-Networks.-A-Comprehensive-Approach.pdf
2. https://speetis.fei.tuke.sk/KomunikacnaTechnika1/prednasky/7_11_2016/kniha_sietovanie.pdf
3. https://ridhanegara.staff.telkomuniversity.ac.id/files/2017/04/Thomas-D.-Nadeau-Ken-Gray-SDN-Software-Defined-Networks-O_039_Reilly-Media-2013.pdf

MOOC Courses Links:

- https://nptel.ac.in/courses/108107107

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	1	-	-	-	-	-
CO2	1	2	1	1	2	-	-	-	-	-	1	-
CO3	1	1	1	1	2	-	-	-	-	-	2	-
CO4	1	2	2	1	2	-	-	-	-	-	2	-
CO5	3	2	2	3	3	-	-	-	-	-		-
CO6	3	2	2	3	3	-	-	-	-	-	1	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)Elective VI
410252(D): Advanced Digital Signal Processing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme:In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 410244(A)Digital Signal Processing

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques and applications of adaptive filtering.
- To learn and understand Multi-rate DSP and applications
- To explore appropriate transforms
- Understand basic concepts of speech production, speech analysis, speech coding andparametric representation of speech
- Acquire knowledge about different methods used for speech coding and understandvarious applications of speech processing
- Learn and understand basics of Image Processing and various image filters with its applications

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand and apply different transforms for the design of DT/Digital systems
CO2: Explore the knowledge of adaptive filtering and Multi-rate DSP
CO3: Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rateDSP
CO4: Explore use of DCT and WT in speech and image processing
CO5: Develop algorithms in the field of speech , image processing and other DSP applications
CO6:Identify Image Processing Techniques

Course Contents

Unit I	DFT and Applications	08 Hours

DFT and Applications – Linear filtering, spectral leakage, Spectral resolution and selection of Window Length, Frequency analysis, 2-D DFT, applications in Image and Speech Processing

#Exemplar/Case Studies	Case Study of Image / Speech Processing Application
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Adaptive FIR and IIR filter Design	08 Hours

Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design:Pade Approximation, Least square design, Applications

#Exemplar/Case	Demonstration of DT filter and FIR filter with suitable application

Studies	
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Multi-rate DSP and applications**	**08 Hours**

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.

#Exemplar/Case Studies	Implementation for sampling rate Conversion Multi-rate Digital Signal Processing
***Mapping of Course Outcomes for Unit II**	CO3

Unit IV	**Spectral Estimation**	**08 Hours**

Spectral Estimation – Estimation of density spectrum, Nonparametric method, Parametric method, Evaluation ,DCT and WT – DCT and KL transform, STFT, WT, Harr Wavelet and Dubecheis Wavelet, Applications of DCT and WT.

#Exemplar/Case Studies	A spectral estimation case study in frequency-domain by subspace methods
***Mapping of Course Outcomes for Unit II**	CO4

Unit V	**Speech processing**	**08 Hours**

Speech processing - Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders. Fundamentals of Speech recognition, Speech segmentation, Text-to-speech conversion, speech enhancement, Speaker Verification, Applications.

#Exemplar/Case Studies	Investigation of data augmentation techniques for disordered speech recognition
***Mapping of Course Outcomes for Unit II**	CO5

Unit VI	**Image Processing**	**08 Hours**

Image Processing – Image as 2D signal and image enhancement techniques, filter design: low pass, highpass and bandpass for image smoothing and edge detection, Optimum linear filter and order statistic filter, Examples – Wiener and Median filters, Applications

#Exemplar/Case Studies	Medical image processing for coronavirus (COVID-19) pandemic: A survey
***Mapping of Course Outcomes for Unit II**	CO6

Books:

Text:

1. J. G. Proakis, D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications," Prentice Hall, 2007, 4th edition, ISBN: 10: 0131873741
2. Dr. Shaila D. Apate , " Advanced Digital Signal Processing," Wiley Publ., 2013, *ISBN*-10: 8126541245
3. S. K. Mitra, "Digital Signal Processing : A Computer Based Approach", McGraw HillHigher Education, 2006, 3rd edition, *ISBN*-10: 0070429537
4. Rabiner and Juang, "Fundamentals of Speech Recognition", Prentice Hall, 1994, ISBN:0-13-015157-2 .
5. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing and Analysis", Pearson Education, 3d Ed., 2007, ISBN: 81-7808-629-8

References:

1. Chanda, Muzumdar, "Digital Image Processing and Analysis," Estern Economy Edition,PHI, 2nd Ed., ISBN: 978-81-203-4096-*1*
2. TarunRawat, "Digital Signal Processing", Oxford University Press, 2015, ISBN-10:0198062281
3. Roberto Crist, "Modern Digital Signal Processing," Thomson Brooks/Cole 2004,ISBN:978-93-80026-55-8.
4. Nelson Morgan and Ben Gold, " Speech and Audio Signal Processing: Processing andPerception Speech and Music", 1999, John Wiley and Sons, ISBN: 0387951547
5. Raghuveer. M. Rao, AjitS.Bopardikar, "Wavelet Transforms: Introduction to Theory and applications," Pearson Education, Asia, 2000.Dale Grover and John R. (Jack) Deller, "Digital Signal Processing and the Microcontroller", Prentice Hall, ISBN:0-13-754920-2

eE Books:

1. Foundations of Signal Processing- http://fourierandwavelets.org/
2. http://www.tka4.org/materials/lib/Articles-Books/Speech%20Recognition/advanced-digital-signal-processing-and-noise-reduction.9780470094945.26435.pdf
3. https://www.riverpublishers.com/pdf/ebook/RP_E9788792982032.pdf
4. https://fmipa.umri.ac.id/wp-content/uploads/2016/03/Andreas-Intoniou-Digital-signal-processing.9780071454247.31527.pdf
5. http://www-syscom.univ-mlv.fr/~zaidi/teaching/dsp-esipe-oc2/Course-Notes__Advanced-DSP.pdf
6. https://dl.icdst.org/pdfs/files/25f1b31b38872a4aea5584206534368a.pdf

MOOC Courses Links:

- **https://onlinecourses.nptel.ac.in/noc22_ee86/preview**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	-	-	-	-	-	-	-
CO2	1	2	2	2	2	-	-	-	-	-	-	-
CO3	2	2	3	2	2	-	-	-	-	-	3	-
CO4	1	2	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	3	2	-	-	-	-	-	-	-
CO6	1	2	1	1	1	-	-	-	-	-	-	-

Savitribai Phule Pune University Fourth Year of Computer Engineering (2019 Course) Elective V 410252(E): Open Elective		
Teaching Scheme: **TH: 03 Hours/Week**	**Credit** **03**	**Examination Scheme:In-Sem (Paper): 30 Marks** **End-Sem (Paper): 70 Marks**

The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time. Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons. With this idea learner opts for the course without any boundaries to choose the approved by academic council and Board of Studies

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(A) : Pattern Recognition

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Fundamentals of Data Structures(210242), Data Structures and Algorithms(210252)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To learn the basic concept of Pattern recognition
- To study different approaches of pattern recognition
- To learn various pattern classification techniques
- To survey on recent advances and applications in pattern recognition
- To implement Optimal Path Searching techniques.
- To Illustrate Pattern Recognition Techniques.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Analyze various type of pattern recognition techniques

CO2: Identify and apply various pattern recognition and classification approaches to solvethe problems

CO3: Evaluate statistical and structural pattern recognition

CO4: Percept recent advances in pattern recognition confined to various applications

CO5:Implement Bellman's optimality principle and dynamic programming

CO6:Analyze Patterns using Genetic Algorithms & Pattern recognition applications.

Selection of Modules:

Kindly note that modules 1,2,3 and module 9 are compulsory and select any two (02) modules from remaining modules

Course Contents

Unit I	Pattern Recognition	07 Hours

Introduction of Pattern Recognition with its application, Pattern Recognition system, Design cycle of pattern recognition, Learning and adaption, Representation of Patterns and classes, Feature Extraction, pattern recognition models/approaches.

#Exemplar/Case Studies	Evaluation on spatial and temporal variations in water quality by pattern recognition techniques.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Error Estimation & Decision Theory	07 Hours

Introduction, Error estimation methods, various distance measures (Euclidean, Manhattan, cosine, Mahalanobis) and distance based classifier, Feature selection based on statistical hypothesis testing, ROC curve.

Introduction, Bayesian decision theory-continuous and discrete features, two- category classification, minimum error rate classification, discriminant functions,

Parametric Techniques:- Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics; Problems of dimensionality.

Non-Parametric Techniques:-Density estimation, Parzen Window, Metrics and Nearest-Neighbor classification; Fuzzy classification

#Exemplar/Case Studies	Spatial and temporal air quality pattern recognition using environ metric techniques
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	**Structural pattern recognition**	**06 Hours**

Tree Classifiers-Decision Trees, Random Forests, **Structural Pattern recognition:** Elements of formal grammars ,String generation as pattern description ,Recognition of syntactic description ,Parsing ,Stochastic grammars and applications ,Graph based structural representation, **Stochastic method:** Boltzmann Learning.

#Exemplar/Case Studies	Case Study on spoken word recognition
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	**Clustering**	**08 Hours**

Introduction, Hierarchical Clustering, agglomerative clustering algorithm, the single linkage, complete, linkage and average, linkage algorithm. Ward's method ,Partition clustering, , K- means algorithm, clustering algorithms based on graph theory(Minimum spanning tree algorithm),Optimization methods used in clustering: clustering using simulating Annealing.

#Exemplar/Case Studies	Case Study on disease recognition from a list of symptoms
***Mapping of Course Outcomes for Unit IV**	CO3

Unit V	**Template Matching and Unsupervised Learning**	**07 Hours**

Measures based on Optimal Path Searching techniques: Bellman's optimality principle and dynamic programming, The Edit distance, Dynamic time Warping, Measures based on correlations, Deformable template models

#Exemplar/Case Studies	Pattern recognition in time series database: A case study on financial database.
***Mapping of Course Outcomes for Unit V**	CO4

Unit VI	**Fuzzy Logic and Pattern Recognition**	**07 Hours**

Fuzzy logic,Fuzzy pattern classifiers, Pattern classification using Genetic Algorithms
Pattern recognition applications: Application of pattern recognition techniques in object recognition, biometric, facial recognition, IRIS scanner, Finger prints, 3D object recognition

#Exemplar/Case Studies	Study of fingerprint recognition
***Mapping of Course Outcomes for Unit VI**	CO5

Learning Resources

Text Books:

1. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", 2nd Edition, Wiley-Inter- science, John Wiley &Sons, 2001
2. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Elsevier, Academic Press, ISBN: 978-1-59749-272-0
3. B.D. Ripley, "Pattern Recognition and Neural Networks", Cambridge University Press. ISBN 0 521 46086 7

Reference Books:

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. David G. Stork and Elad Yom-Tov, "Computer Manual in MATLAB to accompany Pattern Classification", Wiley Inter-science, 2004**,** ISBN-10: 0471429775
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI, ISBN-978-81-203-4091-6
4. eMedia at NPTEL : http://nptel.ac.in/courses/106108057/33

e-Books :

1. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.320.4607&rep=rep1&type=pdf
2. https://cds.cern.ch/record/998831/files/9780387310732_TOC.pdf
3. https://darmanto.akakom.ac.id/pengenalanpola/Pattern%20Recognition%204th%20Ed.%20(2009).pdf
4. https://readyforai.com/download/pattern-recognition-and-machine-learning-pdf/

MOOC Courses Links:

- https://nptel.ac.in/courses/117105101

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	2	-	-	1	1	1	1	1	1
CO2	2	1	-	1	1	1	1	1	1	1	1	1
CO3	2	2	2	1	1	1	1	1	1	1	1	1
CO4	2	2	2	1	1	1	1	1	1	1	1	1
CO5	2	2	2	1	1	1	1	1	1	1	1	1
CO6	2	-	2	1	1	1	1	1	1	1	1	1

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
Elective VI
410253(B): Soft Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Graphics(210244)

Companion Course: Laboratory Practice VI(410255)

Course Objectives:

- To study the various soft computing approaches.
- To understand the soft computing techniques and algorithms for problem solving.
- To be familiar with the various application areas of soft computing.
- To apply the soft computing techniques for developing intelligent systems
- To Explore and solve problems using genetic Algorithms.
- To Understand hybrid systems paradigm and Application Areas of Soft Computing.

Course Outcomes:

On completion of the course, student will be able to–

CO1: Understand requirement of soft computing and be aware of various soft computing techniques.

CO2: Understand Artificial Neural Network and its characteristics and implement ANN algorithms.

CO3: Understand and Implement Evolutionary Computing Techniques.

CO4: Understand the Fuzzy logic and Implement fuzzy algorithms for solving real life problems.

CO5: Apply knowledge of Genetic algorithms for problem solving.

CO6: Develop hybrid systems for problem solving.

Course Contents

Unit I	Introduction To Soft Computing	07 Hours

Introduction to Soft Computing and Computational Intelligence, Characteristics of Soft computing, Comparison Soft Computing Vs Hard Computing, Requirements of Soft Computing, Soft Computing Techniques – Artificial Neural Network, Fuzzy Logic., Evolutionary computing and

Hybrid systems, Applications of Soft Computing

#Exemplar/Case Studies	1. Study of Soft Computing techniques for Waste WaterManagement 2. Study of IBM Research Neuro-symbolic AI- a new look for neuromorphic computing
*Mapping of Course Outcomes for Unit	CO1

Unit II	Artificial Neural Network	07 Hours
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation, functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory, perceptron model, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule coefficient; back propagation algorithm, factors affecting backpropagation training, applications.		
#Exemplar/CaseStudies	Study of Handwriting recognition using ANN.	
***Mapping of Course Outcomes for Unit II**	CO2	

Unit III	Evolutionary Computing	07 Hours
Problem Solving as A Search Task, Hill Climbing And Simulated Annealing, Evolutionary Computing, Evolution Strategies, Evolutionary Programming, Genetic Programming, Selected Applications From The Literature: A Brief Description, Scope Of Evolutionary Computing, Introduction to Evolutionary Single-Objective Optimization, Particle Swarm Optimization: Introduction, inspiration, mathematical model, standard and binary PSO. Artificial hummingbird algorithm		
#Exemplar/Case Studies	Study of Engineering application of Artificial hummingbird algorithm	
***Mapping of Course Outcomes for Unit III**	CO3	

Unit IV	Fuzzy logic	08 Hours
Introduction to Fuzzy Logic, Classical Set, Fuzzy Set- Introduction, Operations on classical sets, properties of classical sets, fuzzy set operations, properties of fuzzy sets, Classical Relation, Fuzzy Relation, **Fuzzy Inference process** – Membership functions, Fuzzification, Membership value Assignment- Inference, Rank ordering, defuzzification – Weighted Average Method, Mean-Max Membership, Fuzzy Bayesian Decision Making, **Developing a Fuzzy Control** – System Architecture and Operation of FLC System, FLC System Models, Application of FLC System		
#Exemplar/Case Studies	Study of Object Detection Robot Using Fuzzy Logic Controller	
***Mapping of Course Outcomes for Unit IV**	CO4	

Unit V	Genetic Algorithm	07 Hours
Introduction To Basic Terminologies in Genetic Algorithm: Individuals, Genes, Fitness, Populations; **Simple GA; General Genetic Algorithm; Operators in Genetic Algorithm:** Encoding, Selection, Crossover (Recombination), Mutation; **Stopping Condition for GA Flow; Constraints in Genetic Algorithms; Problem Solving Using Genetic Algorithm; Holland Classifier System:** The Production System, The Bucket Brigade Algorithm and Rule Generation**; Advantages and Limitations of Genetic Algorithms; Applications of Genetic Algorithms.**		
#Exemplar/Case Studies	Use Genetic Algorithm to design a solution to the Traveling Salesman Problem. **Solution**:1. Use Permutation Encoding 2. Define Objective Function. 3. Apply Selection Method 4. Crossover 5. Mutation 6. RepeatUntil stopping criteria is met. 7.Stop	
***Mapping of Course Outcomes for Unit V**	CO5	

Unit VI	Hybrid System and Application Areas of Soft Computing	07 Hours

Hybrid System towards comprehensive Soft Computing: The hybrid systems paradigm, Hybrid connectionist production systems, Hybrid connectionist logic programming systems, Hybrid fuzzy connectionist production systems, Hybrid systems for speech and language processing, Hybrid systems for decision making.

Application Areas of Soft Computing: Fuzzy-filtered Neural Networks-Plasma Spectrum Analysis, Hand-written Numeral Recognition, Fuzzy sets and Genetic Algorithms in Game Playing, Soft Computing for Color Recipe Prediction.

#Exemplar/Case Studies	Study of Hybrid models for disease prediction.
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. S.N. Sivanandam, “Principles of Soft Computing”, Wiley India- ISBN- 9788126527410
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence”, Prentice Hall, ISBN: 978-0132610667
3. L. N. de Castro, “Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications”, 2006, CRC Press, ISBN-13: 978-1584886433 (Chapter 3)
4. S.Rajasekaran, and G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithms : Synthesis, and Applications”, Prentice Hall of India

Reference Books:

Reference Books :

1. Nikola K. Kasabov, “Foundations of Neural Networks, Fuzzy Systems, and Knowledge Engineering”, MIT Press, ISBN:978-0-262-11212-3
2. Seyedali Mirjalili, “Evolutionary Algorithms and Neural Networks Theory and Applications, Studies in Computational Intelligence”, Vol 780, Springer, 2019, ISBN 978-3-319-93024-4
3. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, Wiley India, ISBN: 978-0-470-74376-8

e-Books :

1. https://kamenpenkov.files.wordpress.com/2016/01/pso-m-clerc-2006.pdf
2. http://www.shahed.ac.ir/stabaii/Files/CompIntelligenceBook.pdf
3. https://ctb.iau.ir/Files/%D9%88%D8%A8%20%D8%B3%D8%A7%DB%8C%D8%AA%20%D8 %A7%D8%B3%D8%A7%D8%AA%DB%8C%D8%AF/fuzzy%20logic%20with%20engineering% 20application-3rdEdition.pdf
4. http://www.soukalfi.edu.sk/01_NeuroFuzzyApproach.pdf
5. https://www.yumpu.com/en/document/read/34361976/evolutionary-computation-a- unified-approach

MOOC Courses Links :

- NPTEL Course – Introduction of Soft Computing, IIT Kharagpur by Prof. Debidas Samantahttps://nptel.ac.in/courses/106105173
- NPTEL Course – Neural Network and Applications, IIT Kharagpur by Prof. Somnath Sengupta,https://nptel.ac.in/courses/117105084
- NPTEL Course – Fuzzy Logic and Neural Networks, IIT Kharagpur by Dilip Kumar Pratiharhttps://nptel.ac.in/courses/127105006

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	1	-	-	-	-	-	1
CO2	3	2	2	3	1	2	-	-	-	-	-	2
CO3	3	2	2	3	1	2	-	-	-	-	-	2
CO4	3	2	2	3	1	2	-	-	-	-	-	2
CO5	3	2	2	3	1	2	-	-	-	-	-	2
CO6	3	2	2	3	1	2	-	-	-	-	-	3

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410253A: Elective-VI Business Intelligence

Teaching Scheme:	Credit:	Examination Scheme:
TH: 03 Hours/Week	03	Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: 310241: Database Management System,310251:Data Science & Big data Analytics,410242: Machine Learning

Companion Course: 410256:Laboratory Practice VI

- **Course Objectives:**

1. To introduce the concepts and components of Business Intelligence (BI)
2. To evaluate the technologies that make up BI (data warehousing, OLAP)
3. To identify the technological architecture of BI systems·
4. To explain different data preprocessing techniques
5. To identify machine learning model as per business need
6. To understand the BI applications in marketing, logistics, finance and telecommunication sector

- **Course Outcomes:** On completion of this course, the students will be able to

CO1: Differentiate the concepts of Decision Support System & Business Intelligence
CO2:Use Data Warehouse & Business Architecture to design a BI system.
CO3:Build graphical reports
CO4:Apply different data preprocessing techniques on dataset
CO5:mplement machine learning algorithms as per business needs
CO6:Identify role of BI in marketing, logistics, and finance and telecommunication sector

Course Contents

Unit I	Introduction to Decision support systems and Business intelligence	07 Hours

Decision support systems: Definition of system, representation of the decision-making process, evolution of information systems, Decision Support System, Development of a decision support system, the four stages of Simon's decision-making process, and common strategies and approaches of decision makers

Business Intelligence: BI, its components & architecture, previewing the future of BI, crafting a better experience for all business users, End user assumptions, setting up data for BI, data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence

#Exemplar/Case Studies	Decision support system in business intelligence: https://www.riverlogic.com/blog/five-decision-support-system-examples
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	The Architecture of DW and BI	07 Hours

BI and DW architectures and its types - Relation between BI and DW - OLAP (Online analytical processing) definitions - Different OLAP Architectures-Data Models-Tools in Business Intelligence-Role of DSS, EIS, MIS and digital Dash boards – Need for Business Intelligence

Difference between OLAP and OLTP - Dimensional analysis - What are cubes? Drill-down and roll-up - slice and dice or rotation - OLAP models - ROLAP versus MOLAP - defining schemas: Stars, snowflakes and fact constellations.

#Exemplar/Case Studies	A case study on Retail Industry : https://www.diva-portal.org/smash/get/diva2:831050/FULLTEXT01.pdf	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Reporting Authoring**	**07 Hours**
Building reports with relational vs Multidimensional data models; Types of Reports – List, crosstabs, Statistics, Chart, map, financial etc; Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Drill up, drill- down, drill-through capabilities. Run or schedule report, different output forms – PDF, excel, csv, xml etc.		
#Exemplar/Case Studies	Power BI Case Study – How the tool reduced hassles of Heathrow & Edsby: https://data-flair.training/blogs/power-bi-case-study/	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Data preparation**	**07 Hours**
Data validation: Incomplete data , Data affected by noise .**Data transformation**: Standardization , Feature extraction. **Data reduction** : Sampling, Feature selection, Principal component analysis, Data discretization .**Data exploration** : **1.Univarate analysis** :Graphical analysis of categorical attributes ,Graphical analysis of numerical attributes , Measures of central tendency for numerical attributes , Measures of dispersion for numerical attributes, Identification of outliers for numerical attributes **2.Bivariate analysis**: Graphical analysis , Measures of correlation for numerical attributes , Contingency tables for categorical attributes, **3.Multivariate analysis**: Graphical analysis , Measures of correlation for numerical attributes		
#Exemplar/Case Studies	Case study on Data preparation phase of BI system https://blog.panoply.io/load-and-transform-how-to-prepare-your-data-for-business-intelligence	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Impact of Machine learning in Business Intelligence Process**	**07 Hours**
Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression. **Clustering:** Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models. **Association Rule**: Structure of Association Rule, Apriori Algorithm		
#Exemplar/Case Studies	Business applications for comparing the performance of a stock over a period of time https://cleartax.in/s/stock-market-analysis	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**BI Applications**	**07 Hours**

Tools for Business Intelligence, Role of analytical tools in BI, Case study of Analytical Tools: WEKA, KNIME, Rapid Miner, R;
Data analytics, Business analytics, ERP and Business Intelligence, BI and operation management, BI in inventory management system, BI and human resource management, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI in salesforce management

#Exemplar/Case Studies	Logistics planning in the food industry https://www.foodlogistics.com/case-studies https://www.barrettdistribution.com/food-distribution-case-study
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Fundamental of Business Intelligence, Grossmann W, Rinderle-Ma, Springer,2015
2. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015

Reference Books :

1. PaulrajPonnian, "Data Warehousing Fundamentals", John Willey.
2. Introduction to business Intelligence and data warehousing, IBM, PHI
3. Business Intelligence: Data Mining and Optimization for Decision Making, Carlo Vercellis, Wiley,2019
4. Data Mining for Business Intelligence, WILEY
5. EMC Educational Services, Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data, Wiley ISBN-13 978 1118876138
6. Ken W. Collier, Agile Analytics: A value driven Approach to Business Intelligence and Data
7. Warehousing, Pearson Education,2012, ISBN-13 978 8131786826

e-Books :

1. https://www.knime.com/sites/default/files/inline-images/KNIME_quickstart.pdf
2. www.cs.ccsu.edu/~markov/weka-tutorial.pdf
3. http://www.biomedicahelp.altervista.org/Magistrale/Clinics/BIC_PrimoAnno/IdentificazioneModelliDataMining/Business%20Intelligence%20-%20Carlo%20Vercellis.pdf
4. https://download.e-bookshelf.de/download/0000/5791/06/L-G-0000579106-0002359656.pdf

NPTEL/YouTube video lecture links:

- Business Analytics for management decision : https://nptel.ac.in/courses/110105089
- Business analytics and data mining modeling using R : https://nptel.ac.in/courses/110107092
- Business Analysis for Engineers : https://nptel.ac.in/courses/110106050

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	-	-	-	-	-	-
CO2	1	1	1	1	1	-	-	-	-	-	-	-
CO3	1	2	1	1	1	-	-	-	-	-	-	-
CO4	2	2	2	1	1	-	-	-	-	-	-	-
CO5	2	2	2	2	1	-	-	-	-	-	-	-
CO6	-	1	-	1	1	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410253(D) Quantum Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Data Structures and Algorithms(210243), Data Science and Big Data Analytics (310251)

Companion Course: Laboratory Practice IV(410247)

Course Objectives:

- To provide introduction and necessary expertise to the learner in the upcoming discipline of Quantum Computing and Machine Learning.
- To enable the students to learn Quantum Computing and Quantum Machine Learning in practical-oriented learning sessions so that he/she can independently use existing open-source Quantum Computing Hardware and Software Frameworks
- To teach the students to develop hybrid solutions by applying Quantum Machine Learning to potential business application areas.
- To study Quantum Information Theory and Quantum Computing Programming Model of Computation.
- To study Quantum Algorithms and apply these to develop hybrid solutions .
- To study Quantum Concepts necessary for understanding the Quantum Computing Paradigm and compare the available hardware and software infrastructure and frameworks made available open source by major players in the Industry and Academia.

Course Outcomes:

On completion of the course, student will be able to–

CO1: To understand the concepts of Quantum Computing
CO2: To understand and get exposure to mathematical foundation and quantum mechanics
CO3: To understand and implement buiding blocks of Quantum circuits
CO4: To understand quantum information, its processing and Simulation tools
CO5: To understand basic signal processing algorithms FT, DFT and FFT
CO6 : To study and solve examples of Quantum Fourier Transforms and their applications

Course Contents

Unit I	Introduction to Quantum Computing	07 Hours

Fundamental Concepts of Quantum computing:
Introduction and Overview, Global Perspective, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum information and Quantum information processing,

*Mapping of CourseOutcomes for Unit I	CO1

Unit II	Mathematical foundation of Quantum Computing	07 Hours

Quantum Mechanics:
Linear Algebra and Quantum mechanics, Postulates of Quantum mechanics, state space, evolution, Quantum measurement, distinguishing quantum states, projective measurements, POVM measurements, Phase, Composite systems, Global view and applications, Density operator

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Building Blocks for Quantum Program**	**07 Hours**
Quantum Computations: Quantum circuits, Quantum algorithms and qubit operations, Controlled operations, Principal deferred and Principal implicit Measurements, Universal Quantum Gates, Two level unitary gates, single qubit and CNOT , discrete set of universal operations, Quantum computational complexity		
***Mapping of CourseOutcomes for Unit III**	CO3	
Unit IV	**Quantum Simulation Algorithms and Fourier Transform**	**07 Hours**
Simulation of Quantum Systems, Simulation in action,exponential complexity growth of quantum systems,, Quantum simulation algorithm, examples of quantum simulations, perspectives of quantum simulation, Understanding Basics of Fourier transform, Discrete Fourier Transform, Fast Fourier Transform, Definitions, mathematical representations of FT, DFT and FFT		
***Mapping of CourseOutcomes for Unit IV**	CO3,CO4	
Unit V	**Quantum Fourier Transform and Applications**	**07 Hours**
Quantum Fourier Transform , Phase estimation performance and requirements, order finding application, factoring application, General applications of Quantum Fourier transform, period finding, discrete algorithms, Other Quantum Algorithms.		
***Mapping of CourseOutcomes for Unit V**	CO5	
Unit VI	**Quantum Machine Learning**	**07 Hours**
Quantum Machine Learning and Quantum AI, Quantum Neural Networks, Quantum Natural Language Understanding, Quantum Cryptography, Application Domains for Quantum Machine Learning: Chemistry/Material Science, Space Tech, Finance related Optimisation Problems, Swarm Robotics, Cyber security		
***Mapping of CourseOutcomes for Unit VI**	CO6	

Learning Resources

Text Books:

1. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University
2. Wittek, “Quantum Machine Learning (What Quantum Computing Means to Data Mining)”, Peter University of Boras, Sweden - Elsevier Publications
3. Andreas Winchert, “Principles of Quantum Artificial Intelligence”,Instituto Superior Técnico - Universidade de Lisboa, Portugal - World Scientific Publishing, British Library Cataloguing-in-Publication Data

Reference Books:

1. Press Stephen Kan, “MetricsandModelsinSoftwareQualityEngineering‖,Pearson,ISBN-10:0133988082; ISBN-13:978-0133988086
2. Michael A. Nielsen, “Quantum Computation and Quantum Information”, Cambridge University PressStephen Kan, ―Metrics and Models in Software Quality Engineering‖, Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086
3. David McMahon, “Quantum Computing Explained”, Wiley
4. Microsoft Quantum Development Kithttps://www.microsoft.com/enus/quantum/development-kit Forest SDK PyQuil: https://pyquil.readthedocs.io/en/stable/
5. Amazon Bracket Documentation on AWS:https://aws.amazon.com/braket/ 7 D-Wave Systems Documentation: https://docs.dwavesys.com/docs/latest/index.html

e-Books :

1.http://mmrc.amss.cas.cn/tlb/201702/W020170224608149940643.pdf
2.http://mmrc.amss.cas.cn/tlb/201702/W020170224608150244118.pdf

MOOC Courses Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs103/preview
2. https://www.coursera.org/learn/introduction-to-quantum-information

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	-	-	-	2	-	2	2
CO2	1	3	3	2	3	-	-	-	2	-	2	-
CO3	1	3	3	2	3	-	-	-	2	-	2	-
CO4	1	3	3	2	3	-	-	-	2	-	2	-
CO5	1	3	3	2	3	-	-	-	-	-	2	1
CO6	**3**	**2**	**1**	**3**	**1**	-	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)Elective IV
410253(E): Open Elective

Teaching Scheme:	Credit	Examination Scheme:
TH: 03Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Companion Course: Laboratory Practice VI (410255)

The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time.

Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons.

With this idea learner opts for the course without any boundaries to choose the approved by academiccouncil and Board of Studies.

Savitribai Phule Pune University
Home
Fourth Year of Computer Engineering (2019 Course)
410255: Laboratory Practice V

Teaching Scheme	Credit	Examination Scheme
Practical: 2 Hours/Week	01	Term Work: 50 arks Practical: 50 Marks

Companion Course: High Performance Computing(410250), Deep Learning(410251)

Course Objectives:

- To understand and implement searching and sorting algorithms.
- To learn the fundamentals of GPU Computing in the CUDA environment.
- To illustrate the concepts of Artificial Intelligence/Machine Learning(AI/ML).
- To understand Hardware acceleration.
- To implement different deep learning models.

Course Outcomes:

CO1: Analyze and measure performance of sequential and parallel algorithms.
CO2: Design and Implement solutions for multicore/Distributed/parallel environment.
CO3: Identify and apply the suitable algorithms to solve AI/ML problems.
CO4: Apply the technique of Deep Neural network for implementing Linear regression andclassification.
CO5: Apply the technique of Convolution (CNN) for implementing Deep Learning models.
CO6: Design and develop Recurrent Neural Network (RNN) for prediction.

Guidelines for Instructor's Manual

Laboratory Practice V is for practical hands on for core courses High Performance Computing and Data Learning. The instructor’s manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). Program codes with sample output of allperformed assignments are to be submitted as softcopy.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness reserving weightage for successful mini-project completion and related documentation.

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student‟s for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related tothe respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.

- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming Languages: Object Oriented Languages
C++/JAVA/PYTHON/R
Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC

Suggested List of Laboratory Experiments/Assignments

410250: High Performance Computing	
Any 4 Assignments and 1 Mini Project is Compulsory	
Group 1	
1.	Design and implement Parallel Breadth First Search and Depth First Search based on existing algorithms using OpenMP. Use a Tree or an undirected graph for BFS and DFS .
2.	Write a program to implement Parallel Bubble Sort and Merge sort using OpenMP. Use existing algorithms and measure the performance of sequential and parallel algorithms.
3.	Implement Min, Max, Sum and Average operations using Parallel Reduction.
4.	Write a CUDA Program for : 1. Addition of two large vectors 2. Matrix Multiplication using CUDA C
5.	Implement HPC application for AI/ML domain.
Group 2	
6.	Mini Project: Evaluate performance enhancement of parallel Quicksort Algorithm using MPI
7.	Mini Project: Implement Huffman Encoding on GPU
8.	Mini Project: Implement Parallelization of Database Query optimization
9.	Mini Project: Implement Non-Serial Polyadic Dynamic Programming with GPU Parallelization
410251: Course Code : Deep Learning	
Any 3 Assignments and 1 Mini Project is Compulsory	
Group 1	

1.	Linear regression by using Deep Neural network: Implement Boston housing price prediction problem by Linear regression using Deep Neural network. Use Boston House price prediction dataset.
2.	**Classification using Deep neural network** (Any One from the following) 1. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition datasethttps://archive.ics.uci.edu/ml/datasets/letter+recognition 2. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset
3.	Convolutional neural network (CNN) (Any One from the following) • Use any dataset of plant disease and design a plant disease detection system using CNN. • Use MNIST Fashion Dataset and create a classifier to classify fashion clothing into categories.
4.	**Recurrent neural network (RNN)** Use the Google stock prices dataset and design a time series analysis and prediction system using RNN.
Group 2	
5.	Mini Project: Human Face Recognition
6.	Mini Project: Gender and Age Detection: predict if a person is a male or female and also their age
7.	Mini Project: Colorizing Old B&W Images: color old black and white images to colorful images

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	1	-	2	1	-	-	-	-	-
CO2	1	2	1	-	-	1	-	-	-	-	-	1
CO3	-	1	1	1	1	1	-	-	-	-	-	-
CO4	3	3	3	-	3	-	-	-	-	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	-	-
CO7	3	3	3	3	3		-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410256: Laboratory Practice VI

Teaching Scheme	Credit	Examination Scheme and Marks
Practical: 02 hours/Week	01	Term Work: 50 Marks

Companion Course: Elective Courses 410252, 410253

Course Objectives:

- To understand the fundamental concepts and techniques of natural language processing (NLP)
- To understand Digital Image Processing Concepts
- To learn the fundamentals of software definednetworks
- Explore the knowledge of adaptive filtering and Multi-rate DSP
- To be familiar with the various application areas of soft computing.
- To introduce the concepts and components of Business Intelligence (BI)
- To study Quantum Algorithms and apply these to develop hybrid solutions

Course Outcomes:

On completion of this course, the students will be able to

CO1: Apply basic principles of elective subjects to problem solving and modeling.

CO2: Use tools and techniques in the area of software development to build mini projects

CO3: Design and develop applications on subjects of their choice.

CO4: Generate and manage deployment, administration & security.

Guidelines for Instructor's Manual

List of recommended programming assignments and sample mini-projects is provided for reference. Referring to these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses. Preferably there should be multiple sets of assignments/mini-project and distributed among batches of students. Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects. Mini-project can be completed in group of 2 to 3 students. Software Engineering approach with proper documentation is to be strictly followed. Use of open source software is to be encouraged. Instructor may also set one assignment or mini-project that is suitable to the respective course beyond the scope of syllabus.

Operating System recommended: - 64-bit Open source Linux or its derivative **Programming Languages**: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, **Backend**: MongoDB/MYSQL/Oracle, Database Connectivity: ODBC/JDBC, **Additional Tools**: Octave, Matlab, WEKA,powerBI

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by students in the form of a journal. Journal may consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab Home Faculty of Engineering Savitribai Phule Pune University

Syllabus for Fourth Year of Computer Engineering assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness reserving weightage for successful mini-project completion and related documentation.

Guidelines for Practical Examination

It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned. Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed. The supplementary and relevant questions may be asked at the time of evaluation to test the student‟s for advanced learning, understanding, effective and efficient implementation and demonstration skills. Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

PART-I 410252 : Elective V

Recommended / Sample set of assignments and mini projects for reference for four courses offered for Elective III and for four courses offered for Elective IV. Respective Student has to complete laboratory work for elective III and IV that he/she has opted.

410252(A) : Natural Language Processing	
Any 4 Assignments and 1 Mini Project is Compulsory	
Group 1	
1.	Perform tokenization (Whitespace, Punctuation-based, Treebank, Tweet, MWE) using nltk library. Use porter stemmer and snowball stemmer for stemming. Use any technique for lemmatization. **Input / Dataset –use any sample sentence**
2	Perform bag-of-words approach (count occurrence, normalized count occurrence), tf-idf on data. Create embeddings using Word2Vec. **Dataset to be used:** https://www.kaggle.com/datasets/CooperUnion/cardataset
3	Perform text cleaning, perform lemmatization (any method), remove stop words (any method), label encoding. Create representations using TF-IDF. Save outputs. **Dataset: https://github.com/PICT-NLP/BE-NLP-Elective/blob/main/3-Preprocessing/News_dataset.pickle**
4	Create a transformer from scratch using the Pytorch library

5	Morphology is the study of the way words are built up from smaller meaning bearing units. Study and understand the concepts of morphology by the use of add delete table
6	Mini Project (Fine tune transformers on your preferred task) Finetune a pretrained transformer for any of the following tasks on any relevant dataset of your choice: • Neural Machine Translation • Classification • Summarization
Virual Lab:https://nlp-iiith.vlabs.ac.in/	
410252(B) : Image Processing	
Any 5 Assignments and 1 Mini Project is Compulsory	
Group 1	
Implement any five assignments from 1 to 7. Assignment no. 8 is compulsory within a group of 2 to 3 students. Programing language: Python/C/C++ using OpenCV	
1.	Consider any image with size 1024*1024. Modify the image to the sizes 512*512, 256*256, 128*128, 64*64 and 32*32 using subsampling technique. Create the original image from all the above subsampled images using resampling technique. Read any image. Display the histogram, Equalized histogram, and image with equalized histogram
2	Consider any image with size 1024*1024. Modify the image to the sizes 512*512, 256*256, 128*128, 64*64 and 32*32 using subsampling technique. Create the original image from all the above subsampled images using resampling technique.
3	Read any image. Display the histogram, Equalized histogram, and image with equalized histogram
4	Read any image. Display the outputs of contrast stretching, intensity level slicing
5	Compare the results of any three edge detection algorithms on the same image dataset and do the analysis of the result.
6	Compare the result of any two image segmentation algorithm on the same image data set
7	Write a program for image compression using any three compression techniques and compare the results.
Group 2:	

8	Mini project: Implement visual surveillance applications and detect moving objects using object detection and tracking algorithm Or Implement any medical image processing application for freely available medical image dataset
410252(C) : Software Defined Networks	
Any 3 Assignments and 1 Mini Project is Compulsory	
Group 1	
1.	Prepare setup for Mininet network emulation environment with the help of Virtualbox and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology(Simple, Linear, and Tree).View flow tables.
2	After studying open source POX and Floodlight controller, Install controller and run custom topology using remote controller like POX and floodlight controller. Recognize inserted flows by controllers.
3	Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller. Ref: https://github.com/mininet/openflow-tutorial/wiki/Create- Firewall
4	Using Mininet as an Emulator and POX controller, build your own internet router. Write simple outer with a static routing table. The router will receive raw Ethernet frames and process the packet forwarding them to correct outgoing interface. You must check the Ethernet frames are received and the forwarding logic is created so packets go to the correct interface. Ref:https://github.com/mininet/mininet/wiki/SimpleRouter
5	Emulate and manage a Data Center via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center. Implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management. Ref:https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf
6	Study Experiment: Study in details CloudS eeds automates IaaS using SDN and a high-performance network from Juniper SDN Framework.
410252(D) : Advanced Digital Signal Processing	
Any 5 Assignments and 1 Mini Project is Compulsory	
Group 1	

Use
A] MATLAB or other equivalent software working with speech and image signals/files and for analysis purpose.
B] C++ or JAVA for working with sampled data (n – point data samples of DT/Digital signal)
C] JAVA or other for image processing assignments

1.	Apply 1-D DFT to observe spectral leakage and frequency analysis of different window sequences, plot the frequency spectrums.
2	Adaptive FIR and IIR filter design: A] Steepest descent and Newton method, LMS method, B] Adaptive IIR Filter design: Pade Approximation, Least square design
3	Power spectrum estimation and analysis: Take a speech signal and perform A] Non parametric method: DFT and window sequences B] Parametric methods: AR model parameters
4	Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion A] Take a speech signal with specified sampling frequency. Decimate by factor D(e.g. factor B] Take a speech signal with specified sampling frequency. Interpolate by factor I(e.g. factor) C] Sampling rate conversion by factor of I/D
5	Write a program to calculate LPC coefficients, reflection coefficients using Levinson Durbin algorithm
6	Feature Extraction of speech signal A] Using LPC and other methods B] Apply different coding methods: harmonic coding, vector quantization
Group 2:	
7	Mini-Project : Discrete Cosine Transform (DCT) A] To find DCT of NxN image block B] To plot spectrum of the speech signal using DCT and find the correlation of DCT transformed signal C] Image filtering using DCT : LPF, edge detection D] Image compression using DCT, Image resizing OR Mini-Project : Image Processing A] Histogram and Equalization B] Image Enhancement Techniques C] Image Filtering: LPF, HPF, Sobel/Prewitt Masks D] Image Smoothing with special filters: Median, Weiner, Homomorphic filters

410252(E) : Open Elective

1.	Suitable set of programming assignments/Mini-projects for open elective Opted.
PART-II 410253 : Elective VI	
410253(A) : Pattern Recognition	
Any 4 Assignments are Compulsory	
1	For face Recognition • Implemented PCA and multiclass LDA. • Using EigenFaces and FisherFaces to recognise faces in the orl faces data set.
2	Perform sentiment analysis on the IMDB movie reviews dataset
3	Perform a classification task on a dataset of modulated radio signals.
4	Perform image segmentation on the Berkley Segmentation dataset
410253(B) :Soft Computing	
Any 4 Assignments and 1 Mini Project is Compulsory	
Group 1	
1	Design an X-OR Gate with feed-forward neural network (also popularly known as a Multilayer Perceptron) classifier.
2	Symmetric and Asymmetric implementation of Particle Swarm Optimization for Traveling Salesman Problem.
3	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
4	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
5	Implement genetic algorithm for benchmark function (eg. Square, Rosenbrock function etc) Initialize the population from the Standard Normal Distribution. Evaluate the fitness of all its individuals. Then you will do multiple generation of a genetic algorithm. A generation consists of applying selection, crossover, mutation, and replacement. Use: • Tournament selection without replacement with tournament size s • One point crossover with probability Pc • bit-flip mutation with probability Pm • use full replacement strategy

Group 2:	
6	Mini Project - Create a small hybrid system for solving a chosen problem by following the given steps below. 1. Explain on one page the main characteristics of hybrid systems. 2. For the task chosen from the list below, create a multimodular block diagram of a possible solution to the problem. 3. Choose appropriate techniques for solving each sub problem represented as a module. What alternatives are there for each of them? 4. Create subsystems for solving each of the sub problems. Compile the whole hybrid system. 5. Make experiments with the hybrid system and validate the results. A) Handwrittn digits recognition B) Bank loan approval decision-making system C) Stock market prediction D) Unemployment prediction E) Spoken words recognition, for example, "on"/"off"; "yes"/"no"; "stop"/ "go." F) Loan approval
410253(C): Business Intelligence	
Any 5 Assignments and 1 Mini Project is Compulsory	
1	Import the legacy data from different sources such as (Excel , SqlServer, Oracle etc.) and load in the target system. (You can download sample database such as Adventureworks, Northwind, foodmart etc.)
2	Perform the Extraction Transformation and Loading (ETL) process to construct the database in the Sqlserver.
3	Create the cube with suitable dimension and fact tables based on ROLAP, MOLAP and HOLAP model.
4	Import the data warehouse data in Microsoft Excel and create the Pivot table and Pivot Chart
5	Perform the data classification using classification algorithm. Or Perform the data clustering using clustering algorithm.
6	Business Intelligence Mini Project: Each group of 4 Students (max) assigned one case study for this; A BI report must be prepared outlining the following steps: a) Problem definition, identifying which data mining task is needed. b) Identify and use a standard data mining dataset available for the problem.
410253(D) : Quantum Computing	

Any 5 assignments are compulsory	
1	Analyze simple states of superposition and the effect of doing the measurement in different basis states .
2	Build simple quantum circuits with single and two-qubit gates
3	Learn how to use the IBM infrastructure to write quantum programs in QASM (Quantum Assembly) language.
4	Analyze quantum circuits with entanglement
5	Analyze the effectiveness of simple error correction scheme
6	.Implement quantum programs in NISQ model of computing
410253(E) : Open Elective	
1.	Suitable set of programming assignments/Mini-projects for open elective Opted.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	2	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	3	-	-	-
CO4	2	-	2	-	-	3	-	-	-	-	-	-

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2019 Course)
410256: Project Work Stage II

Teaching Scheme:	Credit	Examination Scheme:
TH: 06 Hours/Week	06	Term work: 100 Marks Presentation:50Marks

Prerequisite Courses:

Companion Course:

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report

Course Outcomes:

On completion of the course, student will be able to–

CO1: Show evidence of independent investigation

CO2: Critically analyze the results and their interpretation.

CO3: Report and present the original results in an orderly way and placing the open questions in the rightperspective.

CO4: Link techniques and results from literature as well as actual research and future research lines withthe research.

CO5: Appreciate practical implications and constraints of the specialist subject

Guidelines

In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410257: Audit Course 8

Home

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
AC8-I	Usability Engineering
AC8- II	Conversational Interface
AC8-III	Social Media and Analytics
AC8-IV	MOCC-Learn New Skills
AC8-V	Emotional Intelligence

Savitribai Phule Pune University, Pune Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8
AC8 – I: Usability Engineering

In this course you will have a hands-on experience with usability evaluation and user-centered design. This course will not help to learn how to implement user interfaces, but rather how to design based on the needs of users, which you will determine, and learn how toevaluate your designs rigorously. This help in knowing more about the usability; human computer interaction, the psychological aspects of computing, evaluation.

Course Objectives:

- To understand the human centered design process and usability engineering process andtheir roles in system design and development.
- To know usability design guidelines, their foundations, assumptions, advantages, and weaknesses
- Understand the user interface based on analysis of human needs and prepare a prototype system

Course Outcome:

On completion of the course, learner will be able to–

CO1: Describe the human centered design process and usability engineering process and theirroles in system design and development.
CO2: Discuss usability design guidelines, their foundations, assumptions, advantages, andweaknesses.
CO3: Design a user interface based on analysis of human needs and prepare a prototype system.
CO4: Assess user interfaces using different usability engineering techniques.
CO5: Present the design decisions

Course Contents:

1. What Is Usability?: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences
2. Usability in Software Development : The Emergence of Usability, Human ComputerInteraction, Usability Engineering
3. The usability Engineering Lifecycle: Requirement Analysis, Design, Testing, Development
4. Usability Assessment Methods beyond Testing
5. International User Interfaces

Books:

1. Mary Beth Rosson, John Millar Carroll, “Usability Engineering: Scenario- based Development of Human- Computer Interaction”
2. Jakob Nielsen, “Usability Engineering”

1. Deborah J. Mayhew, “ The usability engineering lifecycle”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2019 Course)
410257: Audit Course 8
AC8 – II: Conversational Interfaces

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

- To understand the basics of conversation
- To know the interactive environments for conversational skills
- To acquaint with the speech to text and text to speech techniques

Course Outcome:

On completion of the course, learner will be able to–

CO1: Develop an effective interface for conversation

CO2: Explore advanced concepts in user interface

Course Contents:

1. **Introduction to Conversational Interface:** Preliminaries, Developing a speech based Conversational Interface, Conversational Interface and devices.
2. **A technology of Conversation:** Introduction, Conversation as Action, The structure of Conversation, The language of Conversation.
3. **Developing a Speech-Based Conversational Interface:** Implementing Text to Speech: Text Analysis, Wave Synthesis, Implementing Speech Recognition: Language Model, Acoustic Model, Decoding. Speech Synthesis Markup Language.
4. **Advanced voice user interface design**

Books:

1. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”
2. Michael McTear, ZoraidaCallejas, David Griol, “ The Conversational Interface: Talking to Smart Devices”
3. Martin Mitrevski, “Developing Conversational Interfaces for iOS: Add Responsive Voice Control”
4. SriniJanarthanam, “ Hands-On Chatbots and Conversational UI Development: Build chatbots”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering(2019Course)
410257:AuditCourse8
AC8–III: Social Media And Analytics

Prerequisite : Knowledge of Social Media Networking.

Course Objectives:

- Get strategic understanding of Digital Marketing and Social Media Marketing.
- Understand how to use it for branding and sales.
- Understand its advantages& limitations.
- Become familiar with Best Practices, Tools &Technologies.
- Blend digital and social marketing with offline marketing.
- Plan and manage digital marketing budget.
- Manage Reporting & Tracking Metrics.
- Understand the future of Digital Marketing and prepare for it.

Course Outcome:

On completion of the course, learner will be able to–

CO1: Develop a far deeper understanding of the changing digital land scape.

CO2: Identify some of the latest digital marketing trends and skill sets needed for today's marketer.

CO3: Successful planning, prediction, and management of digital marketing campaigns

CO4: Assessuserinterfacesusingdifferentusabilityengineeringtechniques.

CO5: Implement smart management of different digital assets for marketing needs.

CO6: Assess digital marketing as a long term career opportunity.

Course Contents:

1. Digital Marketing, History of Digital Marketing, Importance of Digital Marketing, Effective use of Digital Marketing, Effects of wrong Digital Marketing, Digital Marketing to develop brands, Digital Marketing for sales, Digital Marketing for product and service development.
2. Techniques for effective Email Marketing and pitfalls, Various online email marketing platforms such as Campaign Monitor and Mail Chimp, Web content, web usability, navigation and design, Bookmarking and News Aggregators, Really Simple Syndication (RSS),Blogging, Live Chat, User Generated Content (Wikipediaetc),Multi-media - Video (Video Streaming, YouTube etc),Multi-media - Audio & Podcasting (iTunes etc),Multi-media - Photos/Images (Flickr etc),Google Alerts and Giga Alert (Brand, product and service monitoring online),Crowd sourcing,Virtual Worlds.
3. Search Engine Optimization (SEO), Search Engine Optimization (SEO) tips and techniques, Google Adwords, Google various applications such as 'Google Analytics', Maps, Places etc to enhance a brand's products, services and operations.
4. Fcebook&LinkedInandotherSocialMediaforarealmarketing,UtilizingFacebookandLinkedIn'sAdvertising functionality and Applications, Brand reputation management techniques, Systems for 'buzzmonitoring'forbrands,productsandservices,EffectivePublicRelations(PR)onlineandbusinessdevelopment.

References:

1. Vandana Ahuja, “Digital Marketing”, OxfordPress, ISBN:9780199455447,1st Edition.
2. Wiley, Jeanniey, Mullen, David Daniels, David Gilmour, “Email Marketing: An Houra Day, -ISBN:978-0-470-38673-6,1st Edition.

Savitribai Phule Pune University
Fourth Year of Engineering (2019 Course)
410257: Audit Course 8
AC8 – IV: MOOC-learn New Skill

This course aims to create awareness among the students regarding various courses available under MOOC and learn new skills through these courses.

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, , students will be able to

CO1: To acquire additional knowledge and skill.

About Course

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you'reinterested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help. World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effortis to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy. This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

4. https://swayam.gov.in/
5. https://onlinecourses.nptel.ac.in/
6. https://www.edx.org

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering
(2019 Course)
410249: Audit Course 8
AC8 – V: Emotional Intelligence

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Expand your knowledge of emotional patterns in yourself and others

CO2: Discover how you can manage your emotions, and positively influence yourself and others

CO3: Build more effective relationships with people at work and at home

CO4: Positively influence and motivate colleagues, team members, managers

CO5: Increase the leadership effectiveness by creating an atmosphere that engages others

Course Contents

1. **Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. **Know and manage your emotions:** emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize „negative" and „positive" emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing „negative" emotions, Techniques to manage your emotions in challenging situations
3. **Recognize emotions in others :**The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
4. **Relate to others**: Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books:

1. Daniel Goleman, "Emotional Intelligence – Why It Matters More Than IQ," , BantamBooks, ISBN-10: 055338371X13: 978-0553383713
2. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
3. Drew Bird , "The Leader"s Guide to Emotional Intelligence" , ISBN: 9781535176002

Home

Acknowledgement

It is with great pleasure and honor that I share the curriculum for Fourth Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all-inclusive curriculum for Fourth Year of Computer Engineering.

Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Pramod D. Patil (Dr. D. Y. Patil Institute of Technology, Pimpri), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

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I am thankful to Prof.Yogesh Shivaji Sapnar SCTR's Pune Institute of Computer Technology, Pune for the time he has spent in critically reading the draft and giving the final touches. I appreciate his initiative and thank him for his time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that's what makes the team stronger! You took the meaning of teamwork to a whole new level. Thank you for all your efforts!

Professor (Mrs.) Dr. Varsha H. Patil, Chairman, and Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil , Dr. P. M. Yawalkar, and Dr. Swati A. Bhavsar.

Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University

Task Force at Curriculum Design

1. **Advisors, the Team of Board of Studies-**
   Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil Dr. P. M. Yawalkar, and Dr. Swati A. Bhavsar.

2. **Team Leader- Dr. Pramod D. Patil, Dr. D. Y. Patil Institute of Technology, Pimpri**

3. **Teams, Course Design-**

Name of Course	Team Coordinator	Team Members	
Design and Analysis of Algorithms	**Dr. Santosh V. Chobe**	Dr. Sunil Dhore	Pragati Chaudhari
		Dr. Rachna Somkunwar	Dr.Vaihsali Tidake
		Prof. S. P. Pingat	
Machine Learning	**Dr. Sheetal Sonawane**	Mr. Rajesh Bharati	Dr. Ajitkumar Shitole
		Mr. Abhijit D. Jadhav	Arpita Gupta(Industry)
		Dr. K. V. Metre	Rajvardhan Oak(Industry)
		Pratik Ratadiya(Industry)	
Blockchain Technology	**Dr. Sonali Patil**	Dr.Geeta.S.Navale	Dr. Swati Nikam
		Dr. Aparna A. Junnarkar	Dr.Mininath Nighot
		Dr. Amar Buchade	
Elective III: Pervasive Computing	**Prof.R.L.Paikrao**	Prof.Sagar Balasaheb Shinde	Prof.Sanjay Agrawal
		Prof. Dhondiram D. Pukale	Prof.Priyanka More
		Mr. B.B.Gite	
Elective III : Multimedia Techniques	**Dr. B.A.Sonkamble**	Dr. Madhuri Pravin Borawake	Mr. Ranjit M. Gawande
		Prof Gosavi	Prof.Shweta Ashish Koparde
Elective III : Cyber Security and Digital Forensics	**Dr. Girija Gireesh Chiddarwar**	Prof. B.L.Dhote	
		Prof. N. D. Kale	
		Dr. Nikita Kulkarni	
		Dr. Uma Godase	
Elective III: Object Oriented Modeling and Design	**Prof. Rahul Patil**	Mr. Balasaheb S. Tarle	Prof. Ashwini A. Jarali
		Mr. Kishor R. Pathak	Mrs. Neelam Patil
		Mr. Santosh Sambare	
Elective III: Digital Signal Processing			
Elective IV:Information Retrieval	**Dr. Sharmila Wagh**	Dr. Jayadevan R.	Mr. Devidas Thosar
		Mr. Prashant Ahire	Dr. S. B . Tambe
		Dr. Dinesh Hanchate	
Elective IV:GPU Programming and Architecture	**Mrs.Jayshree R. Pansare**	Mr. S. A. Thanekar	Dr.Deepak Mane
		Mrs. Asha Sathe	Mr. D.D.Sapkal
		Dr.sandip kadam	Prof. Manisha V. Marathe

Elective IV:Mobile Computing	**Dr. Manisha Bhende**	Dr. (Miss.) R. M. Wahul Dr. Archana Kale Ms. S. V. Bodake	Dr. D. P. Gaikwad Mrs. Nadaph Anisaaara Gulab
Elective IV:Software Testing and Quality Assurance	**Dr. Uday Chandrkant Patkar**	Dr.S.K.Sonkar Dr. S. U. Kadam Mr.Rahul G. Teni Prof. Vina M. Lomte	Dr. Sunil Khatal Ms. Ila Shridhar Savant Prof. Vandana S. Rupnar
Elective IV:Quantum Computing			
Lab Practice III	**Dr.Vaihsali Tidake**	Dr. Santosh V. Chobe Dr. Sheetal Sonawane DR.S.D. Babar	
Lab Practice IV	**Mr. Rajesh Bharati**	Prof.R.L.Paikrao Dr. B.A.Sonkamble Dr. Jyoti Rao Prof. Rahul Patil Dr. Sharmila Wagh	Dr. A.V. Dhumane Dr. Manisha Bhende Dr. Uday Chandrkant Patkar
Project Stage I	**Dr. Swati A. Bhavsar**	**Dr. Swati A. Bhavsar**	
Audit Course 7	**Satish S. Banait**	**Satish S. Banait**	
High Performance Computing	**Dr. Rachna Somkunwar**	Mrs. Archana S. Vaidya Mrs. Rushali Patil Prof.S.P.Khedkar	Dr. G.R.Shinde Mrs.B.Mahalakshmi
Deep Learning	**Dr. Archana Chaugule**	Mr. Abhijit D. Jadhav Prof. A.G.Phakatkar Dr. N. K. Bansode	Prof. (Dr.) Kamini A.Shirsath Jameer kotwal
Natural Language Processing	**Dr. M.S.Takalikar**	Dr. Pankaj Agarkar Prof. Dr. S. V. Shinde Dr. S. B. Chaudhari	Prof. Deptii Chaudhari Mrs. Dipalee Divakar Rane
Image Processing	**Prof. Dr. Sudeep D. Thepade**	M.P. Wankhade Dr. S. R. Dhore	Dr. B.D.Phulpagar Dr.Jayshree Pansare
Software Defined Networks	**Dr. S. D. Babar**	Dr. A. A. Dandavate Dr. K.S. Wagh Dr. Vinod Vijaykumar Kimbahune	**Dr. Geetika Narang** Ms. D. B. Gothwal
Compiler Construction			
Pattern Recognition	**Dr. A. S. Ghotkar**	Dr. Amol Potgantwar Dr. Sable Nilesh Popat Dr.Sandeep Chaware	Mr. P. M. Kamde Dr. V. S. Pawar
Soft Computing	**Dr. Madhuri A. Potey**	Prof. Dr. D. V. Patil	Prof. P.S.Game Dr. Archana Kollu

		Prof. (Dr.) Sandeep Patil Dr. D. V. Medhane	
Business Intelligence	**Dr. K. Rajeswari**	Dr. Zaware Sarika Nitin Prof. Y.A.Handage PROF. DR. M. R. SANGHAVI	Mr. D.G.Modani Mr. Subhash Gulabrao Rathod
Advanced Digital Signal Processing			
Lab Practice V	**Dr. G. R. Shinde**	Dr. Rachna Somkunwar Dr. Archana Chaugule	
Lab Practice VI	**Dr.Kamini A. Shirsath**	Dr. M.S.Takalikar Prof. Dr. Sudeep D. Thepade Dr. Sonali Patil Dr. S. D. Babar	Dr. A.S.Ghotkar Dr. Sulochana Sonkamble Dr. Madhuri A. Potey Prof. Dr. K. Rajeswari
Project Stage II	**Dr. Swati A. Bhavsar**	**Dr. Swati A. Bhavsar**	
Audit Course 8	**Dr. Shaikh Nuzhat Faiz**	**Dr. Shaikh Nuzhat Faiz**	

SAVITRIBAI PHULE PUNE UNIVERISTY, PUNE

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Final Year Electrical Engineering (2019 Course) (w.e.f. 2022-2023)

BE Electrical (2019 Course)

SEM-I

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403141	Power System Operation & Control	3	2	–	–	30	70	25	–	25	150	3	1	–	–	4
403142	Advanced Control System	3	2	–	–	30	70	–	–	50	150	3	1	–	–	4
403143	Elective-I	3	2	–	–	30	70	–	–	25	125	3	1	–	–	4
403144	Elective-II	3	–	2*	–	30	70	25	–	–	125	3	–	1	–	4
403145	Project Stage-I	–	–	–	4	–	–	50	–	50	100	–	–	–	2	2
403146	MOOCs	–	–	–	–	–	–	50	–	–	50	–	–	–	2	2
403147	Audit Course-VII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		**12**	**6**	**2**	**4**	**120**	**280**	**150**	**–**	**150**	**700**	**12**	**3**	**1**	**4**	**20**

403143: Elective-I	403144: Elective-II	403147: Audit Course-VII
403143A: PLC and SCADA 403143B: Power Quality Management 403143C: High Voltage Engineering 403143D: Robotics and Automation	403144A : Alternate Energy System 403144B : Electrical & Hybrid Vehicle 403144C : Special-purpose Machines 403144D: HVDC & FACTS	403147 A: German Language I 403147B: Engineering Economics I 403147C: Sustainability(IGBC)

SEM-II

Course Code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	PW	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	PW	Total
403148	Switchgear and Protection	3	2	–	–	30	70	25	–	50	175	3	1	–	–	4
403149	Advanced Electrical Drives & Control	3	2	–	–	30	70	25	50	–	175	3	1	–	–	4
403150	Elective-III	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403151	Elective-IV	3	–	–	–	30	70	–	–	–	100	3	–	–	–	3
403152	Project stage II	–	–	–	12	–	–	100	–	50	150	–	–	–	6	6
403153	Audit course VIII	2#	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Total		12	4	–	12	120	280	150	50	100	700	12	2	–	6	20

403150: Elective-III	403151: Elective-IV	403153: Audit Course-VIII
403150 A : Digital Control System 403150 B : Restructuring and Deregulation 403 150 C: Smart Grid 403150 D: SensorTechnology (Open Elective)	403151A: EHV AC Transmission 403151B : Illumination Engineering 403151C: Electromagnetic Fields 403151D: AI and ML (Open Elective)	403153A: German Language II 403153B: Engineering Economics II 403153C: Green Building

*** For the tutorial, one credit is given. # Audit Course: Conduct over and above these lectures.**

403141: Power System Operation and Control

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25
					Term work	25

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Course Objectives:

This course aims to:

1. Study the different types of angle, voltage and frequency stability of the power system and methods to improve the stability of the power system.
2. Impart knowledge about various advanced controllers such as FACTs controllers with its evolution, principle of operation, circuit diagram and applications.
3. Introduce frequency control in a single area and two area system.
4. Understand the formulation of unit commitment and economic load dispatch.
5. Illustrate various ways of interchange of power between interconnected utilities.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Summarize angle, voltage and frequency stability in the power system control (UN).
CO2: Illustrate various ways of interchange of power between interconnected utilities (AP).
CO3: Analyze stability and optimal load dispatch using different techniques (AN).
CO4: Select appropriate FACTS devices for stable operation of the system (EV).
CO5: Evaluate the stability of the system and suggest the methods to improve it (EV).

Unit 01	**Power System Stability (Angle Control):** Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and reclosure), methods to improve steady state and transient stability, numerical based on equal area criteria.	08 hrs
Unit 02	**Reactive Power Control:** The necessity of reactive power control, production and absorption of reactive power, reactive power requirements for power factor control and voltage regulation and the loading capability curve of a synchronous generator, types of FACTS controller. **Series compensation:** reactor and capacitor, TCSC, SSSC. **Shunt compensation:** reactor and capacitor, STATCOM, FC-TCR. **Series and shunt compensation:** UPFC. (FACTS devices: working principle, circuit diagram, VI characteristics, applications)	08 hrs
Unit 03	**Automatic Generation Control (Frequency Control):** Introduction to the concept of AGC; complete block diagram representation of load-frequency control of an isolated power system; steady state and dynamic response;	08 hrs

	control area concept; two-area load-frequency control; Schematic and block diagram of the alternator voltage regulator scheme.	
Unit 04	**Economic Load Dispatch and Unit Commitment (Cost Control):** ● **Part A: Economic load dispatch:** Introduction, revision of cost curve, incremental cost curve of thermal, method of Lagrange multiplier, exact coordinate equation (penalty factor), economic scheduling of thermal plant considering effect of transmission losses using Bmn coefficient. (Numerical on method of Lagrange multiplier, penalty factor, Bmn coefficient) ● **Part B: Unit commitment:** Concept of unit commitment, constraints in unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, Numerical on priority list and dynamic programming method.	08 hrs
Unit 05	**Energy Control:** Interchange of power between interconnected utilities (numerical), economic interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools.	06 hrs
Unit 06	**Voltage Stability:** Basic concepts related to voltage stability: transmission system characteristics (PV curve), generator characteristics (QV curve), and load characteristics. Voltage collapse, classification of voltage stability, static and dynamic stability, analysis techniques for dynamic voltage stability, voltage stability indexing.	07 hrs

Text Books:	
[T1]	I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd. (Edition 2)
[T2]	T. J. E. Miller, "Reactive power control in electric systems," Willey.
[T3]	Hadi Saadat, "Power System Analysis," Tata McGraw's Hill
[T4]	S. Sivanagaraju, G. Sreenivasan, "Power System Operation and Control," Pearson Education India, 2009.
[T5]	P. S. R. Murthy, "Power System Operation and Control," Tata McGraw-Hill Publishing Co., Ltd.
[T6]	Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control," Prentice Hall of India.
[T7]	Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTs," IEEE Press.
[T8]	Dr. B.R. Gupta, "Power System-Analysis and Design", S. Chand Publication.

Reference Books:	
[R1]	Allen J. Wood and Bruce F. Wollenberg, "Power Generation, Operation, and Control," Wiley India Edition.
[R2]	R. Mohan Mathur, Rajiv K. Varma, "Thyristor based FACTS controller for electrical transmission systems", by John Wiley and Sons, Inc.

[R3]	Olle I. Elgerd, “Electrical Energy System Theory”, 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd.
[R4]	Dr. K. Uma Rao, “Power System Operation and Control,” Wiley India
[R5]	Prabha Kundur, “Power System Stability and Control,” Tata McGraw’s Hill
[R6]	“Electrical Power System Handbook”, IEEE Press
[R7]	James Momoh, “Smart Grid: Fundamentals of design and analysis,” Wiley, IEEE Press
Online Resources:	
[O1]	https://www.youtube.com/playlist?list=PL86E9AC8CFBA00ADB
[O2]	https://onlinecourses.nptel.ac.in/noc19_ee62/preview
[O3]	https://www.youtube.com/watch?v=uy9lZCdkQIM&list=PLD4ED2FAF3C155625
[O4]	http://nptel.ac.in/courses/108101040/ (PSOC webcourse)
[O5]	https://nptel.ac.in/courses/108101004
[O6]	https://onlinecourses.nptel.ac.in/noc21_ee16/preview

Mapping:

Unit	Text Books	Reference Books
01	T1, T3, T6, T8	R4, R5
02	T2, T4, T7	R2, R4
03	T1, T3, T4, T5	R1, R3, R4, R5
04	T1, T3, T4	R1, R4
05	T1	R1
06	T8	R4, R5, R7

List of Experiments:

A)The following experiments are ***compulsory***:

1. To apply equal area criteria for stability analysis under a fault condition (three-phase fault at the middle point of a parallel transmission line).
2. To study the Lagrange multiplier technique for economic load dispatch (to find the optimal loading of generators).
3. To study load frequency control using an approximate and exact model.
4. To study reactive power compensation using STATCOM.

B) From the following list, perform ***any four*** experiments.

5. To solve the Unit Commitment problem by priority list method/ dynamic programming (DP) approach
6. Plot a swing curve using the point-by-point/4th order Runge-Kutta method.

7. To apply equal area criteria for analysis stability under a sudden rise in mechanical power input.
8. To study load frequency control with proportional and integral control.
9. To study the two area of load frequency control.
10. To study reactive power compensation using simulation of TCR or TCSC.
11. To study the optimum loading of generators considering transmission losses (penalty factor).

Guidelines for the Instructor's Manual:

- The Instructor's Manual should contain the following things related to every experiment:
- Specify prerequisite and objective(s) of experiment
- Include a circuit diagram with specifications (for hardware experiments).
- A related theory of the experiment must be included.
- The circuit diagram of the experiment should be drawn at the beginning.
- For simulation experiments using MATLAB/EMTP, the Simulink diagram with proper details must be included in the write up. For programming, take a printout of the program and the result.
- A conclusion based on calculations, results, and graphs (if any) should be written.

Industrial Visit:

An industrial visit is mandatory to the Load Dispatch Center/Power Station Control Room.

Guidelines for Students' Lab Manual:

- Students should write the journal in their own handwriting, particularly the results, diagrams, conclusions, questions, answers, etc.
- A circuit or connection diagram or construction diagram must be drawn either manually using or using software on graph paper.
- Handwriting and figures must be neat and clean.

Guidelines for Laboratory Conduction:

- Do the continuous assessment. The experiments performed in a particular week must be checked in the next turn in next week.
- During assessment, the teacher should make the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of the experiment and in the index.

403142: Advanced Control System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	50

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Prerequisite:

Control System Engineering, Matrix Algebra, Z-transform, and Laplace transform.

Course Objectives:

This course aims to:

1. Introduce concepts of modern control theory, analysis, and design.
2. Provide an overview of the digital control system and nonlinear control system.
3. Explore advanced control techniques at an introductory level.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Explain compensation networks, common nonlinearities, the concept of state, sampling and reconstruction, and concepts of advanced controls (Understanding)
CO2: Determine transfer function from state model (Applying)
CO3: Test controllability and observability properties of the system (Evaluating)
CO4: Design compensators, state feedback controls, and observers for the system (Creating)

Unit 01	Compensator Design in Frequency Domain	06 hrs

approach to control system design, cascade compensation networks, phase-lead and phase-lag compensator designs using bode plot, physical realization of compensators.

Unit 02	Nonlinear Control Systems	07 hrs

introduction to nonlinear systems, common nonlinearities, describing function method, describing function of an ideal relay, stability analysis with describing function, introduction to Lyapunov stability analysis (basic concepts, definitions, and stability theorem)

Unit 03	Introduction to State-Space	08 hrs

Concept of state, state-space representation of dynamical systems in physical variable form, phase variable forms and Jordon / diagonal canonical form, conversion of the transfer function to state-space model and vice versa, state equation and its solution, state transition matrix and its properties, computation of state transition matrix by Laplace transform and Caley Hamilton method.

Unit 04	State-Space Design	08 hrs

The concept of controllability and observability, Kalman's and Gilbert's tests for controllability and observability, effect of pole-zero cancellation, duality property, control system design using pole-placement using transformation matrix, direct substitution, and Ackermann's formula, State observers, design of a full-order observer.		
Unit 05	Introduction to Digital Control System	08 hrs
Basic block diagram of the digital control system, sampling and reconstruction, Shannon's Sampling theorem, zero-order hold and its transfer function, First-order hold (no derivation), characteristics equation, mapping between s-plane and z-plane, stability analysis in z-plane.		
Unit 06	Advanced control system topics	08 hrs
Concept of sliding mode control, equivalent control, chattering, sliding mode control based on reaching law, Introduction to adaptive control, adaptive schemes, and control problems Optimal control-linear quadratic regulator problem.		
Text Books:		
[T1]	Norman S. Nise, *Control System Engineering*, Sixth Edition, John Wily and Sons, Inc. 2011.	
[T2]	Richard C. Dorf, Robert H. Bishop, *Modern Control Systems*, Twelfth Edition, Pearson Education.	
[T3]	Benjamin C. Kuo, *Digital Control System*, Second Edition, Oxford University Press, 2003.	
[T4]	I. J. Nagarath, M. Gopal, *Control System Engineering*, Fourth Edition, New Age International (P) Limited, Publishers	
[T5]	A. Nagoor Kani, *Advanced Control Theory*, Third Edition, CBS Publishers and Distributes, 2020.	
Reference Books:		
[R1]	Katsuhiko Ogata, *Modern Control Engineering*, Fifth Edition, Prentice-Hall, 2010.	
[R2]	M. Gopal, *Digital Control and State Variable Methods*, Tata McGraw-Hill.	
[R3]	K. Ogata, *Discrete-Time Control System*, Second Edition, PHI Pvt. Ltd. 2006	
[R4]	M. Gopal, *Modern Control Systems Theory*, Second Edition, New Age International (P) Limited, Publishers	
[R5]	Karl J. Åström, Björn Wittenmark, *Adaptive Control*, Second Edition, Dover Publications, Inc. New Yark	
[R6]	C Edwards, Sarah K. Spurgeon, S Spurgeon, *Sliding Mode Control: Theory And Applications*, Taylor and Francis, 1998	
[R7]	Jean-Jacques E. Slotine, Jean-Jacques E.. Slotine, Weiping Li, *Applied Nonlinear Control*, Prentice Hall, 1991.	
Online Resources:		

[O1]	https://nptel.ac.in/courses/108102043
[O2]	https://nptel.ac.in/courses/108102113

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T4, T5	R4
03	T2	R1
04	T2	R1
05	T3	R2,R3
06	T2,T3	R4,R5,R6

List of Experiments:

[Perform any 8 experiments using any simulation software]

1. Simulation of a lead or lag compensator for a given system and comparison of compensated and uncompensated systems responses.
2. Simulation of the closed-loop system with ideal real as a nonlinearity.
3. Software program for determining a state-space model for a given transfer function and vice versa.
4. Software program for determining the state transition matrix.
5. Software program for checking the observability and controllability of a given system.
6. Simulation of state feedback control design using software.
7. Simulation of a full-order observer-based state feedback control system.
8. Effect of sampling and verification of sampling theorem by simulation.
9. Converting a continuous-time system to a discrete-time system and checking the response using the software.
10. Design of a linear quadratic regulator for a given system using simulation.

Industrial Visit:

Industrial visit to a process industry or control and automation industry

Guidelines for the instructor's manual:

Guidelines for the instructor’s manual are given below:

- It should have a title, learning outcomes, aim, software requirement, theory, the problem with the solution, simulation results, comparison (result table, if any), and conclusion.
- All the experiments should have at least one numerical problem, which should be solved analytically, then it should be verified by the simulation. For that matter, theory can be restricted to only definitions and concepts (no detailed explanation).
- Simulation printouts should have readable and self-explanatory block diagrams and figures.
- To develop a proper understanding of all the experiments, it is suggested to take figures with the same physical system (or numerical problem) for all the experiments.

Guidelines for Student’s Lab Manual:

Guidelines for the students' lab manual are given below.

- Students should write the theory, the problem with a solution, and the conclusion on their own in their own handwriting.
- Students should write a program on their own and should compare analytical and simulated results.
- Students should try using different values of the parameters in the numerical problem and should observe the changes in the results.
- Hand writing must be clean and neat.

Guidelines for Laboratory Conduction:

Guidelines for laboratory conduction are as follows:

- At the beginning, the instructor should state the learning outcomes of the experiment and should provide a problem statement to the students.
- Students should solve the problem and then simulate the experiment.
- To have variations in the numerical problem, different parameters can be set for different students.

403143A: PLC and SCADA

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims to:

1. To make the students understand the fundamentals of automation and various automation systems used in the industry, such as PLC.
2. To provide knowledge levels needed for PLC programming and operating.
3. To develop the architecture of SCADA, explaining each unit in detail.
4. To apply knowledge gained about PLCs and SCADA systems to real-life industrial applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Develop and explain the working of a PLC with the help of a block diagram.
CO2:Classify input and output interfacing devices with PLC.
CO3:Design PLC based application by proper selection criteria, developing GUI and ladder program.
CO4:Execute, debug, and test the programs developed for digital and analog operations.
CO5:Develop the architecture of SCADA and explain the importance of SCADA in critical infrastructure.
CO6:Describe the SCADA protocols and digital control systems, along with their architecture for automation.

Unit 01	Introduction to PLC	07 hrs

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition as per NEEMA (National Electrical Engineering Manufacturers' Association), types – fixed/modular/dedicated, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, selection criterion, advantages and disadvantages, specifications, comparison of various PLCs manufactured by Allen Bradley, Siemens, ABB, Mitsubishi, GE, Fanuc and Schneider.

Unit 02	Interfacing of PLC with I/O devices	08 hrs

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices Sensors-temperature, pressure, flow, level Actuators-Electrical, pneumatic, hydraulic Encoders-Incremental, Absolute Transducers, Limit switches, proximity sensors Control Elements- Mechanical, Electrical, Fluid valves

Unit 03	Programming of PLC	08 hrs

Programming languages for PLC, Ladder diagram fundamentals, Rules for proper construction of ladder diagram Timer and counter- types along with timing diagrams, Reset instruction, latch instruction MCR (master control relay) and control zones Developing ladder logic for Sequencing of motors, ON OFF, Tank

level control, ON OFF temperature control, elevator, bottle filling plant, car parking, traffic light controller.		
Unit 04	Advance function and Applications of PLC	08 hrs
Analog PLC operation and PLC analog signal processing, PID principles, typical continuous process control curves, simple closed loop systems, closed loop systems using Proportional, Integral and Derivative (PID), PID modules, PID tuning, tuning methods including the "Adjust and observe" method AC Motor Controls: AC Motor Starter, AC Motor Overload Protection, DC Motor Controller, Variable Speed (Variable Frequency) AC Motor Drive. PLC Applications in developing systems- Tank level controller using analog signals, temperature controller using RTD, speed control of electric motor.		
Unit 05	SCADA Systems	07 hrs
Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system architecture, important definitions HMI, MTU, RTU, communication means, Desirable properties of the SCADA system, advantages, disadvantages, and applications of SCADA. SCADA generations (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, functions and features of SCADA systems, Automatic substation control, Energy management systems (EMS), System operating states, SCADA systems in critical infrastructure: Petroleum Refining Process, Conventional electric power generation, Water Purification System, Chemical Plant.		
Unit 06	SCADA Protocols and Distributed Control Systems	07 hrs
Open systems interconnection (OSI) Model, TCP/IP protocol, Modbus model, DNP3 protocol, IEC 60870-5-101 (IEC101), Control and Information Protocol (CIP), Ether 01111111111111Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Distributed Control System: Introduction to DCS- its working & operation, Architecture , Features, Advantages & Applications of DCS, Comparison between DCS & PLC.		

Text Books:	
[T1]	John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition
[T2]	John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers.
[T3]	Ronald L. Kurtz, "Securing SCADA Systems," Wiley Publishing.
[T4]	Stuart A. Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition.
[T5]	Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
[T6]	Curtis Johnson, "Process Control Instrumentation Technology," Prentice-Hall of India.
Reference Books:	
[R1]	Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols," ELSEVIER
[R2]	Batten G. L., "Programmable Controllers," McGraw Hill Inc., Second Edition

[R3]	Bennett Stuart, “Real Time Computer Control," Prentice Hall, 1988
[R4]	Krishna Kant, “Computer Based Industrial Control," PHI
[R5]	P. K. Srivstava, “Programmable Logic Controllers with Applications," BPB Publications
[R6]	Distributed Computer Control systems in Industrial Automation, D Popovic & Vijay Bhatkar.

Online Resources:

[O1]	NPTEL Course: Electrical Measurement And Electronic Instruments By Prof. Avishek Chatterjee, Dept. of Electrical Engineering, IIT Kharagpur:- Web link https: // nptel.ac.in /courses /108 /105 / 108105153/
[O2]	NPTEL Course: Industrial Instrumentation By Prof. Alok Barua, IIT Kharagpur:-Web linkhttps://nptel.ac.in/courses/108/105/108105064/

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T1, T2, T6	R3, R4
03	T1, T5	R5
04	T1, T2, T6	R2, R5
05	T3, T4	R1
06	T3	R1, R6

List of Experiments:

Minimum 11 experiments should be conducted. 6 experiments should be on PLC and 5 experiments should be on SCADA.

a) Experiments No. ***1 to 5*** are ***compulsory.***

b) ***Any 1*** experiment should be conducted from experiment number ***6 to 9.***

c) Experiments No. ***10 to 13*** are compulsory.

d) ***Any 1*** experiment should be conducted from experiment number ***14 to 17.***

1. Interfacing of lamp and button with PLC for ON and OFF operation. Verify all logic gates.
2. Set / Reset operation: one push button for ON and other push button for OFF operation.
3. Delayed operation of lamp by using push button.
4. UP/DOWN counter with RESET instruction.
5. Combination of counter and timer for lamp ON/OFF operation.
6. DOL starter and star delta starter operation by using PLC.
7. PLC based thermal ON/OFF control.
8. Interfacing of Encoder with PLC
9. PLC based speed, position, flow, level, pressure measurement system.
10. PLC interfaced with SCADA and status read/command transfer operation.
11. Parameter reading of PLC in SCADA.
12. Alarm annunciation using SCADA.
13. Reporting and trending in the SCADA system.

14. Tank level control by using SCADA.
15. Temperature monitoring by using SCADA.
16. Speed control of Machine by using SCADA.
17. Pressure control by using SCADA.

Guidelines for Instructor’s Manual:

- Specify objective(s) of the experiment.
- Include a ladder diagram.
- Related theory of the experiment must be included.
- Include step by step procedure to perform the experiment.
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable.
- Provide space to write conclusions.

Guidelines for Student’s Lab Manual:

Students are expected to write the journal in the following sequence:

- Aim –
- Ladder diagram –
- Theory –
- Conclusions
- Students are expected to draw the ladder diagrams on 1mm graph paper.
    - ➢ They should take the print out or draw SCADA HMI.
    - ➢ Students should write conclusions.
    - ➢ Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Laboratory Conduction:

- Give the safety instructions to students.
- Allow 4-5 students per group to perform the experiment.
- Explain theory related to the experiment to be conducted.
- Introduce PLC and SCADA in detail with specifications to students.
- Explain the ladder diagram of the experiment.
- Ladder diagram should be completed by the students.
- Perform the experiment in the presence of an instructor.
- Verify the results obtained.

403143B: Power Quality Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Prerequisite:

Fundamentals of Power Systems and Power Electronics

Course Objectives:

This course aims to:

1. Develop understanding of power quality attributes.
2. Make students describe problems associated with poor power quality.
3. Make students describe mitigation techniques for improving power quality.
4. Learn various equipment of monitoring and assessment.

Course Outcomes:

Student will be able to

CO1: Understand power quality and attribute of power quality

CO2: Describe voltage flicker and mitigation of it

CO3: Analyze the effect of power system events on voltage sag and its characteristics.

CO4: Identify the sources of harmonics and harmonics produced

CO5: Select proper method for harmonic mitigation along with methods of power quality monitoring.

CO6: Carry out power quality monitoring using power quality analyzers.

Unit 01	Basics of Power Quality	07 hrs

Importance of power quality, terms and definitions of power quality as per IEEE std. 1159-2019 such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding, grounding and power quality, recommended grounding practices for noise and power quality control.

Unit 02	RMS Voltage variations, Flickers and Transient Over-Voltages	07 hrs

RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Ferro-resonance Various means to reduce flickers. Flicker meter and monitoring. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Unit 03	Voltage Sag, Swell and Interruption	07 hrs
Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag, Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of type of fault, fault location and fault level on voltage sag. Phase angle jumps. Types of sags (Type 1 to type 7). Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Measurement of voltage sag half cycle RMS, one cycle rms methods. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions.		
Unit 04	Harmonics-I	07 hrs
Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effects of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices and other indices for assessing impacts of harmonics. A.C. quantities under non-sinusoidal conditions. Triplen harmonics characteristics and non characteristics harmonics. Power assessment under waveform distortion conditions. Harmonic sources and harmonic generation from lighting loads, Computer and allied load including SMPS, household equipment, Office automation devices, Utility equipment like transformer, synchronous machines and FACTS devices. Industrial equipment – induction machines, AC and Dc drives, Arc Furnaces.		
Unit 05	Harmonics-II	7 hrs
Harmonics resonances - series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Modifying the system frequency response. Harmonic filtering, IEEE 1531 standard for key design criteria for filters. Passive filters, Notch filter, Tuned filters, Broadband filters and active filters. IEEE Standard 519-2014 for Harmonic control.		
Unit 06	Power Quality Monitoring & Assessment	07 hrs
Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality instrumentation. Power quality analyser specification requirement as per EN50160 Standard. Selection of power quality equipment for cost effective power quality monitoring, Selection of power quality monitors, selection of monitoring location and period. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring. Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion.		
Text Books:		
[T1]	R. C. Dugan, Mark F. McGranaghan, Surya Santoso, and H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw-Hill Publication.	
[T2]	C.Sankaran, “Power Quality”, CRC Press.	
[T3]	M. H. J. Bollen, “Understanding Power Quality Problems, Voltage Sag and Interruptions”, New York: IEEE Press, 2000, Series on Power Engineering.	
[T4]	Arrillaga, M. R. Watson, and S. Chan, “Power System Quality Assessment," John Wiley and Sons.	
Reference Books:		

[R1]	Enriques Acha, Manuel Madrigal, “Power System Harmonics: Computer Modeling and Analysis," John Wiley and Sons Ltd.
[R2]	Ewald F. Fuchs, Mohammad A. S. Masoum, “Power Quality in Power Systems and Electrical Machines,” Elsevier Publication.
[R3]	Arrillaga, M. R. Watson, “Power System Harmonics”, John Wiley and Sons.
[R4]	G. J. Heydt, “Electric Power Quality”, Stars in Circle Publications.
[R5]	EN50160 and IEEE 1100, 1346, 519, and 1159 standards.

Mapping:

Unit	Text Books	Reference Books
01	T1,T2, T3,T4	R1,R2,R4, R5
02	T1,T2	R2, R4, R5
03	T1,T2, T3	R2, R4, R5
04	T1,T2	R1, R2, R3, R4, R5
05	T1,T2	R1, R2, R3, R4, R5
06	T1,T2,T5	R1, R2, R3, R4, R5

List of Experiments:

A minimum of 9 experiments are to be performed from the following list:
Compulsory experiments:

1. Study of the power quality analyzer and measurement of various power quality parameters.
2. Measurement of harmonic distortion of various non linear loads.
3. Harmonic analysis of SMPS based Equipment such as UPS /AC/DC drive.
4. Harmonic compliance of institute as per IEEE 519-2014 standard and sizing of hybrid (Active + detuned filter).
5. Power quality audit of institute or department.

Any 4 experiments from following list:

1. Harmonic analysis of transformer for various conditions (no load, inrush, full load etc.)
2. Harmonic analysis of UPS/ DC Drive/AC Drive.
3. Analysis of performance of induction motor/transformer operated with sinusoidal supply and under distorted supply conditions supplied by 3 phase inverter.
4. Measurement of voltage sag magnitude and duration by using digital storage oscilloscope/ power quality analyzer.
5. Design of 7% detuned Passive Filter.
6. Simulation study of transient and/or flicker measurement.
7. Simulation studies of harmonic generation sources such as VFD, SVC, STATCOM and FACTS devices and harmonic measurement (THD) by using professional software like MATLAB.
8. Harmonic load flow analysis by using professional software such as ETAP, PSCAD, ATP.

Guidelines for the Instructor’s Manual:

The Instructor's Manual shall have

- Brief relevant theory.

- Equipment with specifications.
- Connection diagram/methodology.
- Format of observation table and sample results.

Guidelines for Students' Lab Manual:

The Student's Lab Journal should contain the following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram or circuit diagram.
- Observation table/simulation waveforms.
- Sample calculations for one or two readings.
- Result table.
- Graph and conclusions
- Few short questions related to the experiment.

Guidelines for Laboratory Conduction:

- Read and understand the power quality analyzer manual completely.
- Make sure that connections of the power analyzer are done as per manual.
- Follow safety protocols while doing a power quality audit.

403143C: High Voltage Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims:

- To make students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials.
- To make students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
- To enable students to understand the charge formation and separation phenomena in clouds, the causes of overvoltage and lightning phenomena,
- To develop the ability among learners to execute testing on various high-voltage equipment as per standards.
- To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Identify, describe and analyze the breakdown theories of gaseous, solid and liquid materials.
CO2: Analyze the occurrence of over voltage and to provide remedial solutions
CO3: Describe and use of various methods of generation of high AC, DC, impulse voltage and current.
CO4: Demonstrate the methods of measurement of high AC, DC, impulse voltage and current, tests on high voltage equipment and devices
CO5: Study design of high voltage laboratory with all safety measures.

Unit 01	Breakdown in Gas	07hrs

Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, Townsend's breakdown criterion, primary and secondary ionization coefficients, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations, Corona discharges for point plane electrode combination with positive and negative pulse application, time lag for and factors on which time lag depends. (Numerical on Townsend's theory and Paschen's law).

Unit 02	Breakdown in Liquid and Solid Dielectrics	07 hrs

- **Breakdown in Liquid Dielectrics:** Pure and commercial liquids, Different breakdown theories: Breakdown in Pure liquid and breakdown in commercial liquids: Suspended Particle theory, Cavitations and bubble theory, Thermal mechanism of breakdown and Stressed Oil volume theory.
- **Breakdown in Solid Dielectrics:** Intrinsic breakdown: electronic breakdown, avalanche or streamer breakdown, electromechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Chemical and electrochemical breakdown, Partial discharge,Composite dielectric material,

	Properties of composite dielectrics, breakdown in composite dielectrics. (Numerical on theories of liquid and solid dielectric materials)	
Unit 03	Lightning and Switching Over Voltages	07 hrs
Lightning phenomenon, Different types of lightning strokes and mechanisms of lightning strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory. Causes of over voltages and its effects on power systems, Over voltage due to switching surges and methods to minimize switching surges. Statistical approach of insulation coordination.		
Unit 04	Generation of High Voltages and Current	07 hrs
Generation of high ac voltages-Cascading of transformers, series and parallel resonance system, Tesla coil. Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current .		
Unit 05	Measurement of High Voltage and High Currents	07 hrs
Sphere gap voltmeter, electrostatic voltmeter, generating voltmeter, peak reading voltmeter, resistive, capacitive and mixed potential divider, capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, Measurement of dielectric constant and loss factor, partial discharge measurements. Measurement of high power frequency a.c using current transformer with electro-optical signal converter, Radio interference measurements.		
Unit 06	High Voltage Testing of Electrical Apparatus and EHV Laboratories	07 hrs
Testing of insulators and bushings, Power capacitors and cables testing, testing of surge arresters. Design, planning and layout of High Voltage laboratory:-Classification and layouts, earthing and shielding of H.V. laboratories.		
Text Books:		
[T1]	C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd.	
[T2]	M. S. Naidu, V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Publication Co. Ltd. New Delhi	
Reference Books:		
[R1]	E. Kuffel, W. S. Zaengl, J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication	
[R2]	Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, "High Voltage Engineering", Khanna Publishers, New Delh	
[R3]	Ravindra Arora, Wolf Gang Mosch, "High Voltage Insulation Engineering", New Age International	
[R4]	High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York and Basel	
[R5]	Subir Ray, "An Introduction to High voltage Engineering" PHI Pvt. Ltd. New Delhi	

[R6]	IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt
[R7]	Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts
[R8]	Pollution test :IEC 60507-1991 on external and internal insulator
[R9]	High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989)

Online Resources:

[O1]	https://nptel.ac.in/courses/108104048

Mapping:

Unit	Text Books	Reference Books
01	T1,T2	R1,R2,R3,R6
02	T1,T2	R1,R2,R3,R5,R6
03	T1,T2	R1,R2,R3,R5,R6
04	T1,T2	R1,R2,R3,R4,R5,R6
05	T1,T2	R1,R2,R3,R4,R5,R6
06	T1,T2	R1,R2,R3,R7,R8,R9

List of Experiments:

[Minimum eight experiments to be conducted from the given list]

1. To find the constants of the breakdown equation of transformer oil.(Analytical and graphical method)
2. Measurement of unknown high a.c. voltage using sphere gap
3. To obtain breakdown strength of composite insulation systems, and observe the effect of parameters like no. of layers, thickness of layer, effect of interfacing.
4. To find out the breakdown of air in uniform and non uniform fields and compare it.
5. To study surface flashover on corrugated porcelain/polymeric insulation systems.
6. To understand the basic principle of corona and obtain audible and visible corona inception and extinction voltage under non uniform field.
7. To perform an experiment on horn gap arrester and understand arc quenching phenomenon.
8. To observe development of tracks and trees on polymeric insulation systems.
9. Parametric analysis of Impulse current generator using virtual Laboratory.
10. To perform an experiment on rod gap arresters.
11. To Study effect of barrier on breakdown voltage of air/ transformer oil.
12. Simulation of lightning and switching impulse voltage generator using any simulation software.
13. To perform various HV insulation tests on cables as per IS.
14. Study of layout /earthing/safety of HV installation /lab in any industry by visit /virtual lab.

Industrial Visit: Industrial visit to high voltage equipment manufacturing industry/EHV substation/High Voltage Testing Lab.

Guidelines for Instructor's Manual:

The Instructor’s Manual should contain following related to every experiment

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Students should be encouraged to visit industries/HV laboratories/HV installations.
- Students should be encouraged to use virtual labs.
- Few short questions related to each practical.
- Assignments based on use of IS and IEC.

Guidelines for Student’s Lab Manual:

The Students lab journal should contain:

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Observations, result tables and proper inferences/ conclusions from each experiment conducted.
- Reports on visit to industries/HV laboratories/HV installations.
- Simulations and print outs of use of virtual labs.
- Few short questions and answers related to each practical.
- Assignments based on use of IS and IEC.

Guidelines for Laboratory Conduction:

There should be continuous assessment for the TW.

- Assessment must be based on understanding of theory, attentiveness during practicals.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

403143D: Robotics and Automation

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	25

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Course Objectives:

This course aims to:
- To know the basic parts of a typical industrial robot system with its anatomy similar to the human body.
- To analyze mathematically the kinematic and dynamic modeling of a typical robot manipulator.
- To select an appropriate type of robot with given specifications for different industrial applications.
- To know the basics of actuators, sensors, and control of an industrial robot for different applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1: differentiate between types of robots based on configuration, method of control, types of drives, sensors used, etc.
CO2: apply mathematical modeling of a robot for a specific application with given specifications.
CO3: analyze the robot arm dynamics for calculation of torques and forces required for different joints of robots for control of the robot arm.
C04 : apply knowledge of Robot for their various applications

Unit 01	Robotics fundamentals	07 hrs

historical development of robotics, Definitions of Industrial Robot, Types of Robots, Asimov's Laws of Robotics, robot components, Robot specifications: repeatability, spatial resolution, compliance, degree of freedom, load carrying capacity, speed of response, work volume, work envelope, reach, etc,Robot configurations, Classification of Robots: Control Method: Servo controlled and non-servo controlled, their comparative study, form of motion: P-T-P (point to point), C-P (continuous path), pick and place etc. and their comparative study.

Unit 02	Mathematical Modeling and Dyanamics of Robots	07 hrs

Direct Kinematics, Coordinate and vector transformations using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogeneous Transformations, The Robotic Manipulator Joint Coordinate System, inverse, Jacobian Transformation in Robotic Manipulation. **Robot Dynamics:** Lagrange's Equation, Kinetic and potential energy Equations, and Euler-Lagrange analysis for a single prismatic joint working against gravity and a single revolute joint. equation of motion.

Unit 03	Forward and Inverse Kinematics	07 hrs

Denavit-Hartenberg (D-H) representation of kinematic chains. Rules for establishing link coordinate frames.

Forward solution of robotic manipulator for SCARA Robot and PUMA Robot. Forward 67i solution for simple robot systems. **Inverse Kinematics:** Concept of Inverse Kinematics, general properties of inverse solution such as existence and uniqueness of solution, inverse solution by direct approach, Geometric approach, inverse solution for simple SCARA Robots, numericals for simple three axis robots based on direct approach.		
Unit 04	Robotics Sensors	07hrs
Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Laser Scanners, Position sensors – Piezo Electric Sensor, LVDT, Resolvers. Encoders: Absolute and Incremental: - Optical, Magnetic, Capacitive, pneumatic Position Sensors Range Sensors: Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors. Safety Sensor: Light Curtain, Laser Area Scanner, Safety Switches; Machine vision		
Unit 05	Differential motion and control	07 hrs
Manipulator Differential Motion: Concept of linear and angular velocity, Relationship between transformation matrix and angular velocity, manipulator Jacobian, Jacobian for prismatic and revolute joint, Jacobian Inverse, Singularities. **Control of Robot Arm:** Modeling of DC motor and load, closed loop control in position servo, the effect of friction and gravity, control of a robotic joint, position velocity and acceleration profiles for trapezoidal velocity profile. **Control of Robot manipulator:** joint position controls (JPC), resolved motion position controls (RMPC) and resolved motion rate control (RMRC).		
Unit 06	Various applications of Robots	07 hrs
Pick and place the robot, Application of Robots in Arc Welding Robots, assembly and mega-assembly Robots perform continuous arc welding, spot welding, spray painting, and assembly operations. Robots for Inspection: Robotic vision systems, image representation, object recognition and categorization, depth measurement. Other industrial applications: coating, deburring, cleaning, Die Casting, Molding, Material handling, Picking, palletizing, packaging, hospitals and patient care, F&B industry, sports and recreation, defense and surveillance industry, home automation, mining industry. A robot-based manufacturing system, robot cell design considerations and the selection of robots, Robot Economics, Functional Safety in Robotic Applications		
Text Books:		
[T1]	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, and Ashish Dutta, “Industrial Robotics:Technology, Programming and Applications," Tata-McGraw-Hill Education Private Limited, New Delhi, 2012.	
[T2]	Richard D. Klafter, Thomas A. Chemielewski, Michael Neign, “Robotic Engineering – An IntegralApproach”, Prentice Hall of India Pvt. Ltd., New Delhi. Eastern Economic Edition.	
[T3]	Robert J. Schilling, “Fundamentals of Robotics: Analysis and Control”, Prentice Hall of India, New Delhi	
Reference Books:		
[R1]	K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, “Robotics: Control Sensing, Vision, and Intelligence”,	

	International Edition, McGraw-Hill Book Co.
[R2]	John J. Craig, “Introduction to Robotics: Mechanics and Control”, Pearson Education
[R3]	R. K. Mittal, I. J. Nagrath, “Robotics and Control”, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
[R4]	Saeed b. Niku, “Introduction to Robotics: Analysis, Control, Applications”, Wiley Publication, 2011.

Online Resources:

[O1]	NPTEL Course on “Robotics”: https://nptel.ac.in/courses/112/105/112105249/
[O2]	NPTEL Course on “Introduction to Robotics”: https://nptel.ac.in/courses/107/106/107106090/

Mapping:

Unit	Text Books	Reference Books
01	T1,T2	R3
02	T1,T2,T3	R1, R2,R3,R4
03	T1,T2,T3	R1,R3,R4
04	T1,T2,T3	R1,R3,R4
05	T2, T3	R1,R2, R3
06	T2	R1

A List of Experiments:

Experiment 9 is compulsory.

List of Laboratory Experiments

1.Identify and selection of Sensors such as IR sensors, Proximity Sensor, Ultrasonic Sensor, White line sensor, Temperature Sensor, Touch sensor, Tilt Sensor, Accelerometer, Gyroscopic Sensor etc. based on given application

2. Identify and selection of Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on application
3. Demonstration of various robotic configurations using industrial robot
4. Design and selection of Gripper / End effector
5. One Programming exercise on lead through programming
6. MATLAB program for simple and inverse kinematics of simple robot configuration
7. To demonstrate simple robotic system using Matlab/ MscAdam / RoboAnalyser software
8.Study of various applications of Robots
9. One Industrial visit for Industrial robotic application

Guidelines for the Instructor’s Manual:

The Instructor's Manual should contain the following things related to every experiment:

- Specify prerequisite and objective(s) of experiment.
- A related theory of the experiment must be included.

- The circuit diagram of the experiment should be drawn at the beginning.
- For simulation experiments, the Simulink diagram with proper details must be included in the write up. For programming, take a printout of the program and the result.
- A conclusion based on calculations, results, and graphs (if any) should be written.

Guidelines for Students' Lab Manual:

- Students should write the journal in their own handwriting, particularly the results, diagrams, conclusions, questions, answers, etc.
- A circuit or connection diagram or construction diagram must be drawn either manually using or using software on graph paper.
- Handwriting and figures must be neat and clean.

Guidelines for Laboratory Conduction:

- Do the continuous assessment. The experiments performed in a particular week must be checked in the next turn in next week.
- During assessment, the teacher should make the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of the experiment and in the index.

403144A: Alternate Energy System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:

1. Develop a fundamental understanding of solar thermal and photovoltaic systems.
2. Provide the knowledge of development and operation of wind energy system
3. Discuss bio-energy resource assessment.
4. Introduce different storage systems, Integration and Economics of Renewable Energy Systems.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Analyze the performance of solar thermal and photovoltaic systems.
CO2:Determine wind turbine performance.
CO3:Explain and evaluate biomass resources in an Indian context.
CO4:Illustrate the importance of storage systems.
CO5:Analyze the economics of renewable energy sources.

Unit 01	Solar Energy-I	08 hrs

Solar radiation at the earth's surface, Solar constant, Spectral distribution, Extraterrestrial Radiation, Solar Terrestrial Radiation, Solar radiation geometry, Computation of cosθ for any location having any orientation, Empirical equations for predicting the availability of solar radiation: Monthly average daily and hourly global and diffuse radiation, Beam and Diffuse radiation under cloudless skies, Solar radiation on tilted surfaces : a)Beam radiation, b)Diffuse radiation, c)Reflected radiation, d)Flux on tilted surface.
Instruments for measuring solar radiation, Devices for thermal collection and storage, Thermal applications, Introduction to concentrating solar power (CSP) plants using technologies like a) Parabolic troughs b) Linear Fresnel reflector, c) Parabolic Dish, etc.

Unit 02	Solar Energy-II	06 hrs

Introduction to family of solar film technology, Single c-Si, Poly c-Si PV Cell, Module and Array, Array Design (factors influencing the electrical design of the solar array) : a) Sun Intensity, b)Sun Angle, c) Shadow Effect, d) Temperature Effect, e) Effect of Climate, f) Electrical Load Matching, g) Sun Tracking, Peak Power Point Operation, Electrical characteristics of Silicon PV Cells and Modules, PV System Components, Efficiency of PV system, MPPT of solar system, PV system design for various applications(residential, commercial and industrial)

Unit 03	Wind Energy	08 hrs

Power Contained in Wind, Thermodynamics of Wind Energy, Efficiency Limit for Wind Energy

Conversion, the maximum energy obtained for a Thrust-operated converter (Efficiency limit), Design of Wind Turbine Rotor, Power-Speed Characteristics, Torque-Speed Characteristics, Wind Turbine Control Systems: a) Pitch Angle Control, b) Stall Control, c) Power Electronics Control, d) Yaw Control, Control Strategy, Wind Speed Statistics, Statistical Wind Speed Distributions, Site and Turbine Selection, Extraction of wind energy and wind turbine power. Introduction to Offshore Wind Energy System and its comparison with Wind Energy System,		
Unit 04	Biomass Energy	06 hrs
Biomass Classification, Biomass Resources and their Energy Potential, Biomass Conversion Technologies: Anaerobic Digestion, Ethanol Fermentation, Biomass Gasification: Gasifiers, Fluidized Bed Gasifier, Biogas Technologies and their factor affecting Biogas Production, Biogas Plants: Floating and Fixed Dome type, designing of biogas plant, Introduction to Biodiesel**,** Power Generation from Municipal Solid Waste (MSW), Landfill Gas, Liquid Waste.		
Unit 05	Fuel Cells and Storage Systems	08 hrs
A. Fuel Cells: Operating principles of Fuel Cell, Fuel and Oxidant Consumption, Fuel Cell System Characteristics, Introduction to Fuel Cell Technology and its type, application and limits. B. Storage systems: Hydrogen storage: Hydrogen production, relevant properties, Hydrogen as an Engine Fuel, methods of Hydrogen storage. Batteries: Introduction to Batteries, Elements of Electro-Chemical Cell, Battery classification, Battery Parameters, Factors affecting battery performance. Introduction to other storage technologies: pump storage, SMES, compressed air storage.		
Unit 06	Integration of RES	06 hrs
A. Integration of RES with grid, Grid codes. B. Economics of RES: Simple, Initial rate of return, time value, Net present value, Internal rate of return, Life cycle costing, Effect of fuel Escalation, Annualized and levelized cost of energy.		
Text Books:		
[T1]	S.P. Sukhatme, “Solar Energy”, Tata McGraw Hill	
[T2]	Chetan Singh Solanki, “Solar Photovoltaics-Fundamentals, Technologies and Applications”, PHI Second Edition	
[T3]	Godfrey Boyle, “Renewable Energy”, Third edition, Oxford University Press	
[T4]	H. P. Garg, J. Prakash, “Solar Energy-Fundamentals and Applications”, Tata McGraw hill Publishing Co. ltd., First Revised Edition.	
[T5]	Mukund R. Patel, “Wind and Power Solar System”, CRC Press	
[T6]	Gilbert M. Masters, “Renewable and Efficient Electrical Power Systems”, Wiley - IEEE Press, August 2004	
Reference Books:		
[R1]	D.P.Kothari, K.C.Singal, Rakesh Rajan,“Renewable Energy Sources and Emerging Technologies”, PHI Second Edition	
[R2]	Tapan Bhattacharya, “Terrestrial Solar Photovoltaics”, Narosa Publishing House	
[R3]	Paul Gipe, “Wind Energy Comes of Age”, John Wiley & Sons Inc.	

[R4]	Donald L.Klass, "Biomass for Renewable Energy, Fuels, and Chemicals, Elsevier, Academic Press
[R5]	Thomas Ackermann, "Wind Power in Power Systems", Wiley Publications.
[R6]	B T.Nijaguna, "Biogas Technology", New Age International Publishers.
[R7]	Tony Burton, Nick Jenkins, David Sharpe, "Wind Energy HandBook-Second Edition", John Wiley & Sons, Ltd., Publication

Online Resources:

[O1]	A review on non-edible oil as a potential feedstock for biodiesel: physicochemical properties and production technologies.
[O2]	Fabrication and Design of Solar cooker.

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2
02	T2, T3, T4	R1
03	T5	R3, R5,R7
04	T6	R4, R6
05	T3,T6	R1
06	T6	R1

List of Tutorial:

It is expected to take ***minimum 8 tutorials*** from the following list:

1. Report on Renewable Energy Scenario in India/ across the Globe.
2. Designing of standalone Solar PV systems for various loads(2 numericals).
3. Report on analysis of Indian solar radiation data/ Wind data.
4. Performance analysis of concentrating solar collector/ solar cooker/ solar air heaters
1. Study of Wind Electric Generators with Grid Integration.
2. Performance of Wind generation (2 or 3 numericals).
3. Design of a community biogas plant for a village in India(1 or 2 numericals).
4. Analysis of Non Edible oil as an alternate energy source.
5. Performance of storage devices(3/4 numericals).
6. Economics of renewable energy sources(2 or 3 numericals).
7. Design of Hybrid system using HOMER demo software

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403144B: Electric and Hybrid Vehicle

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:
1. To gain knowledge of Li-ion battery protection.
2. To learn HEV Subsystems and Configurations.
3. To understand Mathematical Model of Li-ion battery.
4. To familiarize with Hybridization of drivetrains.
5. To learn Star Labeling Schemes for Li-ion Packs.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Analyze the Life Cycle Assessment of Li-ion battery.
CO2 : Describe the different types of Li-ion charging methods
CO3 : Comprehend the knowledge of drivetrain hybridization.
CO4 : Evaluate EV motor sizing.
CO5 : Classify Battery Recycling methods.

Unit 01	Li-ion Battery	07 hrs

Materials used for Li-ion battery, Nanostructured Electrode Materials for Li-Ion Batteries, Li-ion battery protection, Wireless charging of EV, Life Cycle Assessment of Li-ion battery, Solid-state Battery, Panasonic 18650 & 2170 cell,

Unit 02	Battery Charging and Modelling	07 hrs

TSCC/CV charging and CVCC/CC charging of Li-Ion battery, BMS standards,
SoC Estimation methods (Kalman Filter, Neural Network, Fuzzy logic), Public EV charging stations, Solar Powered Charging Stations, Modeling of Lithium-ion batteries, Thermal Modeling of Li-ion battery.

Unit 03	Electric Vehicle Technologies	07 hrs

Battery Swapping System, EV Fleet Management, Sensors for Electric Vehicles
Electric bus, Electric trucks, Fuel cell vehicles, Introduction of EV Subsystems and Configurations, Energy management strategies and its general architecture.

Unit 04	Plug-In Hybrid Electric Vehicles	07 hrs

Hybridization of drivetrains in HEVs, Hybridization of energy sources in EVs, Power Flow control in hybrid drive train topologies, Power Management Strategies in HEV, Introduction of HEV Subsystems and Configurations, Vehicle Dynamics Fundamentals and HEV Modeling (Series Hybrid), Fuel

efficiency analysis.		
Unit 05	EV Components Design	07 hrs
Criteria for battery selection , Forces on EV calculation, Power for EV calculation, Sizing the Power Converter, Sizing of Electric Machine for EVs and HEVs, Motor Torque Calculation, Induction motor control, PMSM motor control, Battery pack design, In vehicle networks- CAN		
Unit 06	Electric Vehicle Policies and Startups	07 hrs
FAME-II Policy , Charging Infrastructure for Electric Vehicles - Revised Guidelines and Standards , Star Labeling Schemes for Li-ion Packs- BEE India, EV Tariff, EV Startup examples, Li-ion Battery Recycling Policy and Standards		

Text Books:

[T1]	Energy Systems for Electric and Hybrid Vehicles Edited by K.T. Chau
[T2]	Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011
[T3]	Electric and Hybrid Vehicles by Tom Denton

Reference Books:

[R1]	Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010
[R2]	James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003..

Online Resources:

[O1]	NPTEL Course : Electric Vehicles - Part 1 by Prof. Amit

List of Tutorials:

Any 8 of the following

1. Introduction to battery modeling MATLAB Simulink
2. Introduction to BLDC motor control MATLAB Simulink
3. Introduction to Induction Motor control MATLAB Simulink
4. Power Converter selection in MATLAB Simulink
5. Study of EV subsidies in different states.
6. Visit to the Electric Vehicle Charging Station.
7. Study of Thermal Modeling in Ansys software
8. Study of Harmonics issues of EV charging.
9. Fuel efficiency evaluation of a series HEV in city and high-way.
10. Various strategies for improving vehicle energy/fuel efficiency regenerating braking.
11. Study of various Battery Recycling Methods.

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403144C: Special-Purpose Machines						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

The course aims:-
1. To gain knowledge of operation and performance of synchronous reluctance motors.
2. To learn the operation and performance of stepping motors.
3. To understand operation and performance of switched reluctance motors.
4. To familiarize with operation and performance of permanent magnet brushless D.C. motors.
5. To illustrate operation and performance of permanent magnet synchronous motors.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Reproduce principal of operation of PMSM, Stepper motor, SRM, Switch reluctance and linear motors.
CO2: Develop torque - speed and performance characteristics of above motors.
CO3: Enlist application of above motors.
CO4: Demonstrate various control strategies.

Unit 01	**Generalized Machine Theory**	06 hrs

Energy in singly excited magnetic field systems, determination of magnetic force and torque from energy. Determination of magnetic force and torque from co-energy, Forces and torques in systems with permanent magnets. MMF of distributed winding, Magnetic fields production of EMFs in rotating machines.

Unit 02	**Permanent Magnet Synchronous and brushless D.C. Motor Drives**	06 hrs

Synchronous machines with PMs, machine configurations. Types of PM synchronous machines Sinusoidal and Trapezoidal. EMF and torque equations Torque - speed characteristics, Concept of electronic commutation, Comparative analysis of sinusoidal and trapezoidal motor operations. Applications.

Unit 03	**Control of PMSM Machine**	06 hrs

abc-$\alpha\beta$ and $\alpha\beta$-dq transformations, significance in machine modeling, Mathematical Model of PMSM (Sinusoidal), Basics of Field Oriented Control (FOC), Control Strategies: constant torque angle, unity power factor.

Unit 04	**Reluctance Motor**	06 hrs

Principle of operation and construction of Switch Reluctance motor, Selection of poles and pole arcs, Static and dynamics Torque production, Power flow, effects of saturation, Performance, Torque speed characteristics, Synchronous Reluctance, Constructional features; axial and radial air gap motors; operating principle; reluctance torque; phasor diagram; motor characteristics Introduction to control of Reluctance Drive. Applications.

Unit 05	**Stepper Motor**	06 hrs

Construction and operation of stepper motor, hybrid, Variable Reluctance and Permanent magnet, characteristics of stepper motor, Static and dynamics characteristics, theory of torque production, figures of merit; Concepts of lead angles, micro stepping, Applications selection of motor.

Unit 06	**Linear Electrical Machines**	06 hrs

Introduction to linear electric machines. Types of linear induction motors, Constructional details of linear induction motor, Operation of linear induction motor. Performance specifications and characteristics Applications.

Text Books:

[T1]	K. Venkatratnam, ‘Special Electrical Machines’, University Press
[T2]	A.E. Fitzgerald Charles Kingsley, Stephen Umans, ‘Electric Machinery’, Tata McGraw Hill Publication
[T3]	T.J.E. Miller, ‘Brushless Permanent magnet and Reluctance Motor Drives’ Clarendon Press, Oxford 1989
[T4]	V. V. Athani, ‘Stepper Motors: Fundamentals, Applications and Design’, New age International, 1997.
[T5]	P.S. Bhimbra, Generalized Theory Of Electrical Machines

Reference Books:

[R1]	R Krishnan, ‘Permanent Magnet Synchronous and Brushless D.C. Motor Drives’ CRC Press.
[R2]	Ion Boldea, ‘Linear Electric Machines, Drives and maglevs’ CRC press.
[R3]	Ion Boldea S. Nasar, ‘Linear Electrical Actuators and Generators’, Cambridge University Press.

Online Resources:

[O1]	NPTEL video lectures on all the special purpose machines can be observed.

Mapping:

Unit	Text Books	Reference Books
01	T2	R1

02	T1, T3	R1
03	T1, T5	R1
04	T1	R1
05	T1, T4	R1
06	T5	R2,R3

List of Tutorials: Minimum eight tutorials are to be performed out of the list mentioned as below:

1. Experimental analysis of PMSM motor drive
2. Experimental analysis of BLDC (Trapezoidal Motor) Drive
3. Experimental analysis of Switched Reluctance Motor Drive.
4. Experimental analysis of Synchronous Reluctance Motor Drive
5. Experimental analysis of Stepper Motor Drive.
6. Laboratory demonstration of Linear Induction Motor.
7. Simulation for the performance analysis of PMSM/BLDC drive. (Any software can be used)
8. Simulation of Switched Reluctance Drive.
9. Software programming for abc-αβ and αβ-dq transformations

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.
- Prepare tutorial assessment sheet which may be used for the term work marks.

403144D: HVDC and FACTs

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Tutorial	02	Hrs/Week/Batch	Tutorial	01	ESE	70
					Term work	25

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Course Objectives:

This course aims to:

1. To develop understanding of modern trends in power transmission.
2. To make students describe the operation of HVDC System and Control.
3. To make students describe applications of power electronics in the control of power transmission.
4. To understand fundamentals of FACTS Controllers.

Course Outcomes:

At the end of this course, students will be able to:

CO1:Choose a proper FACTS controller for the specific application based on system requirements.
CO2:Analyze shunt, series, and combined controllers to explore different benefits.
CO3:Compare EHVAC and HVDC systems and to describe various types of DC links.
CO4:Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems.

Unit 01	HVDC -I	07 hrs

EHVAC versus HVDC transmission, power flow through HVDC link, Graetz circuit, equation for HVDC power flow bridge connection, control of DC voltage and power flow, effects of angle of delay and angle of advance commutation, CIA, CC and CEA control.

Unit 02	HVDC – II	07 hrs

Twelve pulse converter operation, Harmonics in HVDC systems. HVDC system layout and placement of components, HVDC protection, grounding, multi terminal HVDC systems, configurations and types.

Unit 03	VSC based HVDC System	07 hrs

Introduction to VSC transmission, power transfer characteristics, structure of VSC link, VSC DC system control, HVDC light technology. HVDC plus, introduction, construction, operation and applications to renewable energy sources Principles of DC Link Control in a VSC based HVDC system: Power flow and dc voltage control. Reactive Power Control / AC voltage regulation using VSC. Real and Reactive power control using a VSC.

Unit 04	Fundamentals of FACTS Controllers	08 hrs

Basics, Challenges and needs of Power Electronic Controllers, Review of rectifiers and inverters, back to back converter, dc link converter, static Power converter structures, AC controller based structures, DC link converter topologies, converter output and harmonic control, power converter control. Reactive power

control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.		
Unit 05	Shunt and Series Controllers	08 hrs
Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM comparison. Series compensation – objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes. Comparison between STATCOM and SVC, V –I and V –Q Characteristics, Transient stability, Response Time. Comparison between TSCS and SSSC		
Unit 06	Unified Power Flow Controller and advanced controllers	08 hrs
Unified power flow controller (UPFC) – Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.		

Text Books:

[T1]	S Kamakshaiah and V Kamaraju, "HVDC Transmission," TMH Publications, 2011.
[T2]	K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011
[T3]	Hingorani ,L.Gyugyi, "Concepts and Technology of Flexible AC Transmission System", IEEE Press, New York, 2000, ISBN –0780334588.
[T4]	Padiyar K.R., "FACTS Controllers for Transmission and Distribution systems", New Age International Publishers, 1st Edition, 2007.

Reference Books:

[R1]	Jos Arrillaga, "High Voltage Direct Current Transmission", IET Power and Energy Series 29
[R2]	Erich Uhlmann, "Power Transmission by Direct Current," Springer International
[R3]	Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
[R4]	Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS" —Modeling and simulation in Power Networks, John Wiley & Sons, 2002.
[R5]	J. Arrillaga, "High Voltage Direct Current Transmission," Peter Peregrinus Ltd., London, UK

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2, R5
02	T1, T2	R1, R2, R5

03	T1, T2	R1, R2, R5
04	T3, T4	R3, R4
05	T3, T4	R3, R4
06	T3, T4	R3, R4

List of Tutorials:

1. Study of various HVDC transmission system components and its applications.
2. Study of AC/DC side voltage and current waveforms of a six-pulse converter system under variable RL load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow, etc.).
3. Study of AC/DC side voltage and current waveforms of a twelve-pulse converter system under variable R-L load using simulation. (Hint: input PF, THD, converter efficiency, reactive power flow, etc.).
4. Study of Reactive Power Control in an HVDC Transmission system
5. Study of various types of multi-terminal HVDC transmission systems
6. Study of DC link control in VSC-based HVDC transmission systems.
7. Study of various passive filters used in LCC-based HVDC transmission systems
8. Operation of VSC for power factor correction at AC side of HVDC system using sinusoidal pulse width modulation.

Guidelines for Assessment of Tutorial:

- Maintain Record in file or separate notebook.
- Timely submission of tutorials.
- Assessment of the report must be based on understanding, presentation and contents.

403145: Project Stage I

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	4	Hrs./Week	SEM/PW/IN	2	ORAL	50
					Term work	50

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Preamble:

Project is an important part of the engineering curriculum covered in the final year. It is divided into Project Stage I and Project Stage II at Semesters I and II of the Final Year. This project is a substantial piece of work that will require creative activity and original thinking. The project aims to provide students with a transitional experience from the academic world to the professional world. The objectives, outcomes, and guidelines for Project Stage I are given below.

Course Objectives:

The objectives of this course are to:

1. Provide an opportunity to learn new software, interdisciplinary theory, concepts, technology, etc. not covered in earlier subjects.
2. Empower students to use engineering knowledge and skills learned in previous courses to deliver a product that has passed through the design, analysis, testing, and evaluation.
3. Encourage multidisciplinary project work through the integration of knowledge.
4. Allow students to develop problem-solving, analysis, synthesis, and evaluation skills.
5. Encourage teamwork.
6. Improve students' communication skills by asking them to produce both a professional report and to give an oral presentation.

Course Outcomes:

Course outcomes can be different for the different projects undertaken by the student groups. However, in general, the course outcomes for Project Stage-I can be stated as follows.
At the end of this course, students should be able to:
CO1:Define the project problem statement and identify the scope of the project.
CO2:Search the appropriate research papers, standards and e-resources and write a literature survey.
CO3:Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project.
CO4:Justify the selection of electrical, electronic and mechanical components for the project prototyping
CO5:Simulate or develop a system for software or hardware verification.
CO6:Write a project report with proper interpretation of results.

Guidelines for students:

1. Form a group of 3-4 students.
2. Select a project problem statement based on an industrial or societal issue and ideate on it.
3. Research on the project topic through existing theories, literature, technology, patents, etc.
4. Define objectives, scope, and outcomes of the project in the 1st presentation.
5. Maintain a notebook to keep records of all the meetings, discussions, notes, etc. This is to be done by the individual student.
6. Some of the parameters mentioned in the above table will be evaluated and assessed at the group

level and some at an individual level.

Guidelines:

Term work evaluation guidelines are given below.

Sr. No.	Activity	Deadline (Semester I)	Parameters for Evaluation
1.	Topic Approval Presentations	Up to 3rd Week	• Problem definition clearly stated (YES/NO) • Objectives clearly defined (YES/NO) • The overall project idea is feasible (YES/NO)
2.	Progress Review-1 Presentation	Up to 8th Week	• Problem Definition (5) • Scope & Objectives (10) • Literature Review (10) • Methodology (10) • Block Diagram / Architecture (10) • Project Planning (5) • **Total Marks (50)**
3.	Progress Review-2 Presentation	Up to 12th Week	• Requirement Specification (10) • Literature Review (revised) (5) • Detailed Design (10) • Experimental Setup/Simulation (10) • Performance Parameters (10) • Partial Conclusion (5) • **Total Marks (50)**
4.	Submission of Project Stage –I Report	Up to 14th Week	• Timely submission (5) • Formatting and Report Writing Style (5) • Abstract, Literature Survey, Conclusion (5) • Refereed References (5) • Grammatical correctness in the report (5) • **Total Marks (25)** **(Review 1+ Review 2) conversion to 25 marks +Report (25 marks) = 50 Marks**

403146: MOOCs

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	–	Hrs./Week	SEM/PW/IN	2	ORAL	–
					Termwork	50

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Preamble:

Massive Open Online Courses (MOOCs) is essentially an asynchronous teaching learning platform. To enhance the students learning and to motivate self learning, MOOCs have been added in the BE Electrical 2019 course. It is advised to students that they have to registers MOOCs courses thorough SWAYAM-NPTEL platform.

Course Objectives:

The objectives of this course are to:

1. Provide an opportunity to learn new software, interdisciplinary theory, concepts, technology, etc. not covered in earlier subjects.
2. Make students employable in the industry or pursue a suitable higher education program.
3. Exposure to relevant tools and technologies.
4. Enrich the learning experience by using audio video and multimedia and state of the are pedagogy.

Course Outcomes:

At the end of this course, students should be able to:
CO1:Enables the students to directly engage and learn from the best faculty in the country in order to strengthen the fundamentals.
CO2:Explore new areas of interest in a relevant field.
CO3:Enable self learning initiative in learners..
CO4:Develop critical thinking to solve complex problems in engineering, science and humanities.
CO5:Improve communication skills by interacting with peers and course teachers.

Guidelines:

Guidelines for students:

1. Students have to register on the SWAYAM portal.
2. Through the SWAYAM portal, explore the courses available by NPTEL coordinator.
3. The minimum duration of the NPTEL course to be registered by the students has to be 8/12 weeks. (as per the course offered in the semester.)
4. Students can register the courses of engineering, science, humanities, management, and multidisciplinary in the NPTEL portal.
5. Students have to submit the assignments as per schedule given by NPTEL course structure and take part in a self assessment test.
6. Students have to register for the certificate examination of NPTEL by paying the required fees.
7. Students will be awarded credits of MOOCs only when they earn the certificate of the registered course.

7. Students have to submit proof (certificate) to the department in order to get credits.

Guidelines for institute:

1. It is advised that the institute should register for the NPTEL local chapter.
2. Keep the track of student registration in SWAYAM-NPTEL course.
3. Check the certificate authenticity submitted by student through online portal

Guidelines for Assessment:

1. The NPTEL will give percentage grades in certificates out of 100.
2. The percentage obtained needs to be converted to 50 marks and submitted as term work marks to university. (if someone got 75% marks then TW calculation will be 75/2=37.5=38 (out of 50) and round up the nearest integer.)
3. External examiner appointed by the university will assess certificates and marks obtained physically at the institute.

403147A: German Language-I

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Get introduced to the Culture, Routine of the German Society through language.
2. Meet the needs of ever growing German industry with respect to language support.

Course Outcomes:

At the end of this course, students:
CO1: Will have the ability of basic communication.
CO2: Will have the knowledge of German script.
CO3: Will get introduced to reading ,writing and listening skills
CO4: Will develop interest to pursue profession in Indo-German Industry.

Unit 01	Introduction to the German Language-I	06 hrs

Introduction of German Alphabets, Spell the names, Addresses, Numbers, Telephone numbers, Ordinal Numbers, Pin code Numbers, Dates, Birthdates, Age, days of the week, Months.

Unit 02	Introduction to the German Language-II	06 hrs

Basic Greetings, Personal Pronouns, Possessive Pronouns.

Unit 03	Introduction to the German Language-III	06 hrs

Self-Introduction, Introducing other people, about family, friends, course mates, seasons, and seasons in Germany and in neighboring countries.

Text Books:

[T1]	Netzwerk A-1 (Deutsch als Fremdsprache) Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

[R1]	Tipps und Uebungen A1

Online Resources:

[O1]	Practice Material like Listening Module, reading Texts

403147B: Engineering Economics-I

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Describe basics of economics and its application in engineering.
2. Explain the concept of Time value of Money and Cash flow

Course Outcomes:

At the end of this course, students will be able to:
CO1:Discuss concepts related to business and its impact on enterprise.
CO2:Illustrate time value of money in economic analysis.

Unit 01	Engineering Economics	10 hrs

Nature and scope, General concepts on micro & macro economics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply and elasticity of supply. Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product, Design selection for a product, Process planning.

Unit 02	Time Value of Money and Cash flow analysis	10 hrs

Time value of money: Simple and compound interest, Nominal Interest rate, Effective Interest rate, Principle of economic equivalence.
Cash Flow – Diagrams, Categories & Computation
Depreciation: Meaning Causes, Factors affecting depreciation, Methods of providing depreciation, Straight Line Method & Diminishing Balance Method

Text Books:

[T1]	Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
[T2]	D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books:

[R1]	Sasmita Mishra, “Engineering Economics & Costing “, PHI
[R2]	Sullivan and Wicks, “ Engineering Economy”, Pearson
[R3]	R. Paneer Seelvan, “ Engineering Economics”, PHI

403147C: Sustainability							
Teaching Scheme			**Credits**		**Examination Scheme**		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

- Increase awareness among students about sustainability.
- Understand role of engineering and technology within sustainable development.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Understand different types of environmental pollution problem.
CO2: Suggest solutions for sustainable development.
CO3: Develop a broader perspective in thinking for sustainable practices by utilizing engineering principle and knowledge

Unit 01	Sustainability Introduction		11 hrs

Introduction, need and concept of sustainability, social, environmental and economical sustainability concepts, sustainable development, 17 goals defined by UN, Nexus between technology and sustainable development and its challenges, multilateral environmental agreements and protocols-CDM, Environmental legislations in India-Water Act, Air Act.
Air, water and solid waste pollution sources and impacts, Sustainable water treatment. Zero waste concept. Global environmental issues, climate change, global warming, ozon layer depletion.

Unit 02	Sustainable Solution		11 hrs

Carbon credits and trading, carbon foot print, Green engineering, sustainable urbanization, industrialization and poverty reduction, Industrial process: Material selection, pollution preventions, industrial ecology and symbiosis, Global institutions: UNEP, IPCC, UNDP, WHO, Kyoto protocols. Certification and labelling in energy and carbon: Energy Star, Compliance and voluntary carbon credits, Green-e. Tools and techniques: ISO 14001, ISO26000, ABCD planning method.Assessment measurement: Indicators, F2B2, LCA, LCC, ROI.

Text Books:

[T1]	Allen D. T. and Shonnard D. R. “Sustainable Engineering: Concept design and case studies”, Prentice hall
[T2]	Environmental Impact Assessment Guidelines, Notification of Government of India 2006
[T3]	Mackenthun K. M. “Basic Concept of Environmental Management”, Lewis publication London 1998
[T4]	ECBC code 2007, BEE, New Delhi, BEE publication, TERI publication

[T5]	Ni Bin Chang, “Systems Analysis for sustainable engineering: Theory and Applications ”, Mc-Graw-Hill Professional
Reference Books:	
[R1]	“Sustainable Excellence Associate: Study Guide” International society of sustainability professional, https://community.sustainabilityprofessionals.org/store/viewproduct.aspx?id=13043928
Online Resources:	
[O1]	https://www.globalgoals.org/goals/

403148: Switchgear and Protection

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Oral	50
					Termwork	25

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Course Objectives:

This course aims to:

- Acquaint about construction and working principles of different types of HVCBs.
- Elaborate the need for protective relaying and the operating principles of different types of relays.
- Explain the different types of faults in the transformer, alternator, and 3-phase induction motor and the various protective schemes related to them.
- Impart knowledge about transmission line protection schemes and the characteristics of different types of distance relays.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Understand the fundamentals of protective relaying.
CO2:Demonstrate the arc interruption and analyze the RRRV in circuit breakers
CO3:Demonstrate the construction and working principle of air brake circuit breakers, SF6 circuit breakers, and a vacuum circuit breaker.
CO4:Explain the characteristics of static and digital relays and their applications in power systems.
CO5:Apply the differential protection scheme to large transformers, alternators, and induction motors.
CO6:Apply distance protection, three stepped protection for transmission line.

Unit 01	Fundamentals of protective relaying	08hrs

Need for protective system, nature and causes of fault, types of faults, effects of faults, evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Trip circuit of circuit breaker, zone of protection. Various basic operating principles of protection- over current, (current graded and time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, current and time setting in induction relay, Numericals on TSM , PSM and operating time of relay.

Unit 02	Fundamentals of arc interruption	07 hrs

Ionization of gasses, deionization, Electric arc formation , Current interruption in AC circuit breaker, high and low resistance principles, arc interruption theories, arc voltage, recovery voltage, derivation and definition of restriking voltage and RRRV, current chopping, interruption of capacitive current, resistance switching, Numerical on RRRV, current chopping and resistance switching.

Unit 03	Circuit Breaker	08 hrs

Different ratings of circuit breaker (like rated voltage, rated current, rated frequency, rated breaking capacity – symmetrical and unsymmetrical breaking, making capacity, rated interrupting duties, rated operating sequence, short time rating). Classification of high voltage circuit breakers. Working and constructional features of ACB, SF6 , VCB- advantages, disadvantages and applications. Auto reclosing, Testing of circuit breakers. Introduction to GIS , its advantages over conventional substation		
Unit 04	Static and Digital Relaying	06 hrs
Overview of Static relay, block diagram, operating principle, merits and demerits of static relay. Numerical Relays :-Introduction and block diagram of numerical relay, Sampling theorem, Anti –Aliasing Filter, Block diagram of PMU and its application.		
Unit 05	Equipment protection	08 hrs
I. Power Transformer Protection: Types of faults in transformer, Percentage differential protection in transformers, Restricted E/F protection, incipient faults, Buchholz relay, protection against over fluxing, protection against inrush current. II. 3 Phase Induction Motor Protection: Abnormal conditions and causes of failures in 3 phase Induction motor, single phasing protection, Overload protection, Short circuit protection. III. Synchronous Generator (Alternator) Protection: Various faults in Alternator, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.		
Unit 06	Transmission line protection	08 hrs
Over current protection for feeder using directional and non directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, three stepped distance protection, Effect of arc resistance, and power swing on performance of distance relay. Realization of distance relays(impedance, reactance, and mho relay) using numerical relaying algorithm(flowchart, block diagram), Introduction to PLCC, block diagram, advantages, disadvantages, Introduction to Wide Area Measurement (WAM) system.		
Text Books:		
[T1]	Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill Publishing Co. Ltd.	
[T2]	Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India	
[T3]	Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.	
[T4]	J.B.Gupta " Switchgear and Protection", S.K. Kataria and Sons.	
[T5]	Power system protection and switchgear by Oza, Nair, Mehta, Makwana	
Reference Books:		
[R1]	S. Rao, "Switchgear Protection and Power Systems", Khanna Publications	

[R2]	J Lewis Blackburn , “Protective Relaying- Principles and Applications”, Dekker Publications.
[R3]	A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(John Willy and Sons Inc New York)
[R4]	Mason C.R., “Art and Science of Protective Relaying”, Wiley Eastern Limited.
[R5]	Arun Ingole, “Switchgear and Protection”, Pearson.
[R6]	Bhuvanesh Oza, “Power System Protection and Switchgear”, McGraw Hill Education.

Online Resources:

[O1]	Prof. Dr S.A. Soman, IIT Mumbai, A Web course on “Digital Protection of power System” http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html
[O2]	NPTEL Course on power system protection.

Mapping:

Unit	Text Books	Reference Books
01	T1,T2,T4	R1, R2, R6
02	T1,T3,T4	R1, R6
03	T1,T4	R1, R6
04	T2,T3,T4	R3, R4, R6
05	T1 , T5	R1 ,R5, R6
06	T1,T4	R1,R2, R5, R6

List of Experiments:

A) Compulsory Experiments

1. Study of switchgear testing kit.
2. Protection of Transmission line using Impedance relay

B) Minimum 6 Experiments to be performed from the following list:

1. Study and testing of fuse , MCB.
2. Study and testing of contactors.
3. Study and testing of ACB.
4. Study and testing of MCCB.
5. Study and testing of thermal overload relay for Induction Motor protection.
6. Study and plot Characteristics of IDMT type Induction over current relay
7. Study and plot Characteristics of digital over current relay
8. Percentage differential protection of transformer (Merz Price Protection).
9. Protection of alternators.

Guidelines for Instructor's Manual:

Lab manual must contain;

- Title of the experiment
- Aim
- Apparatus.
- Theory: Brief theory explaining the experiment
- Circuit / connection diagram or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
- Detailed constructional diagram with nomenclature:
- Procedure: Write down step by step procedure to perform the experiment.
- Specifications of Switchgear:
- Observation table:
- Graph:
- Conclusion:

Guidelines for Student's Lab Manual:

- Students should write the journal in his own handwriting using A4 size both side ruled paper.
- Circuit / Connection diagram or construction diagram must be drawn either manually or using software. [Do not use Photocopy of standard journal] on A4 size blank/graph paper.
- Hand writing must be neat and clean.
- Journal must contain a certificate indicating the name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
- Index must contain Sr. number, title of the experiment, page number, and the signature of staff along with date.
- Use black or blue ink pen for writing.

Guidelines for Laboratory Conduction:

- Check whether the MCB / main switch is off.
- Make connections as per circuit diagram. Do not keep loose connections. Get it checked by the teacher / Lab Assistant.
- Perform the experiment only in the presence of a teacher or Lab Assistant.
- After completion of the experiment, switch off the MCB / main switch.
- Write the experiment in the journal and get it checked within a week.

Industrial Visit:

Industrial visit to switchgear training center /or switchgear/relay manufacturing unit/ or 220 kV substation visit and report to be submitted.

Assignments:

Minimum 2 assignments (at least 4 to 6 questions in each) to be submitted as a part of term-work.

403149: Advanced Electrical Drives and Control

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
Practical	02	Hrs/Week/Batch	Practical	01	ESE	70
					Practical	50
					Termwork	25

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Course Objectives:

This course aims to:

- Understand motor load dynamics. ·
- Study and analyze the operation of the converter fed and chopper fed dc drives. ·
- Study and understand braking methods of D.C. and Induction motor drive.
- Study vector control of induction motors. ·
- Study synchronous and BLDC motor drive. ·
- Study classes and duty of motor. ·
- Understands the modes of operation of drive in various applications.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Explain motor load dynamics and multi quadrant operation of drives.
CO2: Analyze operation of converter fed and chopper fed DC drives.
CO3: Apply different braking methods of D.C. and induction motor drive.
CO4: Elaborate vector control for induction motor and BLDC drives.
CO5: Elaborate synchronous motor, reluctance motor drive.
CO6: Differentiate between classes and duty cycles of motors and select suitable drives in various industrial applications.

Unit 01	Electrical Drives	07 hrs

A. Definition, components of electric drive system, types of electrical drives (DC and AC), selection of drive parameters, List of Industrial Applications
B. Motor-Load dynamics, speed-torque conventions and multi-quadrant operation, equivalent values of drive parameters, load torque components, nature and classification of load, constant power operation of a drive, steady-state stability.

Unit 02	DC Motor Drives:	08 hrs

A. Single-phase and three-phase fully controlled converter drives and performance of converter fed separately excited DC Motor for speed control operations, 12 pulse converter drives.
B. Chopper controlled drives for separately excited and series DC Motor operations. Closed-loop speed control of DC motor below and above base speed for starting, speed control and braking

Unit 03	Induction Motor Drives:	08 hrs

Regenerative braking, dynamic braking, Plugging, Numerical based on braking and speed control, voltage source inverter (VSI) control, Steady State Analysis. Current source inverter (CSI) control-open and closed loop, Regenerative braking and multi quadrant operation of Induction motor drives, Principle of vector control, Block diagram of Vector control of induction motor, Failure modes of Drives.		
Unit 04	BLDC drive:	07 hrs
Construction (Block diagram) and working for motoring and regenerative braking, Speed and torque Characteristics, closed loop control of BLDC drive (PI controller) , vector control of BLDC drive, Applications in EV (descriptive treatment)		
Unit 05	Synchronous Motor drives:	08 hrs
A. PMSM Drive: Construction (Block diagram) and working for motoring and regenerative braking, Speed and torque Characteristics, closed loop control of PMSM drive (PI controller) , vector control of PMSM drive. B. Synchronous Reluctance Motor -Introduction, working of SRM , application in EV (descriptive treatment)		
Unit 06	Drive Application	07 hrs
A. Classes of motor duty, types of enclosures for motor. B. Specific requirement and choice of drives for following applications: Machine tools , Textile mills, Steel rolling mills, Sugar mills, Traction drives, Crane and hoist drives, Solar and battery powered drives		
Text Books:		
[T1]	G. K. Dubey, “Fundamentals of Electric Drives”, 2nd Edition, Narosa Publishing House	
[T2]	N. K. De, P. K. Sen, “Electric Drives”, Prentice Hall of India Eastern Economy Edition	
[T3]	S. K. Pillai, “Analysis of Thyristor Power Conditioned Motors”, University Press	
[T4]	G.K. Dubey, “Power Semiconductor controlled drives”, PHI publication	
[T5]	B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education	
Reference Books:		
[R1]	R. Krishnan, “Electric Motor Drives – Modeling Analysis and Control”, PHI India	
[R2]	B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education	
[R3]	V. Subrahmanyam, “Electric Drives: Concepts and Application”, Tata Mc-Graw Hill (An imprint of Elsevier)	
[R4]	M.D. Singh and Khanchandani “Power Electronics”, Tata Mc-Graw Hill	
[R5]	Austin Huges, “Electrical motor and drives: Fundamental, types and applications”, Heinemann Newnes, London	

[R6]	Tyagi MATLAB for engineers oxford (Indian Edition)
[R7]	Malcolm Barnes, “Practical Variable Speed Drives and Power Electronics”, Elsevier Newnes Publications

Online Resources:

[O1]	NPTEL online course on Fundamentals of Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
[O2]	NPTEL online course on advanced Electric Drives, I.I.T. Kanpur by Dr. S.P. Das.
[O3]	Allen Bradley Powerflex 700 AC Drives User manual.

Mapping:

Unit	Text Books	Reference Books
01	T1	R3
02	T1,T5	R2,R4
03	T1,T4	R1,R5
04	T1,T2,T5	R1,R2
05	T1,T3,T5	R1,R6
06	T1,T2	R3,R5,R7

List of Experiments:

Total 9 experiments to be conducted from the following list of practical.

A) Following 5 experiments are compulsory (Hardware based)

1. Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).
2. Speed control characteristics of single phase fully converter fed separately excited D.C. motor
3. VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics.
4. Chopper fed D.C. series/separately motor speed control characteristics.
5. Electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging, Regenerative Braking).

B) Any 4 experiments from following (Hardware/software)

6. Speed control characteristics of 3-ph fully converter fed separately excited D.C. motor.
7. Simulation of Induction Motor Vector Control.
8. Study of constant torque and constant power characteristic of induction motor.
9. Study of speed control of BLDC / PMSM drive.
10. Simulation of closed loop control of BLDC / PMSM drive.
11. Simulation of vector control of PMSM/BLDC motor

Guidelines for Instructor’s Manual:

- Title and circuit diagram of power electronic controlled drives/ electrical machine circuit. ·
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit used to control the electric motor.
- Procedure to carry out the experiment

Guidelines for Student's Lab Manual:

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit and expected machine performance with speed torque characteristics.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on the left side of the journal and aim, theory related to experiment and procedure must be written on the right side.
- Analyze and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory Conduction:

- Each group in the lab should have not more than three students. ·
- All the students in the group must do the connections and perform the practical under the guidance of the staff member. ·
- Staff member has to check the results of all the groups.

403150A: Digital Control System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Make students elaborate basic concepts of discrete signals and systems.
- Educate students to analyze the stability of discrete systems.
- Explain formulation of state space discrete model and design the digital controllers.
- Elaborate digitize analog controllers using various numerical methods.
- Explore application of the theory of digital control to practical problems.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Analyze digital control system and its stability.
CO2: Differentiate between various control systems
CO3: Present system in state space format.
CO4: Design observer for system.
CO5: Understand digital controllers
CO6: Elaborate applications such as digital temperature control and position control

Unit 01	Discrete systems and Signals	07 hrs

Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing and quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

Unit 02	State - Space analysis	07 hrs

Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete – time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation

Unit 03	Design using state space	07 hrs

Controllability and observability of linear time invariant discrete-data system, Tests for Controllability and observability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback.

Unit 04	Design of State Observers	07 hrs

Full order state observer, reduced order state observer, State estimation and full order observer design. Ackermann's formula. Compensator design by the separation principle, State feedback with integral control, State regulator design.		
Unit 05	State space model and digitizing analog controllers	07 hrs
State space model of digital systems: Transformation of state-space model to various forms (controllable, observable, diagonal and Jordan canonical forms). Numerical approximation of differential equations, Euler's forward and backward method, Trapezoidal method, Bilinear transformation with frequency warping. Numerical differentiation, Matching step and other response. Pole-zero matching		
Unit 06	Digital control system applications	07 hrs
Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.		

Text Books:

[T1]	K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009
[T2]	B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press
[T3]	M. Gopal, "Digital Control Engineering", New Age International Publishers
[T4]	M. Gopal, "Digital Control and State Variable Methods", 3rd Edition The McGraw Hill Co.

Reference Books:

[R1]	Load D. Landau, Gianluca Zito, 'Digital Control Systems: design, Identification and Implementation' Springer.
[R2]	Mohammed Santina, Allen Stubberud, Gene Hostetter 'Digital control System Design', Sanders College publishing
[R3]	K.J. Astrom, B Wittenmark 'Computer Controlled Systems: Theory and Design' Prentice-Hall Inc New Jersey, 2011 Dover.

Mapping:

Unit	Text Books	Reference Books
01	T2, T2	R3
02	T2	R3
03	T1, T2	R3
04	T1,T2	R1, R2
05	T1,T3	R1, R2
06	T2,T4	R3

403150B: Restructuring and Deregulation

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Give brief introductions about the various institutions and their roles in the Indian Power sector and introduce the restructured power system .
- Introduce Fundamentals of Power Sector economics.
- Educate about the process and operation of restructuring of power systems and tariff setting principles.
- Explain Power Sector Restructuring Models and to introduction concept of energy trading
- Introduce the concept of electricity markets and various operations involved in the market .
- Explain the fundamental concept of congestion, its management and transmission pricing and concept of transmission pricing.

Course Outcomes:

At the end of this course, students will be able to:

CO1: Identify the various institutions in the Indian power sector and explain their role in the Indian power sector .

CO2: Explain the various fundamentals of power sector economics

CO3: Describe the regulatory process in India and list the steps involved in tariff determination and explain the phases of tariff determination

CO4: Describe and explain different power sector restructuring models and explain the concept of energy trading

CO5: Explain the types of electricity markets and compare the types of electricity markets .

CO6: State different transmission pricing methods and describe and compare various congestion management methods.

Unit 01	Power Sector in India	07hrs

Introduction to various institutions in the Indian Power sector such as the Ministry of Power ,MNRE, CEA, Planning Commissions, PGCIL, PFC, CERC, SERC, Load dispatch centers (National, regional and state) and their roles. Critical issues / challenges before the Indian power sector, Need of regulation and deregulation of the power industry. Conditions favoring deregulation in the power sector. An overview of the restructured power system, Difference between integrated power system and restructured power system

Unit 02	Fundamentals of Power Sector Economics	07hrs

Introduction, Consumer behaviour, Supplier behaviour, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Typical cost components and cost structure of the power sector, Concept of life cycle cost, annual rate of return .Elasticity of demand and

supply curve, Market equilibrium, Consumer and supplier surplus. Perfectly competitive market. Key Indices for assessment of utility performances.(Generation, transmission and distribution).Financial tools to compare investment options.		
Unit 03	Power Sector Regulation	07hrs
Regulatory process in India, types and methods of Regulation - rate of return regulation, benchmarking or yardstick regulation, performance-based regulation. Role of regulatory commission. Considerations of socio economic aspects in regulation. Principles of Tariff setting, Phases of Tariff determination. Consumer tariff structures and considerations, different consumer categories. Comparison of different tariff structures for different load patterns. The Electricity Act 2003, The Electricity Act 2010, National Electricity policy. Recently Amended Electrical policy.		
Unit 04	Introduction to Power Sector Restructuring Models and Introduction to energy trading	07hrs
Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Introduction to energy exchange , Day ahead market (DAM) and Term ahead market (TAM), procedure adopted in energy exchanges and trading of Renewable energy credits and carbon credits.		
Unit 05	Electricity markets	07hrs
Rules that govern electricity markets, peculiarity of electricity as a commodity. Various electricity markets such as spot markets, forward contracts and forward markets , future contracts and future markets .Market operation – settlement process , market clearing price (MCP) , Market efficiency . Market power Electricity markets under imperfect competition Sources of market power, Effect of market power, Identifying market power, HHI Index, Entropy coefficient, Lerner index, Market power mitigation, Effects of contract for differences.		
Unit 06	Transmission Pricing and Congestion Management	07hrs
Cost components of transmission system, cost allocation of transmission system, Transmission pricing methods, physical transmission rights, Open access. Congestion in power networks, reasons for congestion, congestion management methods . Non-market methods, Market based methods. Definition of terms - Total transfer capability (TTC), Available transfer capability (ATC), Transmission Reliability Margin (TRM), Capacity Benefit Margin (CBM), Existing Transmission Commitments (ETC). Locational marginal Pricing (LMR), Firm Transmission Right (FTR)		
Text Books:		
[T1]	Know Your Power: A citizen Primer on the electricity Sector, Prayas Energy Group, Pune	
[T2]	Daniel S. Kirschen, Goran Strbac, “Power System Economics” John Wiely and Sons Publication Ltd. August 2006	
[T3]	Mohammad Shahidehpour, Muwaffaq Alomoush, “Restructured Electrical Power Systems: Operation Trading and Volatility” CRC Press, 06-J	
Reference Books:		
[R1]	Steven Stoft, “Power System Economics: Designing Markets for Electricity”, John Wiley and Sons, 2002	

[R2]	Sally Hunt, “Making Competition Work in Electricity”, 2002, John Wiley Inc
[R3]	Geoffrey Rothwell, Tomas Gomez, “Electricity Economics Regulation and Deregulation” A John Wiley and Sons Publication 2003
[R4]	Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, “Market operations in Electric Power System” A John Wiley and Sons Publication
[R5]	Deregulation in Power Industry – A course under continuing Education Program, Department of Electrical Engineering , IIT Bombay
Online Resources:	
[O1]	http://www.cercind.gov.in/Function.html
[O2]	www.cercind.gov.in/serc.html
[O3]	http://www.power.gov.ng/index.php/about-us/our-functions
[O4]	http://planningcommission.nic.in/reports/genrep/arep9920/ar9920role.htm
[O5]	http://www.cea.nic.in/functions.html
[O6]	https://nptel.ac.in/courses/108101005
[O7]	https://posoco.in/
[08]	https://www.iexindia.com/

Mapping:

Unit	Text Books	Reference Books
01	T1	[O1]-[O6]
02	T1	R3
03	T1	R1
04	T2	R5,[O8]
05	T2	R5,R2,R4
06	T3	R1

403150C: Smart Grid

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Explain the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
- Describe the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors, Home and Building Automation, Phase Shifting Transformers.
- Elaborate the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System, Phase Measurement Unit.
- Elaborate the concept of microgrid.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Apply the knowledge to differentiate between Conventional and Smart Grid
CO2: Describe importance of Supercapacitors.
CO3: Identify the need of Smart metering.
CO4: Apply the communication technology in smart grid.
CO5: Comprehend the issues of micro grid.

Unit 01	Introduction to Smart Grid	07 hrs

Concept of Smart Grid, Need of Smart Grid, Functions of Smart Grid, Opportunities and Barriers of Smart Grid, Drivers of SG in India, Functionalities and key components of smart grid, Difference between conventional and smart grid, Smart Grid Vision and Roadmap for India, Concept of Resilient and Self-Healing Grid, Smart Grid National Policies, Smart Cities, Pilot projects in India

Unit 02	Smart Grid Technologies	07 hrs

Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid (V2G), Energy Storage Technologies and applications – Battery (flow and advanced), SMES, Super Capacitors, Compressed Air Energy Storage (CAES) and its comparison.

Unit 03	Smart Meters and Advanced Metering Infrastructure	07 hrs

Introduction to Smart Meters, Prepaid meters, Net Metering, Advanced Metering Infrastructure (AMI), Real Time Pricing, Automatic Meter Reading (AMR), Outage Management System (OMS), Smart Substation , IEC 61850, Smart Sensors, Geographic Information System (GIS), IS 16444, LowPAN RF meter

Unit 04	Communication Technology for Smart Grid	07 hrs
Communication Architecture of SG, Wide Area Measurement Protection and Control (WAMPAC), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN)., ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing and Cyber Security for Smart Grid, LORaWAN, NB-IoT, SigFox.		
Unit 05	Microgrids	07 hrs
Concept of Microgrid, need and applications of Microgrid, Microgrid Architecture, DC Microgrid, Hybrid Microgrid, Formation of Microgrid, Issues of interconnection, protection and control of Microgrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Renewable Energy based Microgrid system		
Unit 06	Power Quality issues and Challenges	07 hrs
Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources , Smart Grid data analytics, Distributed Generation, Reliability Indices (CAIDI, CAIFI, MAIDI, MAIFI), Load Forecasting Methods, Smart Appliances, Home and Building Automation.		
Text Books:		
[T1]	Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”,CRC Press	
[T2]	Stuart Borlase, “Smart Grids-Infrastructure, Technology and Solutions”, CRC Press, Taylor and Francis group	
[T3]	Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley Publications.	
[T4]	Nikos Ziargyriour, “Micro grid, Architecture and Control”, IEEE Press, Wiley Publications.	
Reference Books:		
[R1]	Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press, Taylor and Francis group	
Online Resources:		

403150D: Sensor Technology (Open Elective)

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

Course Outcomes:

At the end of this course, students will be able to:
CO1: Understand the characteristics of sensors used for system monitoring and protection.
CO2: Interface the various position sensors to microcontrollers.
CO3: Demonstrate the characteristics of sensors used for light and image sensing.

Unit 01	Sensor fundamentals and characteristics	06 hrs

Sensor Classification, Performance and Types, Error Analysis characteristics

Unit 02	Optical Sources and Detectors	06 hrs

Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

Unit 03	Light & image sensing	06 hrs

Sensors and sensing AFEs for capturing a broad range of wavelengths introduction, 3D Depth Sensor, Near Infrared spectroscopy, OPT3007 Light Sensor, Optical Isolators.

Unit 04	System monitoring & protection sensing	06 hrs

Principle of operation and application of following sensors for Real-time system protection, feedback control and high-accuracy system monitoring: LM35 Temperature Sensor, INA240 current sense amplifier, DRV5053 Hall Effect based current sensor, HDC1080 / HDC1010 / HDC2010 Humidity Sensor.

Unit 05	Position Sensing	06 hrs

Absolute and relative position sensing solutions including: angular, presence, proximity, distance, flow, level, and velocity basics, DRV 5032 Hall Effect Sensor, mmWave Sensor, AFE5805 Ultrasonic sensor, Encoder, Resolver, Inductive position sensor, Capacitive Position Sensor, LVDT.

Unit 06	Special Sensors -	06 hrs

GPS, Bluetooth, smart sensor - film sensor, MEMS and nano sensors, laser sensors, touch screen sensors, heading sensors - compass gyroscope inclinometer, application of sensors in drone.

Text Books:

[T1]	Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd edition, Springer, New York. 2. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.
[T2]	Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.

Reference Books:

[R1]	Gerd Keiser,”Optical Fiber Communications”, 2012, 4th edition, McGraw-Hill Science, Delhi.
[R2]	John G Webster, “Measurement, Instrumentation and sensor Handbook”, 2014, 2nd edition, CRC Press, Florida.
[R3]	Eric Udd and W.B. Spillman, “Fiber optic sensors: An introduction for engineers and scientists”, 2013, 2nd edition, Wiley, New Jersey.
[R4]	Bahaa E. A. Saleh and Malvin Carl Teich, “Fundamentals of photonics”, 2012, 1st edition, John Wiley, New York.

Online Resources:

[O1]	https://www.ti.com
[O2]	https://www.mouser.in/

Mapping:

Unit	Text Books	Reference Books
01	[01]	[R1]
02	[02]	[R2],[R4]
03	[01],[02]	[R3]
04	[01],[02]	[01] Online
05	[01],[02]	[02] online
06	[01],[02]	[R2],[R4]

403151A: EHV AC Transmission

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- Explain the need of EHV and UHV systems.
- Describe the impact of such voltage levels on the environment.
- Identify problems encountered with EHV and UHV transmissions.
- Describe methods of governance on the line conductor design, line height and phase etc.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Highlight need for EHV ac transmission.
CO2:Calculate line and ground parameters.
CO3:Enlist problems encountered in EHV transmission.
CO4:Describe the effect of electric and magnetic fields on human beings.

Unit 01	EHVAC Transmission	07 hrs

Need for EHV transmission lines, Power handling capacity and line loss, Mechanical considerations in line performance, Vibrations. Traveling wave equations, transmission reflection attenuation and distortion of traveling waves, transmission and reflection coefficients and examples.

Unit 02	Calculation of line and ground parameters	07 hrs

Resistance of conductors, effect of temperature on overhead conductors, temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of current carrying single conductor, Inductance of EHV line configurations, Line capacitance calculations

Unit 03	Voltage Gradient of Conductor	07 hrs

Electrostatic Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, charge potential relations for multi-conductor lines, Maximum charge condition on three phase line.
Surface voltage gradient on conductors-single conductor, two conductors and multi-conductor bundle, Maximum surface voltage gradient, Mangoldt formula, design of cylindrical cage for corona gradients.

Unit 04	Electrostatic and magnetic fields of EHV lines	07hrs

Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level.
Electrostatic induction on an un-energized circuit of a double circuit line. Insulated ground wire and induced voltage in insulated ground wires. Magnetic field calculation of horizontal configuration of single circuit of

three phase lines, Effects of power frequency magnetic fields on human health.		
Unit 05	Corona and its effects	07 hrs
Corona formation, corona inception voltage, visual corona voltage, critical field for corona inception and for visual corona under standard operating condition and conditions other than standard operating conditions. Power loss due to corona, corona loss formulae, corona current waveform, charge-voltage diagram and corona loss. Audible noise operation and characteristics limits for audible noise, AN measurement and meters, microphone, weighting networks.		
Unit 06		07 hrs
A. Design of EHV line: Design of EHV lines based upon steady state limits and transient over voltages, design factors under state. Design examples: steady state limits. Line insulation design based on transient over voltages. B. Extra high voltage cable transmission: Classification of cables, Electrical characteristics of EHV Cables, Properties of cable insulation materials.		
Text Books:		
[T1]	Rakosh das Begamudre "Extra high voltage transmission", New Age International publishers.	
Reference Books:		
[R1]	S. Rao , "EHV AC and DC Transmission" Khanna publication.	

Mapping:

Unit	Text Books	Reference Books
01	T1	R1
02	T1	–
03	T1	–
04	T1	R1
05	T1	R1
06	T1	R1

403151B: Illumination Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- To explain conventional and modern lamps and their accessories.
- To get detailed insight of indoor and outdoor illumination system components, control and design aspects.
- To know the requirements of energy efficient lighting.
- To introduce the modern trends in the lighting

Course Outcomes:

At the end of this course, students will be able to:
CO1: Define and reproduce various terms in illumination.
CO2: Identify various parameters for illumination system design.
CO3: Design indoor and outdoor lighting systems.
CO4: Enlist state of the art illumination systems.

Unit 01	Importance of Lighting in Human Life	07 hrs

Optical systems of human eye, Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting and perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification and Measurement of light.

Unit 02	Light Sources and Electrical Control of Light Sources	08 hrs

Light Sources- Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high pressure mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps - Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL)
High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.
Ballast, ignitors and dimmers for different types of lamps

Control of Light Sources

Photometric Control of Light Sources and their Quantification: Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures. Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).

Unit 03	Design Considerations for illumination schemes	07 hrs
Zonal cavity method for general lighting design, determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization), beam angles and polar diagrams. Factors to be considered for design of indoor illumination scheme		
Unit 04	Design of lighting schemes-I	07 hrs
Indoor illumination design for following installations Residential (Numerical) Educational institute Commercial installation Hospitals Industrial lighting Special purpose lighting schemes Decorative lighting Theatre lighting Aquarium, swimming pool lighting		
Unit 05	Design of lighting schemes-II	07 hrs
Factors to be considered for design of outdoor illumination scheme Outdoor Lighting Design: Road classifications according to BIS, pole arrangement, terminology, lamp and luminaries' selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method. Outdoor illumination design for following installations: Road lighting (Numerical) Flood lighting (Numerical) Stadium and sports complex Lighting for advertisement/hoardings		
Unit 06	Modern trends in illumination	07 hrs
LED luminary designs Intelligent LED fixtures Natural light conduiting Organic lighting system LASERS, characteristics, features and applications, non-lighting lamps Optical fiber, its construction as a light guide, features and applications		
Text Books:		
[T1]	H. S. Mamak, "Book on Lighting", Publisher International lighting Academy.	
[T2]	Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications	
[T3]	M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-Butterworth Heinemann (ISBN 978-0-415-50308-2)	

[T4]	Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002

Reference Books:

[R1]	"BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi.
[R2]	D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0.
[R3]	"IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society of North America.
[R4]	"IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society of North America
[R5]	IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition 2000
[R6]	Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.
[R7]	IS 3646: Part I: 1992, Code of practice for interior illumination.
[R8]	Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4

Mapping:

Unit	Text Books	Reference Books
01	T1, T4	R6
02	T3, T4	R1, R3, R4, R8
03	T2, T4	R2, R3, R7
04	T3, T4	R2,R3, R4, R5, R7
05	T2, T3, T4	R3, R4, R6, R7
06	T1, T2, T4	R2, R3, R5, R8

403151C: Electromagnetic Fields						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:

- To impart knowledge on the basics of electric and magnetic fields and their applications for utilization in the development of the theory for power transmission lines and electrical machines.
- To describe how materials affect electric and magnetic fields
- To discuss the boundary conditions
- To analyze the relation between the fields under time varying situations
- To give insight to Maxwell's equations in different form and media

Course Outcomes:

At the end of this course, students will be able to:
CO1: Describe time varying Maxwell's equations and their applications in electromagnetic problems
CO2: Interpret electric and magnetic field with the help of associated laws
CO3: Solve simple electrostatic and magnetic boundary conditions
CO4: Determine the relationship between time varying electric and magnetic fields and electromotive force
CO5: Solve electromagnetic problems with the help of mathematical tools.

Unit 01	Introduction	07 hrs

Sources and effects of Electro-Magnetic Fields, Scalar and vector, Unit vector, Mathematical operations of Vector, Scalar and vector fields, Different Coordinate System, Operator Del, Physical interpretation of gradient, divergence and curl, Conversion between coordinate system, Expression for gradient, divergence and curl in three coordinate system.

Unit 02	Basic Electrostatics	07 hrs

Coulomb's law, Electric field, Electric Field Intensity (EFI), EFI due to - point charge, line charge, surface charge and volume charge, Electric displacement, Electric flux density, Gauss's law (scalar and vector form), Applications of Gauss law, Electric field due to – point charge, infinite long straight conductor and infinite plane sheet of charge, Divergence theorem, Stoke's theorem

Unit 03	Applied Electrostatics	07 hrs

Electric Potential, Relationship between E and V, Equipotential surfaces, Electric dipole and flux lines, Electric field due to dipole, Energy density in electrostatic field, Energy stored in terms of D and E, Convection and Conduction currents, Current and current density, Continuity equation for current, Poisson's and Laplace's equations, Capacitor and its capacitance, Parallel plate capacitor, Capacitors with multiple dielectrics, Spherical capacitor, Coaxial capacitor.

Unit 04	Magnetostatics and Applications	07 hrs

Magnetic flux density, Magnetic field intensity (MFI), Magnetic permeability, Biot-Savart's law, Applications of Biot-Savart's law, MFI due to - infinite long straight filament, finite length element, on the axis of circular loop, Ampere's Circuital law, Field due to – infinite line current, coaxial cable, uniform current sheet density, Magnetic flux density, Scalar magnetic potential, Vector magnetic potential, Poisson's Equations for Magnetostatic field, Derivations of BiotSavart law and Ampere's law based on magnetic potential, Forces due to magnetic field, Magnetic dipole.

Unit 05	Boundary Conditions and Analysis	07 hrs

Conductors, Ohm's law employing mobility, Dielectrics, Polarization in Dielectrics, Dielectric constants and strength, Relaxation time, Boundary conditions : Dielectric-Dielectric boundary conditions, Conductor – Dielectric boundary conditions, Conductor – Free space boundary conditions, Boundary conditions for Magnetostatic fields

Unit 06	Time Varying Fields and Maxwell's equations	07 hrs

Faraday's law, Transformer and motional EMFs – stationary loop in time varying B field, moving loop in static B field and moving loop in time varying field, Displacement current, Maxwell's equations in point form and integral form, Power and Poynting theorem, Time varying potentials, Time Harmonic Field, Maxwell's equations in point form and integral form for harmonic field, Concept of uniform plane wave.

Text Books:

[T1]	W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", Tata McGraw Hill.
[T2]	Mathew Sadiku, "Elements of Electromagnetics", Oxford University Press

Reference Books:

[R1]	R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill.
[R2]	Liang Chi Shen, Jin Au Kong, Amalendu Patnaik, "Engineering Electromagnetics", CENGAGE Learning
[R3]	K. B. Madhu Sahu, "Electromagnetic Fields", SciTech Publication.
[R4]	N. N. Rao, " Elements of Engineering Electromagnetics", Pearson Education.
[R5]	Edminister J. A., " Electromagnetics", Tata McGraw Hill.

Mapping:

Unit	Text Books	Reference Books
01	T2	R2, R3, R4
02	T1, T2	R1, R2, R3
03	T1, T2	R2, R3, R4, R5
04	T1, T2	R2, R3
05	T2	R1, R4, R5
06	T1, T2	R2, R3, R4

403151D: Artificial Intelligence and Machine Learning

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hrs/Week	Theory	03	ISE	30
					ESE	70

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Course Objectives:

This course aims to:
- Understand the basic concept of AI, strength and weakness of problem solving and search.
- Know about various Expert System tools and applications.
- Understand the basic concepts of machine Learning and apply different dimensionality reduction techniques.
- Optimize the different linear methods of regression and classification.
- Interpret the different supervised classification methods of support vector machine.
- Acquire the knowledge of different generative models through unsupervised learning.

Course Outcomes:

At the end of this course, students will be able to:
CO1: Evaluate Artificial Intelligence (AI) and Machine Learning(ML) methods and describe their foundations.
CO2: Demonstrate knowledge of reasoning and knowledge representation for solving real world problems.
CO3: Illustrate the construction of learning and expert system Discuss current scope and limitations of AI and societal implications
CO4: Distinguish between different types of learning types.
CO5: Apply the different supervised, unsupervised and reinforcement learning methods.

Unit 01	Introduction to AI	07 hrs

Definitions – Foundation and History of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment. Artificial Intelligence vs Machine learning, Statistical Analysis: Relationship between attributes: Covariance, Correlation Coefficient, Chi Square. Intelligent Agent: Concept of Rationality, nature of environment, structure of agents.

Unit 02	Problem Solving	07 hrs

Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A* algorithm, Bestfirst Search; Problem Reduction. Constraint Satisfaction problem: Interference in CSPs; Back tracking search for CSPs; Local Search for CSPs; structure of CSP Problem. Beyond Classical Search: Local search algorithms and optimization problem, local search in continuous spaces, searching with nondeterministic action and partial observation, online search agent and unknown environments.

Unit 03	Knowledge and Reasoning	07 hrs

Knowledge and Reasoning: Building a Knowledge Base: Propositional logic, first order Logic, situation calculus. Theorem Proving in First Order Logic, Planning, partial order planning. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks. Probabilistic reasoning over time: time and uncertainty, hidden Markova models, Kalman filter, dynamic bayesian network, keeping track of many objects

Unit 04	Introduction to ML and Supervised Learning	07 hrs
Introduction to Machine Learning, Examples of Machine Learning Applications, Learning Types **Supervised Learning** -Learning a Class from Examples, Vapnik-Chervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning,Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, **Dimensions of a Supervised Machine Learning** Algorithm Dimensionality Reduction-Introduction,Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis,Isomap, Locally Linear Embedding		
Unit 05	Linear Regression	08 hrs
Introduction, Linear Regression Models and Least Squares, Subset Selection, Shrinkage Methods-Ridge Regression, Lasso Regression, Least Angle Regression, Methods Using Derived Input Directions-Principal Components Regression, Partial Least Squares, A Comparison of the Selection and Shrinkage Methods , Multiple Outcome Shrinkage and Selection, More on the Lasso and Related Path Algorithms, Logistic Regression-Fitting Logistic Regression Models, Quadratic Approximations and Inference, L1 Regularized Logistic Regression		
Unit 06	Unsupervised and reinforcement learning	08 hrs
Introduction, Association Rules-Market Basket Analysis, The Apriori Algorithm, Unsupervised as Supervised Learning,Generalized Association Rules, Cluster Analysis. Proximity Matrices, Clustering Algorithms-K-mean, Gaussian Mixtures as Soft K-means Clustering. **Reinforcement Learning:** Introduction, Single state case, elements of reinforcement learning, model based learning, Temporal difference learning		
Text Books:		
[T1]	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall	
[T2]	J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016	
[T3]	Introduction to Machine Learning Edition 2, by Ethem Alpaydin	
[T4]	The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.	
[T5]	Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997	
Reference Books:		
[R1]	Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010 2. S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011	
[R2]	Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill	
[R3]	Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson	
[R4]	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT	

[R5]	Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
[R6]	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
[R7]	Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.
Online Resources:	
[O1]	https://nptel.ac.in/courses/106/106/106106139/
[O2]	https://nptel.ac.in/courses/106/106/106106202/
[O3]	https://nptel.ac.in/courses/106/106/106106198/
[O4]	https://nptel.ac.in/courses/106/105/106105152/
[O5]	https://nptel.ac.in/courses/106/106/106106213/
[O6]	https://www.coursera.org/learn/machine-learning

Mapping:

Unit	Text Books	Reference Books
01	T1, T2	R1, R2, R3
02	T1, T2	R1, R2, R3
03	T1, T2	R1, R2, R3
04	T3, T4, T5	R4, R5, R6, R7
05	T3, T4, T5	R4, R5, R6, R7
06	T3, T4, T5	R4, R5, R6, R7

403152: Project Stage II

Teaching Scheme			Credits		Examination Scheme	
SEM/PW/IN	12	Hrs./Week	SEM/PW/IN	6	ORAL	50
					Termwork	100

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Preamble:

Project is an important part of the engineering curriculum covered in the final year. It is divided into Project Stage I and Project Stage II in Semesters I and II of the Final Year. This project is a substantial piece of work that will require creative activity and original thinking. The project aims to provide students with a transitional experience from the academic world to the professional world. The objectives, outcomes, and guidelines for Project Stage II are given below.

Course Objectives:

The objectives of this course are to:
1. Provide an opportunity to learn new software, interdisciplinary theory, concept, technology, etc. not covered in earlier subjects
2. Empower students to use engineering knowledge and skills learned in previous courses to deliver a product that has passed through the design, analysis, testing, and evaluation
3. Encourage multidisciplinary project work through the integration of knowledge
4. Allow students to develop problem-solving, analysis, synthesis, and evaluation skills.
5. Encourage teamwork.
6. Improve students' communication skills by asking them to produce both a professional report and to give an oral presentation
7. Exposed to the project management skills and ethical practices in project

Course Outcomes:

Course outcomes can be different for the different projects undertaken by the student groups. However, in general, the course outcomes for Project Stage-II can be stated as follows.
At the end of this course, students should be able to:
CO1: Identify tools, techniques, methods, concepts, measuring devices, and instruments required for the project to define the methodology of the project
CO2: Justify the selection of electrical, electronic and mechanical components for the project prototyping
CO3: Select the appropriate testing method for system performance evaluation
CO4: Interpret results obtained by simulation, and hardware implementation and decide on further action or write a conclusion
CO5: Write a project report and research paper on the project work

Guidelines:

Termwork evaluation guidelines are given below.

Sr. No.	Activity	Deadline (Semester II)	Parameters for Evaluation
1	Progress Review-3 Presentation	Up to 6th Week	Revised Final Design (10) Tools and Techniques Used with justification (10) Partial Implementation/ development (15) Partial Results (15)

			Total Marks (50)
2	Progress Review-4 Presentation	Up to 12th Week	Implementation Status of project (10) Testing and Evaluation (10) Intermediate Results (15) Conclusion (10) Future Scope (5) **Total Marks (50)**
3	Submission of Project Stage –II Report	Up to 14th Week	Timely submission (5) Formatting and Report Writing Style (5) Abstract, Literature Survey, Conclusion (10) Grammatical correctness in the report (5) Publication/participation in project exhibition (20) **Total Marks (50)** **Review 3+ Review 4+ Final Project Report = 150 Rounded to 100 Marks**

Guidelines to students:

1. Continue with the same group and identify opportunities for self-learning and upgrading skills.
2. Actively participate in all the activities related to the project.
3. Document the project in the form of a hard-bound report at the end and submit it to the department.
4. Attempt to make a prototype, working model, and demonstration of the project to display during the final presentation.
5. Participate in project competitions, paper presentations, etc.
6. Maintain an institutional culture of authentic collaboration, self-motivation, peer learning, and personal responsibility.
7. Maintain a notebook to keep records of all the meetings, discussions, notes, etc. This is to be done by the individual student and submitted at the end to the supervisor or guide.
8. Some parameters, mentioned in the above table, will be evaluated and assessed at a group level and some at an individual level.

403153A: German Language-II

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:
- Get introduced to the Culture, Routine of the German Society through language.
- Meet the needs of ever growing German industry with respect to language support.

Course Outcomes:

At the end of this course, students:
CO1: Will have the ability of advanced communication.
CO2: Will develop reading, writing and listening skills.
CO3: Will understand tenses in German Language.
CO4: Will develop interest to pursue a German language course.

Unit 01	Introduction of Cases:	06 hrs

Introduction of Cases: Nominative, Akkusative, Dative.
Personal & Possessive Pronouns in Nominative, Akkusative, Dative.

Unit 02	Prepositions:-	06 hrs

Prepositions:- Akkusative & Dative.

Unit 03	Tenses:-	06 hrs

Tenses:-
Past tense of sein & haben Verbs, Perfect tense

Text Books:

[T1]	Netzwerk A-1 (Deutsch als Fremdsprache), Goyal Publishers & Distributors Pvt. Ltd.

Reference Books:

[R1]	Tipps und Uebungen A1

Online Resources:

[O1]	Practice Material like online Worksheets regarding the Grammar, listening Module, reading Texts.

403153B: Engineering Economics-II

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	–	ISE		–

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Course Objectives:

This course aims to:

1. Describe basics methods of Engineering Economic Analysis
2. Explain inflation and its impact on business decisions.

Course Outcomes:

At the end of this course, students will be able to:

CO1:Apply various techniques for evaluation of engineering projects.

CO2:Assess cash flow under risk with varying parameters.

Unit 01	Engineering Economic Analysis	10 hrs

Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Public Sector Economic Analysis (Benefit Cost Ratio Method).Introduction to Lifecycle Costing, Introduction to Financial and Economic Analysis.Case Study – Tata Motors

Unit 02	Inflation and Risk Analysis	10 hrs

Concept of Inflation., Measuring Inflation, Equivalence Calculation Under Inflation, Impact of Inflation on Economic Evaluation.

Sources of Project Risks, Methods of Describing Project Risks, Sensitivity Analysis, Break Even Analysis, Scenario Analysis, Probability Concept of Economic Analysis, Decision Tree and Sequential Investment Decisions

Text Books:

[T1]	Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India.
[T2]	D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books:

[R1]	Sasmita Mishra, “Engineering Economics & Costing “, PHI
[R2]	Sullivan and Wicks, “ Engineering Economy”, Pearson
[R3]	R. Paneer Seelvan, “ Engineering Economics”, PHI
[R4]	Chan S. Park, Contemporary Engineering Economics, Prentice Hall, Inc.

403153C: GREEN BUILDING

Teaching Scheme			Credits		Examination Scheme		
Theory	02	Hrs/Week	Theory	--	ISE		--

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Course Objectives:

This course aims to:

- To learn the principles of planning and orientation of buildings.
- To acquire knowledge on various aspects of green buildings.

Course Outcomes:

At the end of this course, students will be able to:
CO1:Design green and sustainable techniques for both commercial and residential buildings.
CO2:Design water, lighting, energy efficiency plan using renewable energy sources.
CO3:Explain the principles of building planning, its bylaws and provide facilities for rainwater harvesting
CO4:Understand the concepts of green buildings

Unit 01	Sustainability and Building design	06 hrs

Sustainability, objectives of sustainable development, Sustainable aspects of habitat design, sustainable buildings, principles, approaches and characteristics, climate data, climate parameters and zones, comparative analysis of various climatic zones, site planning recommended checklist for identifying site characteristics, site development and layout. Efficient water management and waste water treatment, solid waste management.

Unit 02	Energy efficiency	06 hrs

Solar passive techniques in building design to minimize load on conventional systems i.e. heating, cooling, ventilation and lighting. Designing Energy efficient lighting and HVAC systems. Use of renewable energy systems to meet part of building load. Green building certification. Overview of various green buildings in India. Policy and regulatory mechanisms.

Text Books:

[T1]	Seven Wonders of Green Building Technology: Karen Sirvaitis, Twenty-First Century Books.
[T2]	Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
[T3]	Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
[T4]	Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

Reference Books:

[R1]	Sustainable Building Design Manual, Volume 2, TERI, New Delhi
[R2]	Energy Efficient Buildings in India, TERI, New Delhi
[R3]	Sustainable Building Design Manual, Volume 1 TERI, New Delhi
[R4]	Mili Majumdar, "Energy-efficient buildings in India" Tata Energy Research Institute, 2002.
[R5]	TERI "Sustainable Building Design Manual- Volume I & II" Tata Energy Research Institute, 2009.
Online Resources:	
[O1]	https://nptel.ac.in/courses/105102175
[O2]	https://theect.org/energy-efficiency-buildings-distance-learning/
[O3]	https://www.udemy.com/topic/energy-management/
[O4]	https://archive.nptel.ac.in/noc/courses/noc19/SEM1/noc19-ce13/
[O5]	https://beeindia.gov.in/content/certification
[O6]	https://elearning.iea.org/
[O7]	https://onlinecourses.nptel.ac.in/noc20_ce08/preview

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
For
Fourth Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering
(2019 Course)
Board of Studies – Mechanical and Automobile Engineering
(With Effect from Academic Year 2022-23)

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-VII														
402041	Heating Ventilation Air-Conditioning and Refrigeration	3	2	-	30	70	-	-	25	125	3	1		4
402042	Dynamics of Machinery	3	2	-	30	70	-	-	25	125	3	1		4
402043	Turbomachinery	2	2	-	-	50	25	-	25	100	2	1	-	3
402044	Elective – III	3	-	-	30	70	-	-	-	100	3	-	-	3
402045	Elective - IV	3	-	-	30	70	-	-	-	100	3	-	-	3
402046	Data Analytics Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
402047	Project (Stage - I)	-	4	-	-	-	50	-	50	100	-	2	-	2
	Total	**14**	**12**		**120**	**330**	**125**	**-**	**125**	**700**	**14**	**6**	**-**	**20**
Semester-VIII														
402048	Computer Integrated Manufacturing	3	2	-	30	70	25	-	25	150	3	1	-	4
402049	Energy Engineering	3	2	-	30	70	25	-	25	150	3	1	-	4
402050	Elective - V	3	-	-	30	70	-	-	-	100	3	-	-	3
402051	Elective - VI	3	-	-	30	70	-	-	-	100	3	-	-	3
402052	Mechanical Systems Analysis Laboratory	-	2	-	-	-	25	-	25	50	-	1	-	1
402053	Project (Stage - II)	-	10	-	-	-	100	-	50	150	-	5	-	5
		12	**16**	**-**	**120**	**280**	**175**	**-**	**125**	**700**	**12**	**8**	**-**	**20**

Elective-III		Elective-V	
402044A	Automobile Design	402050A	Quality and Reliability Engineering
402044B	Design of Heat Transfer Equipments	402050B	Energy Audit and Management
402044C	Modern Machining Processes	402050C	Manufacturing Systems and Simulation
402044D	Industrial Engineering	402050D	Engineering Economics and Financial Management
402044E	Internet of Things	402050E	Organizational Informatics
402044F	Computational Fluid Dynamics	402050F	Computational Multi Body Dynamics
Elective-IV		**Elective-VI**	
402045A	Product Design and Development	402051A	Process Equipment Design
402045B	Experimental Methods in Thermal Engineering	402051B	Renewable Energy Technologies
402045C	Additive Manufacturing	402051C	Automation and Robotics
402045D	Operations Research	402051D	Industrial Psychology and Organizational Behavior
402045E	Augmented Reality and Virtual Reality	402051E	Electrical and Hybrid Vehicle

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam, **TW**: Term Work, **OR**: Oral

- Student can select any elective subjects from the list given as per his/her choice. However, it is advised to select the subjects from within a group identified for specialization.

Instructions:

- Practical/Tutorial must be conducted in **FOUR batches per division** only.
- Minimum number of Experiments/Assignments in PR/Tutorial shall be carried out **as mentioned in the syllabi** of respective courses.
- Assessment of tutorial work has to be carried out similar to term-work. The Grade cum marks for Tutorial and Term-work shall be awarded on the basis of **continuous evaluation.**

Program Outcomes (POs)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude and behaviour that students acquire through the program.

The POs essentially indicate what the students can do from subject-wise knowledge acquired by them during the program. As such, POs define the professional profile of an engineering graduate.

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems:

    a. that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques;

    b. that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions;

    c. that require consideration of appropriate constraints / requirements not explicitly given in the problem statement such as cost, power requirement, durability, product life, etc.;

    d. which need to be defined (modelled) within appropriate mathematical framework; and

    e. that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.

5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long Learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

402041: Heating, Ventilation, Air Conditioning and Refrigeration					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Pre-requisites: Thermodynamics, Applied Thermodynamics, Fluid Mechanics, Heat and Mass transfer.

Course Objectives:

1. To understand and compare different refrigerants with respect to properties, applications and Environmental issues and air refrigeration systems.
2. To understand Multi stage compression cycles and multistage evaporator systems.
3. To understand various components, operating and safety controls employed in Refrigeration and air conditioning systems and advanced refrigeration systems.
4. To understand the basic air conditioning processes on psychometric charts, human comfort and to provide the knowledge of indoor and outdoor air quality requirements.
5. To study the ventilation and infiltration in air conditioning and duct design for various comfort conditions and industrial air conditioning systems.
6. To understand advanced A/C systems and heat pump.

Course Outcomes:

On completion of the course the learner will be able to;

CO1.**ANALYSE** different air-craft refrigeration systems and **EXPLAIN** the properties, applications and environmental issues of different refrigerants.

CO2.**ANALYSE** multi pressure refrigeration system used for refrigeration applications.

CO3.**DISCUSS** types of compressors, condensers, evaporators and expansion valves along with regulatory and safety controls and **DESCRIBES** Transcritical and ejector refrigeration systems.

CO4.**ESTIMATE** cooling load for air conditioning systems used with concern of design conditions and indoor quality of air.

CO5.**DESIGN** air distribution system along with consideration of ventilation and infiltration.

CO6.**EXPLAIN** the working of types of desiccants, evaporative, thermal storage, radiant cooling, clean room and heat pump systems.

Course Contents

Unit 1	**Gas Cycle Refrigeration and Refrigerants**

Gas Cycle Refrigeration: Application to air-craft refrigeration, Simple system, Bootstrap, Regenerative, reduced ambient system, Concept of Dry Air Rated Temperature (DART)

Refrigerants: Introduction, Definition and requirement, Classification of refrigerants, Designation of refrigerants, Desirable properties of Refrigerants-Thermodynamic, Chemical and Physical. Properties of ideal refrigerant. Environmental issues like ODP, GWP & LCCP. Selection of environment friendly refrigerants, Alternative refrigerants, Secondary refrigerants, Anti-freeze solutions, Zeotropes and Azeotropes, Refrigerant recovery, reclaims, recycle and recharge.

Unit 2	**Multi Pressure Systems Systems**

Multistage or compound system: Need of multi staging, Two stage compression with flash gas removal, flash intercooler and complete multistage compression system

Multi evaporator system: single compressor-individual expansion valve, single compressor-multiple expansion valve, individual compressor-multiple expansion valve, individual compressor with compound compression and flash inter cooling. (Limited to two evaporators). Ammonia-CO_2 cascade cycle.

Unit 3	**Practical aspects of Vapor Compression and Advanced Refrigeration Systems**

Major components of refrigeration cycle: Types of compressors, Characteristics of reciprocating and centrifugal compressors, Types of evaporators, Types of condensers and Types of expansion valves

Safety Controls: LP/HP cut-off, Low temperature control, Frost control, Motor overload control, Oil pressure failure control. Capacity control of different compressors

Advanced Refrigeration System: Transcritical cycle and their types, Simple ejector refrigeration system (analysis and numerical)

Unit 4	**Applied Psychrometry**

Psychrometric Chart, Psychrometric processes using BPF, ADP, SHF, RSHF, GSHF, ESHF, ERSHF and adiabatic mixing of two air streams. Heat load estimation: - Air conditioning, heating & cooling load calculations

Envelop Load estimation: Concept of sol-air temperature, Time lag & Decrement method and ETD or CLTD methods

Thermal Comfort: Basic parameters, Thermodynamics of human body, Thermal comfort and Comfort charts, Factors affecting thermal comforts

Indoor Air Quality (IAQ): Indoor air contaminants, Basic strategies to improve indoor air quality

Outdoor Design Conditions: Outdoor air requirements for occupants, Use of outdoor weather data in design, Outdoor weather characteristics and their influence

Unit 5	**Ventilation, Infiltration & Air Distribution Systems (Ducts)**

Ventilation and infiltration: Natural ventilation, Mechanical ventilation

Duct Design: Definition of duct and types of ducts, Economic factors influencing duct layout, Materials for ducts and its specification, Flow through duct, Pressure in ducts, Friction loss in ducts, Friction chart for circular ducts, Equivalent diameter of a circular duct for rectangular sections, Methods of duct designs. (Numerical treatment on duct design)

Air Distribution System: Factors considered in air distribution system, (simple numerical). Types of air distribution devices. Fan coil unit, Fan laws, Types of fans used air conditioning applications, Types of supply air outlets, Selection and location of outlets, Filters, Diffusers, Grillers, and Dampers

Unit 6	**Advanced Air Conditioning Systems**

Advanced AC Systems: Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning

Desiccant-Based Air Conditioning Systems: Introduction, Sorbents & Desiccants, Dehumidification, Liquid spray tower, Solid packed tower, Rotary desiccant dehumidifiers, Hybrid cycles, Solid desiccant Air-Conditioning (Theoretical treatment)
Evaporative Cooling Air Conditioning Systems, Thermal storage Air Conditioning systems, Clean room Air Conditioning systems, Radiant cooling. (No numerical), Heat pumps and its different circuits

Text Books:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill.
2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983.
3. McQuiston, - Heating Ventilating and air Conditioning: Analysis and Design‖ 6th Edition, Wiley India.
4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi.
5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt.Ltd, New Delhi,1994.
6. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992.
7. S.N.Sapali , Refrigeration and Air conditioning, Eastern Economy Edition.
8. Arora R.C., Refrigeration and Air Conditioning, PHI, India.

References Books:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000.
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi.
4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications.
5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance.
6. ASHRAE Handbook (HVAC Equipments) & ISHRAE handbook.
7. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGraw Hill Publications.
8. Wilbert Stocker, Industrial Refrigeration, McGraw Hill Publications.
9. ASHRAE, Air Conditioning System Design Manual, IInd edition, ASHRAE.

Term Work

The student shall complete the following activity as a Term Work (Any eight experiments, No. 8 or 9 are compulsory)

1. Test on Ice plant test rig.
2. Performance Simulation of Central Air-conditioning plant using Newton Raphson Method.
3. Test on air-conditioning system for cooling load estimation
4. Performance analysis of Counter flow or cross flow cooling tower. (Theoretical/Practical)
5. Building heat load simulation using suitable software (Trace 700, Energy plus etc.)
6. Design of cold storage with process layout.
7. Analysis of VCC by Cool pack software.
8. Visit to Refrigeration or cold storage Plant
9. Visit to Air Conditioning Plant.
10. Trial on heat pump/ejector/cascade/desiccant/evaporative systems

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402042: Dynamics of Machinery					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Pre-requisites: Strength of Materials, Engineering Mechanics, Kinematics of Machinery, Engineering Mathematics and Numerical Methods

Course Objectives:

1. To conversant with balancing problems of machines.
2. To understand mechanisms for system control – Gyroscope.
3. To understand fundamentals of free and forced vibrations.
4. To develop competency in understanding of vibration in Industry.
5. To develop analytical competency in solving vibration problems.
6. To understand the various techniques of measurement and control of vibration and noise.

Course Outcomes:

On completion of the course, students will be able to -

CO1. **APPLY** balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.

CO2. **ANALYZE** the gyroscopic couple or effect for stabilization of Ship, Airplane and Four wheeler vehicles.

CO3. **ESTIMATE** natural frequency for single DOF un-damped & damped free vibratory systems.

CO4. **DETERMINE** response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.

CO5. **ESTIMATE** natural frequencies, mode shapes for 2 DOF un-damped free longitudinal and torsional vibratory systems.

CO6. **DESCRIBE** noise and vibration measuring instruments for industrial / real life applications along with suitable method for noise and vibration control.

Unit 1	**Balancing**

Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines. Introduction to Balancing machines - Types, Classification and Methods

Unit 2	Gyroscope

Introduction, Precessional angular motion, Gyroscopic couple, Effect of gyroscopic couple on an airplane, Effect of gyroscopic couple on a naval ship during steering, pitching and rolling, Stability of a Four Wheel drive moving in a curved path, Stability of a two wheel vehicle taking a turn, Effect of gyroscopic couple on a disc fixed rigidly at a certain angle to a rotating shaft.

Unit 3	Single Degree of Freedom Systems – Free Vibration

Fundamentals of Vibration: Elements of a vibratory system, vector representation of S.H.M., degrees of freedom, Introduction to Physical and Mathematical modeling of vibratory systems: Bicycle, Motor bike and Quarter Car. types of vibration, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)

Un-damped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems.

Damped free vibrations: Different types of damping, Viscous damping - over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations.

Unit 4	Single Degree of Freedom Systems - Forced Vibrations

Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility, Quality Factor. Half power bandwidth method, Critical speed of shaft having single rotor of un-damped systems.

Unit 5	Two Degree of Freedom Systems – Un-damped Vibrations

Free vibration of spring coupled systems - longitudinal and torsional, torsionally equivalent shafts, natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method, Combined rectilinear and angular motion, Vibrations of Geared systems.

Unit 6	Measurement and Control of Vibrations, Introduction to Noise

A) Measurement: Vibration Measuring Instruments, Accelerometers, Impact hammer, Vibration shakers, Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards related to measurement of vibration.

B) Control: Vibration control methods - passive, semi active and active vibration control, control of excitation at the source, control of natural frequency, Vibration isolators, Tuned Dynamic Vibration Absorbers.

C) Noise: Fundamentals of noise, Sound concepts, Decibel Level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement, Noise control at the Source, along the path and at the receiver, Reverberation chamber, Anechoic Chamber, Noise standards. (Unit VI – Only theoretical treatment)

Books

Textbook:

1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi.

2. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee
3. Wiiliam J Palm III, Mechanical Vibration, Wiley India Pvt. Ltd, New Delhi
4. Uicker J. John, Jr, Pennock Gordon R, Shigley Joseph E., Theory of Machines and Mechanisms, International Version, OXFORD University Press, New Delhi.
5. M L Munjal, Noise and Vibration Control, Cambridge University Press India
6. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.

References:

1. Weaver, Vibration Problems in Engineering, 5th Edition Wiley India Pvt. Ltd, New Delhi.
2. Bell, L. H. and Bell, D. H., Industrial Noise Control – Fundamentals and Applications‖, Marcel Dekker
3. Alok Sinha, Vibration of Mechanical System, Cambridge university Press, India
4. Debabrata Nag, Mechanical Vibrations, Wiley India Pvt. Ltd, New Delhi.
5. Kelly S. G., Mechanical Vibrations, Schaums outlines, Tata McGraw Hill Publishing Co. Ltd.
6. Meirovitch, L., Elements of Mechanical Vibrations‖, McGraw Hill.
7. Ver, Noise and Vibration Control Engineering, Wiley India Pvt. Ltd, New Delhi.
8. Bies, D. and Hansen, C., Engineering Noise Control - Theory and Practice, Taylor and Francis.
9. Shrikant Bhave, Mechanical Vibrations Theory and Practice, Pearson, New Delhi

Term Work

A] Compulsory Experiments (Sr. No. 1 to 6)

1. Balancing of wheel / rotor on computerized balancing machine OR Experimental verification of dynamic balancing of rotating masses.
2. To determine the natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient.
3. To obtain frequency response curves of single degree freedom system of vibration for different amount of damping.
4. To verify natural frequency of torsional vibration of two rotor system and position of node.
5. To measure vibration of healthy and faulty beam using FFT analyzer in time and/ or frequency domain and further classify the condition.
6. To measure noise of any healthy and faulty machine element and represent it into time and/or frequency domain and further predict the condition in future.

B] Any Two Experiments from the following:

1. To determine critical speed of shaft with single rotor.
2. Experimental verification of principle of dynamic vibration absorber.
3. Experiment on shock absorbers and to plot its characteristic curve.
4. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect.
5. Industrial visit based on Conditioning Monitoring and Fault Diagnosis.

C] List of Compulsory Assignment:

1. Simulation (using suitable software) of free response of SDOF damped system to demonstrate different damping conditions by solving differential equation numerically.

OR

2. Simulation (using suitable software) of total response of SDOF damped system to harmonic excitation by solving differential equation numerically.

OR

3. A case study based on conditioning monitoring and fault diagnosis using machine learning.

402043: Turbomachinery					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**2 Hrs./week**	**Theory**	**2**	**In-Semester**	**-**
Practical	**2 Hrs./week**	**Term Work**	**1**	**End-Semester***	**50 marks**
				Term Work	**25 marks**
				Oral	**25 marks**

Prerequisites: Fluid Mechanics, Thermodynamics, Heat Transfer, Engineering Mathematics

Course Objectives:

1. To provide the knowledge of basic principles, governing equations and applications of Turbomachines.
2. To provide the students with opportunities to apply basic thermos-fluid dynamics flow equations to Turbomachines.
3. To explain construction and working principles of Turbomachines.
4. To evaluate the performance characteristics of Turbomachines.

Course Outcomes:

On completion of the course the learner will be able to;

CO 1: **VALIDATE** impulse moment principle using flat, inclined and curved surfaces and **INVESTIGATE** performance characteristics of hydraulic turbines.

CO 2: **DETERMINE** performance parameters of impulse and reaction steam turbine along with discussion of nozzles, governing mechanism & losses.

CO 3: **MEASURE** performance parameters of single & multistage centrifugal pumps along with discussion of cavitation and selection.

CO 4: **EXPLAIN** performance parameters of centrifugal compressor along with discussion of theoretical aspects of axial compressor.

Course Contents	
Unit 1	**Impact of Jet and Hydraulic Turbines**

Introduction and Impact of Jet: Introduction to Turbomachines (Hydraulic & Thermal), Classification of Turbo machines, Applications of Turbomachines. Impulse momentum principle and its application to fixed and moving flat, inclined, and curved plate/vanes. Velocity triangles and their analysis, work done equations, vane efficiency (No numerical)

Hydraulic Turbines:
Introduction to Hydro power plant, Classification of Hydraulic Turbines, Concept of Impulse and Reaction Turbines. Construction, Principle of Working, design aspects, velocity diagrams and its analysis of Pelton wheel, Francis, and Kaplan turbines, Degree of reaction, Draft tube: types and efficiencies, governing of hydraulic turbines,Cavitation in turbines.

Unit 2	**Steam Turbines**

Steam Nozzle: Equations for velocity and mass flow rate (No derivation, no numerical)
Steam Turbines: Construction and working of Impulse and Reaction steam turbine, velocity diagram, work done efficiencies, Multi-staging, compounding, Degree of reaction, losses in steam turbine, governing of steam turbines

Unit 3	**Centrifugal Pumps**

Introduction & classification of rotodynamic Pumps, Main Components of Centrifugal Pump, Construction and Working of Centrifugal Pump, Types of heads, Velocitytriangles and their analysis, Effect of outlet blade angle, Work done and Efficiency, Series and parallel operation of pumps, Priming of pumps, specific speed

Unit 4	**Rotary Compressors**

Centrifugal Compressors: Classification of Centrifugal Compressor, construction and working, velocity diagram, flow process on T-S Diagram, Euler's work, actual work input, various losses in Centrifugal Compressor

Axial flow compressors: Construction and working, stage velocity triangle and it's analysis, enthalpy entropy diagram, stage losses and various efficiencies of axial flow compressors, [No numerical]

Books and other resources

Text Books:

1. Fluid mechanics and hydraulic machines, Dr. R.K. Bansal, Laxmi Publication
2. Hydraulics & Fluid Mechanics and Machinery, Modi P N & Seth S N, Standard Book House
3. Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
4. Turbomachines, B. U. Pai, Wiley India
5. Steam and Gas Turbines and Power Plant Engineering, R. Yadav, Central Publication house

Web References:

https://nptel.ac.in/courses/112105206

https://nptel.ac.in/courses/112105182
https://nptel.ac.in/courses/112104117

Guidelines for Laboratory Conduction

- Term work shall consist of eleven experiments.
- Experiment No1,3,8,10,11 and 12 are compulsory.
- From remaining experiments (2,4,5,6,7 and 9) any five experiments are to be performed.
- Data from any one trial performed should be analyzed by using suitable software.

Term Work

The student shall complete the following activity as a Term Work:

1. Study of Impulse momentum principle and its application to fixed flat, moving, inclined, and curved plates/vanes.
2. Verification of Impulse Momentum Principle.
3. Study of Unit quantities, Specific speed and performance characteristics of hydraulic turbines.
4. Study and Trial on Impulse water Turbine and plotting the main and operating characteristics
5. Study and Trial on any one hydraulic Reaction Turbine and plotting the main and operatingcharacteristics.
6. Study and Trial on Convergent-Divergent Air/Steam nozzle
7. Study and Trial on steam Turbine and plotting the operating characteristics.
8. Study of Cavitation, NPSH, Thoma’s cavitation factor, maximum suction lift.
9. Study and Trial on Centrifugal Pump and plotting the operating characteristics.
10. Study of Surging, stalling and choking phenomenon in compressors, performancecharacteristics of Centrifugal and Axial flow Compressors.
11. Visit to hydro/steam power plant and report to be submitted.
12. Visit to Pumping Station and report to be submitted.

OR

12. Design of Pumping system installation using Manufacturers catalogue, specific to housing or industrial application.

402044A: Automobile Design

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Engineering Mathematics-I and II, Systems in Mechanical Engineering, Engineering Mechanics, Theory of Machines, **Automobile Engineering**, Design of Machine Elements

Course Objectives: To understand, design and develop modern automobile and e-vehicles.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **DESIGN** of Principal Engine Components

CO2: **DESIGN** of Drive train

CO3: **DESIGN** of brakes and Suspension

Course Contents

Unit 1 | Design of Principal Engine Components

Design of piston, piston ring, piston pin, connecting rod, crankshaft, flywheel, Design of cooling system, Design of fuel system for CI engine, Governor design, Design of carburetor, Design of intake and exhaust system Engine friction and wear, Selection of lubricant, lubricating system, pump and filters.

Unit 2 | Design of Drive train, Axel and Steering

Design of Drive train: Design of propeller shaft and U-joints, Design of propeller shaft, criteria, failure theories, u-joint design, Design of Final drive and differential, Design of bevel, worm and hypoid type of final drive, differential.

Design of axel and Steering: Axle and shaft design, design of fully floating, half floating axle and dead axle, Steering gear and steering mechanism design, geometry for correct steering, linkages.

Unit 3 | Design of brakes and Suspension

Internal expanding shoe brake, braking condition, friction lining material, mechanical and hydraulic braking system, leaf spring, coil spring, materials, suspension system and linkages, independent suspension.

Unit 4 | Introduction to Hybrid and Electric Vehicles

Types of EVs, Hybrid Electric Drive-train, Tractive effort in normal driving.

Electric Drives: Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor.

Unit 5	**Energy Source-Battery**

Energy Source-Battery: Battery Basics, Different types, Cell Discharge Operation, Cell Charge Operation, Construction, Alternative Batteries, Battery Parameters, Battery Capacity, Discharge Rate, State of Charge, State of Discharge, Depth of Discharge, Technical Characteristics, Practical Capacity, Capacity Redefined, Battery Energy, Constant Current Discharge, Specific Energy, Battery Power, Specific Power, Battery Pack Design, Ragone Plots, Targets and Properties of Batteries, Battery Modeling, Constant Current Discharge Approach, Fractional Depletion Model, Standard Driving Cycles , Power Density Approach.

Design and Application of the Battery Management System: The Functions and Architectures of a Battery Management System, Architecture of the Battery Management System, High-voltage battery management systems (BMS) for electric vehicles, Cell balancing, battery state estimation, and safety aspects of battery management systems for electric vehicles, Thermal management of batteries for electric vehicles.

Unit 6	**Fuel Cell Vehicles**

Operating Principles of Fuel Cells, Fuel Cell Technologies, Fuel Supply, Nonhydrogen Fuel Cells, Fuel Cell Hybrid Electric Drive Train Design, Configuration, Control Strategy, Parametric Design.

Books

Text Books:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", 2013, Society of Automobile Engineers Inc.,
2. Engine Design – Giles J. G., Lliffe Book Ltd.
3. Engine Design – Crouse, Tata McGraw Publication, Delhi.
4. Design of Automotive Engine – A. Kolchin and V. Demidov
5. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Muhammad H. Rashid, Series Editor University of West Florida

References Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003,
2. Husain, I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2010.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
4. Tariq Muneer and Irene IllescasGarcía, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013

402044B: Design of Heat Transfer Equipments					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Thermodynamics, Heat Transfer

Course Objectives:

1. Understand the basic concept and design methodology of heat exchangers.
2. Identify the design requirements for different types of heat exchangers
3. Define the important heat-exchanger design parameters
4. Perform sizing of a given type of heat exchanger for a specific application.
5. Make use of basic knowledge of fluid mechanics, heat transfer, and material properties in both performance and design calculations.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **EXPLAIN** the design aspect of heat exchanger considering fouling factor for Heat Transfer Applications

CO2: **SELECT** and **DESIGN** the double tube heat exchangers for process industry

CO3: **DESIGN** the Shell & Tube Heat Exchangers for specified conditions

CO4: **DESIGN** the condensers and evaporators for refrigeration applications

CO5: **DESIGN the** compact heat exchangers

CO6: **ANALYSE** the performance of counter and cross flow cooling tower.

Course Contents

Unit 1	**Fundamentals of Heat Exchanger Design**

Introduction: Introduction, classification of heat exchangers and their applications, different standards used for heat exchanger

Basics of heat exchanger design: Basic design equation, LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi –pass heat exchangers, Effectiveness - NTU method for heat exchanger design/analysis

Fouling of Heat Exchanger: Introduction, causes of fouling, types of fouling, effect of fouling, fouling factor, overall heat transfer coefficient with fouling, fouling factors for various process and services, methods to reduce fouling, cleaning process of fouled heat exchanger

Unit 2	**Double Pipe Heat Exchanger**
Constructional features, Applications, Thermal and Hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop, Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow, different methods to enhance the heat transfer coefficient (Theoretical Treatment only)	
Unit 3	**Shell & Tube Heat Exchangers**
Tube layouts for exchangers, Baffled heat exchangers, Calculation of shell and tube heat exchangers, Shell side film coefficients, Shell side equivalent diameter (Kerns method, Bell-Delaware method), The temperature difference in a 1-2 heat exchanger. Shell side pressure drop, Tube side pressure drop, Analysis and performance of 1-2 heat exchanger and design of shell & tube heat exchangers.	
Unit 4	**Condensers and evaporators for Refrigeration systems**
Design considerations of heat exchangers for refrigeration and air conditioning applications, thermal design of heat exchanger used for refrigeration applications, air cooled condenser, Design considerations of Evaporative condensers. **Evaporator**: Evaporator for refrigeration and air-conditioning, thermal analysis of evaporator, standards for evaporators and condensers,	
Unit 5	**Design of compact heat exchangers**
Classification of compact heat exchangers, Plate heat exchangers (Numerical treatment), plate fin heat exchanger, tube fin heat exchanger (Numerical treatment), coiled tube heat exchangers (Numerical treatment), mini and micro channel heat exchangers, factors affecting on design of heat exchanger, Thermal analysis in compact heat exchanger.	
Unit 6	**Direct Contact Heat Exchanger**
Cooling towers, relation between wet bulb & dew point temperatures, Classification of cooling towers, Cooling tower internals and the roll of fills, Heat Balance, Analysis of cooling tower requirements, Deign of counter flow, cooling towers, Determination of the number of diffusion units.	
Books and other resources	
Text Books: 1. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication 2. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill 3. Process Heat transfer by Donald Q Kern, McGraw Hill	

References Books:

1. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
2. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press

Web References:

1. https://www.pdfdrive.com/heat-exchanger-design-handbook-e56045839.html
2. https://www.pdfdrive.com/heat-exchangers-book-e25375475.html
3. https://www.pdfdrive.com/heat-exchangers-selection-rating-and-thermal-design-third-edition-e186214274.html
4. https://www.pdfdrive.com/compact-heat-exchangers-selection-application-design-and-evaluation-e186388889.html

402044C - Modern Machining Processes					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite
Engineering Materials and Metallurgy, Manufacturing Processes

Course Objectives
1. To understand the different modern machining process.
2. To evaluate the process parameters of modern machining processes.
3. To able to select the process for application.
4. To apply the knowledge of different modern machining for manufacturing.

Course Outcomes
On completion of the course, learner will be able to
- CO1. **UNDERSTAND** and **ANALYZE** the mechanism, process parameters of mechanical assisted modern machining processes.
- CO2. **UNDERSTAND** the mechanism, construction and working of laser, plasma and electron beam assisted machining.
- CO3. **CLASSIFY** and **ANALYZE** the mechanism, process parameters of the chemical and electrochemical machining.
- CO4. **RELATE** and **ANALYZE** the mechanism and select process parameters Electrical Discharge Machining for an application.
- CO5. **ILLUSTRATE** the application of micromachining processes.
- CO6. **SUGGEST** appropriate nanomachining process for the specific application.

Course Contents

Unit 1	**Mechanically Assisted Modern Machining Process**

Introduction to modern manufacturing processes, Need and classification of modern manufacturing methods.

Introduction to advanced Mechanical Energy Process machining processes and their classification, -Abrasive Jet Machining (AJM), Abrasive Water Jet Machining (AWJM), Ultra Sonic Machining (USM), Water Jet Machining (WJC) -Principle, Working, process parameters, Effect of process parameters on Material removal rate, tool wear, surface finish, Advantages, Limitations & applications, economics of machining.

Unit 2	Energy Assisted Modern Fabrication Process
Introduction to Energy Process machining processes, Principle, applications, classifications and selection, process parameters, concept of energy level, Heat Affected Zone and economics of the process in Laser beam machining (LBM) Laser Optics, Plasma arc machining (PAM), Electron Beam Machining (EBM), Focused Ion beam (FIB).	
Unit 3	**Electro-chemical Machining Process**
Electro chemical machining (ECM): Introduction, Working Principle, equipment, process parameters, material removal rates, surface integrity, type of electrolyte, Advantages, limitations & applications of ECM, economics of machining. Electrochemical Grinding (ECG), Electro stream Drilling (ESD), Photochemical machining (PCM) Chemical machining (ChM).	
Unit 4	**Electro-thermal Machining Process**
Electric discharge machining (EDM): Introduction, Working Principle, EDM-Spark Circuits, selection of tool electrodes and dielectric fluids, process parameters, material removal rates, surface integrity, Heat Affected zone, Advantages, limitations & applications of EDM, Wire Electric Discharge Machining (W-EDM), Electric Discharge Grinding (EDG), Electric Discharge Diamond Grinding (EDDG), economics of machining. Electrochemical discharge machining (ECDM)	
Unit 5	**Micro And Precision Manufacturing Process**
Micro machining processes that include working principle, material removal mechanism, effect of process parameters, materials processed, applications - Diamond turn machining, micro turning, Micro drilling, micro engraving, micro milling, Micro electro discharge machining, Case study on each process. economics of machining.	
Unit 6	**Nano-Machining And Nano Finishing Techniques**
Fundamental of micro and nano technology, Effect of material aspects, concepts of micro and Nano systems and Microsystems Products, Microsystems and Microelectronics, Micro and Nano fabrication-wet and dry etching, photolithography-LIGA process, Application of Microsystems, Case study on MEMS. Magnetic Abrasives Finishing (MAF), Abrasive Flow Finishing (AFF) Magnetorheological Finishing (MRF), Rotational - Magnetorheological Abrasive Flow Finishing (R-MRAFF).	
Books & Other Resources	

Text Books

1. V. K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill.
3. Production technology, HMT, McGraw Hill Education India Pvt. Ltd. 2001.
4. M. P Groover., "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 6th edition, Wiley 2015.

Reference Books

1. V. K. Jain, "Micro manufacturing Processes", CRC Press.
2. R. Balasubramaniam, RamaGopal V. Sarepaka, Sathyan Subbiah, "Diamond Turn Machining:

Theory and Practice”, CRC Press.
3. MEMS Material and Process Handbook, Reference proceedings, Reza Ghodssi, Pinyen Lin, Springer.
4. Hassan El-Hofy, “Advanced Machining Processes”, McGraw Hill Publications.
5. Julian W. Gardner, “Microsensors MEMS and smart devices”, Wiley.
6. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
7. A. Ghosh and A. K. Mallik, Manufacturing Science, East-West Press, New Delhi, 2006.

Web References

1. https://nptel.ac.in/courses/112/103/112103202
2. https://nptel.ac.in/courses/112/104/112104028
3. https://nptel.ac.in/courses/112/105/112105212

402044D: Industrial Engineering

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial		**Tutorial**		**End-Semester**	**70 Marks**

Prerequisites: Basic concepts of Mathematics and Mechanical Engineering, Industrial Orientation, Quality Control, Human Psychology, Basic Finance, Passion for Continual Improvement.

Course Objectives:

1. To introduce the concepts, principles, and framework of Industrial Engineering and Productivity enhancement approaches.
2. To familiarize the students with different time study and work measurement techniques for productivity improvement.
3. To introduce various aspects of facility design.
4. To acquaint the students with various components and functions of Production Planning and Control.
5. To acquaint the student about inventory management and approaches to control.
6. To acquire the students with concepts of ergonomics, value engineering and job evaluation.

Course Outcomes

Learner will be able to:

CO1. **EVALUATE** the productivity and **IMPLEMENT** various productivity improvement techniques.
CO2. **APPLY** work study techniques and **UNDERSTANDS** its importance for better productivity.
CO3. **DEMONSTRATE** the ability to **SELECT** plant location, appropriate layout and material handling equipment.
CO4. **USE** of Production planning and control tools for effective planning, scheduling and managing the shop floor control.
CO5. **PLAN** inventory requirements and **EXERCISE** effective control on manufacturing requirements.
CO6. **APPLY** Ergonomics and legislations for human comfort at work place and **UNDERSTANDS** the role of value engineering in improving productivity.

Course Contents

Unit 1 — Introduction to Industrial Engineering and Productivity

Introduction to Industrial Engineering, Historical background and scope, Contribution of Taylor, Gilbreth, Gantt, Maynard, Ford, Deming and Ohno. Importance of Industrial engineering. Introduction to Work system design

Productivity: Definition of productivity, Measures of Productivity, Total Productivity Model, Need for Productivity Evaluation, Productivity measurement models, Productivity improvement

approaches, Principles, Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques. (Numerical on productivity measurement)	
Unit 2	**Work Study**
Method Study: Introduction and objectives, Areas of application of work study in industry, Selection and Basic procedure. Recording techniques, Operations Process Chart, Flow Process Chart (Man, Machine & Material) Multiple Activity Chart, Two Handed process chart, Flow Diagram, String Diagram and Travel Chart, Cycle and chronocycle graphs, SIMO chart, Therbligs, Micro motion and macro-motion study: Principles of motion economy, Normal work areas and work place design. **Work Measurement**: Techniques, time study, steps, work sampling, Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time, and standard time determination. (Numerical) Introduction to PMTS, MTM, and MOST	
Unit 3	**Production Facility Design**
Plant Location: Introduction, Factors affecting location decisions, Multi-facility location **Plant Layout**: Principles of Plant layout and Types, factors affecting layout, methods, factors governing flow pattern, travel chart for flow analysis, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors, and process plant. Layout planning, Quantitative methods of Plant layout and relationship diagrams. Dynamic plant layout **Material Handling**: Objectives and benefits of Material handling, Relationship between layout and Material handling, Equipment selection	
Unit 4	**Production Planning and Control**
Types and methods of Production, and their Characteristics, functions and objectives of Production Planning and Control, Steps: Process planning, Loading, Scheduling, Dispatching and Expediting with illustrative examples, Capacity Planning, Aggregate production planning and Master production scheduling. Introduction to a line of balance, assembly line balancing, and progress control **Forecasting Techniques**: Causal and time series models, Moving average, Exponential smoothing, Trend and Seasonality. (Numerical)	
Unit 5	**Inventory and Inventory Control**
Materials: Profit Centre: Role of materials management techniques in material productivity improvement, cost reduction and value improvement. **Purchase Management**: Purchase management, incoming material control. Acceptance sampling and inspection. Vendor rating system.	

Inventory: Functions, Costs, Classifications, Deterministic inventory models and Quantity discount

Inventory Control: EOQ (Numericals), concepts, type of Inventory models-deterministic and probabilistic, Selective inventory control, Fundamental of Material Requirement Planning (MRP-I), Manufacturing Resource Planning (MRP-II), Enterprise Resource Planning (ERP), Just-in-Time system (JIT) and Supply Chain Management (SCM)

Unit 6	**Ergonomics, Value Engineering and Job Evaluation**

Ergonomics: Introduction to ergonomics and human factors Engineering - physiological basis of human performance, basic anatomy of human body and its functional systems; principles of ergonomics, design of display and controls in relation to information processing by human being, Introduction to Rapid Upper Limb Assessment (RULA) and Rapid Entire Body Assessment (REBA)

Value Engineering: VE concepts, Principles, Methodologies and standards, methods of functional analysis.

Job Evaluation and Wage Plan: Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans, Performance appraisal, concept of KRA (Key Result Areas), Introduction to industrial legislation.

Books and other resources

Text Books:

1. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
2. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication.

References Books:

1. Askin, Design and Analysis of Lean Production System, Wiley, India
2. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBH Publishing Company, New Delhi, Second Indian Adaptation, 2008.
3. H. B. Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw Hill Education.
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002
5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press.
6. Barnes, Motion and time Study design and Measurement of Work, Wiley India
7. Sumanth, D.J, "Productivity Engineering and Management", TMH, New Delhi, 1990.
8. Edosomwan, J.A, "Organizational Transformation and Process re- Engineering", British Cataloging in publications, 1996.
9. Prem Vrat, Sardana, G.D. and Sahay, B.S, "Productivity Management - A systems approach", Narosa Publications, New Delhi, 1998.
10. Francis, R.L., and White, J.A, "Facilities layout and Location", Prentice Hall of India, 2002.
11. James A. Tompkins, John A. White, "Facilities Planning", Wiley, 2013
12. Richard L. Francis, Leon F Mc Ginnes and John A. White, "Facility Layout and Location-

An Analytical Approach", PHI, 1993
13. G. K. Agarawal, "Plant Layout and Material Handling", Jain Brothers, 2007

Web References:

1. https://archive.nptel.ac.in/courses/112/107/112107143/#
2. https://nptel.ac.in/courses/112107249
3. https://onlinecourses.nptel.ac.in/noc22_me04/preview
4. https://nptel.ac.in/courses/112107292
5. https://nptel.ac.in/courses/112107142

402044E: Internet of Things					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Systems in Mechanical Engineering**,** Programming and Problem Solving, Basic Electronics Engineering, Solid Mechanics, Solid Modeling and Drafting, Electrical and Electronics Engineering, Mechatronics, Measurement Laboratory, Fluid Power & Control Laboratory

Course Objectives:

1. Introduction to IoT, Overview of IoT Building Blocks
2. Build small applications in IoT for Mechanical Engineering Applications using Sensors, Actuators, Microcontrollers and Cloud
3. Learn commonly used IoT Simulation Hardware platforms
4. Understand different Communication Technologies used in IoT
5. Development of application level protocol and Security of IoT Ecosystem
6. Understand IoT applications in different domains

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** the Applications/Devices, Protocols and Communication Models of IoT

CO2. **DEMONSTARTE** small Mechanical Engineering IoT oriented applications using Sensors, Actuators, Microcontrollers and Cloud

CO3. **SELECT** commonly used IoT Simulation Hardware platforms

CO4. **APPLICATION** of Interfacing and Communication Technologies for IoT

CO5. **ILLUSTRATE** IoT Application Development and Security of IoT Ecosystem

CO6. **EVALUATE** Present and Future Domain specific Applications of IoT Ecosystem

Course Contents

Unit 1	**Introduction to the Internet of Things (IoT)**

Overview, History, Definition and Characteristics, Connectivity Terminologies, Building blocks, Types of technologies used in IoT System, Baseline Technologies (Machine-to-Machine (M_2M) communications, Cyber-Physical-Systems (CPS)), IoT Vs M_2M, IoT enabled Technologies, IoT Levels and Templates, Design Methodology, The Physical Design Vs Logical Design of IoT, Functional blocks of IoT and Communication Models/Technologies, Development Tools used in IoT, IoT Architecture and Protocols, Various Platforms for IoT, Real time Examples of IoT, Challenges in IoT, The process flow of an IoT application, Evolution of Connected Devices,

<table>
<tr><td colspan="2">Applications of IoT, IoT Enablers, Overview of Governance, Privacy and Security Issues.</td></tr>
<tr><td>Unit 2</td><td>Sensors, Actuators and Microcontrollers</td></tr>
<tr><td colspan="2">Measuring physical and virtual quantities in digital world, Overview of Sensors working, Analog Vs Digital Sensors, Wired Vs Wireless Sensors, Types of Sensors, Types of Converters

Types of Transducers and Actuator, Controlling Hardware, Types of Controller, Role of microcontroller as gateway to interfacing sensors and actuators, Microcontroller Vs Microprocessor, Type of microcontrollers in embedded System</td></tr>
<tr><td>Unit 3</td><td>IoT Simulation Environment Hardware platforms and Endpoint Interfacing</td></tr>
<tr><td colspan="2">IoT supported Hardware platforms: Introduction to IoT Simulation Environment and Devices (Raspberry Pi, Espressif Processors, Arduino), Architecture, Setup, IDE, Installation, Interfaces (serial, SPI, I_2C), Programming with focus on interfacing for reading input from pins, connecting external gadgets/sensors/actuators, Controlling and Displaying Output, Libraries, Basics of Embedded C programming

Interfacing: Interfacing Input, Intermediate, Output and Display Sensors, Converters, Actuators, Controlling Hardware, Controllers and Network Devices,

IoT Architecture: Building architecture and Open source architecture (OIC), Main design principles and needed capabilities, An IoT architecture outline, Standards Considerations</td></tr>
<tr><td>Unit 4</td><td>Interfacing and Communication for Building IoT Applications</td></tr>
<tr><td colspan="2">Communication: Overview and Working of Controlled Systems, Connectivity models - TCP/IP Vs OSI model, IoT Communication Models, IoT Communication APIs, Serial Vs Parallel Communication, Wires Vs Wireless Communication, their Technologies and Hardware

IoT Communication Protocols: Protocol Standardization for IoT, Role of M_2M in IoT, M_2M Value Chains, IoT Value Chains, M_2M and WSN Protocols (SCADA and RFID)

Physical Servers and Cloud Platforms: Web server, Posting sensor(s) data to web server, Introduction to Cloud Storage models and Communication APIs Webserver, API Virtualization concepts and Cloud Architecture, Advantages and limitations of Cloud computing, IoT Cloud platforms, Cloud services</td></tr>
<tr><td>Unit 5</td><td>IoT Application Development and Security of IoT Ecosystem</td></tr>
<tr><td colspan="2">Application Protocols: MQTT, REST/HTTP, SQL Back-end Application Designing (Designing with Apache, MySQL, HTML, CSS), Non SQL Back-end Application Designing (MongoDB Object Type Database, jQuery for UI Designing), JSON lib for data processing

Security: Need of security in IoT, Security & Privacy during development, Privacy for IoT</td></tr>
</table>

enabled devices, IoT security for consumer devices, Security levels, protecting IoT devices, Security, Privacy and Trust in IoT-Data-Platforms

Unit 6	Present and Future Domain specific Applications of IoT Ecosystem

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, Business, Manufacturing, Smart Homes/Home automation, Surveillance applications, Connected Vehicles, Agriculture, Healthcare, Activity Monitoring, Retail, Logistics, Security, Health and Lifestyle, Legal challenges, IoT in Environmental Protection Modern Day IoT Applications, Smart Grid, Smart Cities - Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities

Future: Future IoT ecosystem, Need of powerful core for building secure algorithms, Examples for new trends (AI, ML penetration to IoT)

Books and other resources

Text Books:

1. Bahga, A. and Madisetti, V., (2015), "Internet of Things - A Hands-on Approach," Universities Press, ISBN: 9788173719547
2. Hajjaj, S S H. and Gsangaya, K. R., (2022), "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers," CRC Press, ISBN: 9781032110950
3. Raj, P. and Raman, A. C., (2017), "The Internet of Things: Enabling Technologies, Platforms, and Use Cases," Auerbach Publications/CRC Press, ISBN: 9781498761284
4. Adrian McEwen, A. and Cassimally, H., (2013), "Designing the Internet of Things," John Wiley and Sons, ISBN:
5. Veneri, G., Capasso, A., (2018), "Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0," Packt Publishing, ISBN: 9781789537222
6. Hersent, O, Boswarthick, D., Elloumi, O., (2012), "The Internet of Things: Key Applications and Protocols", Wiley, ISBN: 9781119994350
7. Uckelmann, D., Harrison, M., Michahelles, F., (2011), "Architecting the Internet of Things," Springer, ISBN: 9781119994350

References Books:

1. daCosta, F., (2013), "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, ISBN: 9781430257417
2. Waher, P., (2015), "Learning Internet of Things," Packt Publishing, ISBN: 9781783553532
3. Ovidiu, V. and Friess, P., (2014), "Internet of Things - From Research and Innovation to Market Deployment," River Publishers, ISBN: 9788793102941, https://www.riverpublishers.com/pdf/ebook/RP_E9788793102958.pdf
4. Ida, N., (2020), "Sensors, Actuators and Their Interfaces," SciTech Publishers, ISBN: 9781785618352
5. Pfister, C., (2011), "Getting Started with the Internet of Things," O'Reilly Media, ISBN:

9781449393571

6. Wallace, S., Richardson, M., Wolfram Donat, W., (2021), “Getting Started With Raspberry Pi: Getting to Know the Inexpensive ARM-Powered Linux Computer,” Make Community, LLC, ISBN: 9781680456998
7. Elangovan, U., (2019), “Smart Automation to Smart Manufacturing: Industrial Internet of Things,” Momentum Press, ISBN: 9781949449266
8. Jha, S., Tariq, U., Joshi, G. P., Solanki, V. K., (2022), “Industrial Internet of Things: Technologies, Design, and Applications,” CRC Press, ISBN: 9780367607777
9. Schwartz, M., (2016), “Internet of Things with Arduino Cookbook,” Packt Publishing, ISBN: 9781785286582
10. Kurniawan, A., (2019), “Internet of Things Projects with ESP32: Build exiting and powerful IoT projects using the all-new Expresif ESP32,” Packt Publishing, ISBN: 9781789956870

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1. https://nptel.ac.in/courses/106105166
2. https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/
3. http://playground.arduino.cc/Projects/Ideas
4. http://www.megunolink.com/articles/arduino-garage-door-opener
5. http://www.willward1.com/arduino-wifi-tutorial
6. http://www.toptechboy.com/arduino-lessons
7. https://www.eprolabs.com
8. http://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives

402044F: Computational Fluid Dynamics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Systems in Mechanical Engineering, Engineering Thermodynamics, Applied Thermodynamics, Fluid Mechanics, Numerical & Statistical Methods, Heat & Mass Transfer, Computer Aided Engineering

Course Objectives:

1. Model fluid / heat transfer problems, apply fundamental conservation principles and Identify Discretization methods
2. Formulate a model the for conduction and advection problems
3. Formulate a model the for Convection-Diffusion problems
4. Understand the External/Internal flow simulation
5. Recognize the Scales of turbulence and Understand the formulation methods
6. Understand the Fluid-Structure Interaction Problems and their applications

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **DISTINGUISH** and **ANALYSE** the governing equations of fluid mechanics and heat transfer in various formulations

CO2. **ANALYZE** and **MODEL** the conduction and advection problems

CO3. **ANALYZE** and **MODEL** the Convection-Diffusion problems

CO4. **IDENTIFY** and **EVALUATE** the External/Internal flow and its simulation

CO5. **DISTINGUISH** and **COMPARE** concepts of stability and turbulence.

CO6. **USE** and **APPLY** a CFD tool for effectively solving practical Fluid-Structure Interaction problems

Course Contents

Unit 1	**Introduction to Computational Fluid Dynamics**

Introduction to Computational Fluid Dynamics, CFD as a research and design tool, Applications in various branches of Engineering, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions, Discretization methods for the CFD (FDM, FVM, FEM, Hybrid Methods), Intro to Meshless Methods, Meshed Vs Meshless Methods

Unit 2	Conduction and Advection
Conduction: Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Stability Criteria **Advection:** Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD, second order upwind and QUICK convection schemes	
Unit 3	**Convection-Diffusion**
Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number	
Unit 4	**Introduction to External/Internal flow simulation**
Solution of Navier-Stoke' equation for incompressible flow using SIMPLE algorithms for lid driven cavity flow problem, Introduction to external flow simulation – Flow over circular Cylinder and Aerfoils.	
Unit 5	**Turbulent Flow Modeling**
Introduction to turbulence, Scales of turbulence, Reynolds Averaged Navier-Stokes (RANS) equation, One equation model (Derivation) and two equation model, Introduction to Direct Numerical Simulation (DNS), Large Eddy Simulation (LES)	
Unit 6	**Introduction to Fluid-Structure Interaction**
Types of Fluid-Solid Couplings, Applications, Mechanical Forces and Equilibrium, Rigid Body Motions, Balance Laws in Lagrangian and Eulerian Form, Lagrangian Solid System, Eulerian Fluid System, Kinematics of Eulerian and Lagrangian Modeling, Continuum Mechanics of Moving Domains, Coupled Fluid-Structure Equations, Application of Arbitrary Lagrangian Eulerian (ALE) Formulation	
Books and other resources	

Text Books:

1. Ghoshdastidar, P. S. (2017), "Computational Fluid Dynamics and Heat Transfer," Cengage learning, ISBN: 9788131533079
2. Atul Sharma, A., (2016), "Introduction to Computational Fluid Dynamics: Development, Application and Analysis," Wiley, ISBN: 9781119002994
3. Versteeg, H. K., Malalasekhara, W., (2007), "An Introduction to Computational Fluid Dynamics: The Finite Volume Method," PHI, ISBN: 9780131274983
4. Muralidharan, K., Sundarajan , T., (2009), "Computational Fluid Flow and Heat Transfer," Narosa Pub, ISBN: 9788173195228
5. Rao, J.S., (2017), "Simulation Based Engineering in Fluid Flow Design," Springer, ISBN: 9783319463810
6. Anderson, Jr., D. A. A (2017), "Computational Fluid Dynamics - the Basics with

Applications," , McGraw Hill Education, ISBN: 9781259025969
7. Jaiman, R. K. and Joshi, V., (2022), "Computational Mechanics of Fluid-Structure Interaction: Computational Methods for Coupled Fluid-Structure Analysis," Springer, ISBN: 9789811653544

References Books:

1. Thompson, J. F., Soni, B. K., Weatherill, N. P., (1998), "Handbook of Grid Generation," CRC Press, ISBN: 9780849326875
2. Ferziger, J. H., Perić, M., Street, R. L., (2019), "Computational Methods for Fluid Dynamics,"Springer, ISBN: 9783319996912
3. Pletcher, R.H., Tannehill, J.C., Anderson, D.A., (2012), "Computational Fluid Mechanics and Heat Transfer," CRC Press, ISBN: 9781591690375
4. Patankar, S. V., (2017), "Numerical Heat Transfer and Fluid Flow," CRC Press, ISBN: 9781138564695
5. Chung, T. J., (2014), "Computational Fluid Dynamics," Cambridge University Press, ISBN: 9781107425255
6. Tu, J., Yeoh, G-H. and Liu, C., (2018), "Computational Fluid Dynamics: A practical approach," Butterworth-Heinemann, ISBN: 9780081011270
7. Date, A. W., (2005), "Introduction to Computational Fluid Dynamics," Cambridge University Press, ISBN: 9780521685337
8. Schlichting, H., Gersten, K., (2016), "Boundary-Layer Theory," Springer, ISBN: 9783662529171
9. Tennekes, H. and Lumley, J. L., (2018), "A First Course in Turbulence," The MIT Press, ISBN: 9780262536301
10. Wilcox, D.C., (1998), "Turbulence Modeling for CFD," DCW Industries, ISBN: 9780963605153
11. Paidoussis M. P., Price, S. and de Langre, E., (2011), "Fluid-Structure Interactions: Cross-Flow-Induced Instabilities," Cambridge University Press, ISBN: 9780521119429
12. Bungartz, H-J. and Schäfer, M., (2006), "Fluid-Structure Interaction: Modelling, Simulation, Optimization," Springer, ISBN: 9783540345954

Web References:

1. Singh, K. M., (2019), "Computational Fluid Dynamics," IIT Roorkee, https://nptel.ac.in/courses/112107080
2. Ramakrishna, M., (2019), "Introduction to CFD," IIT Madras, https://archive.nptel.ac.in/courses/101/106/101106045/
3. Roy, A., (2019), "Introduction to CFD," IIT Kharagpur, https://archive.nptel.ac.in/courses/101/105/101105085/
4. Chakraborty, S., (2020), "Computational Fluid Dynamics," IIT Kharagpur, https://archive.nptel.ac.in/courses/112/105/112105254/
5. Chandrasekaran, S., (2019), "Advanced Marine Structures," IIT Madras, https://nptel.ac.in/courses/114106037

402045A: Product Design and Development

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Pre requisites: Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes Etc.

Course Objectives:

To explain student's significance of

1. Product design and Product development
2. Market Survey & Product Specification Finalization
3. Concept Inception, Verification and selection
4. Concept Exploration & Development
5. Design Verification and Validation
6. Robust Design and Development

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** Product design and Product development processes
CO2. **UNDERSTAND** Processes, tools and techniques for Market Survey & Product Specification Finalization
CO3. **UNDERSTAND** Processes, tools and techniques for Concept Inception, Verification and selection
CO4. **UNDERSTAND** Processes, tools and techniques for Concept Exploration & Development
CO5. **UNDERSTAND** Processes, tools and techniques for Design Verification and Validation
CO6. **UNDERSTAND** Processes, tools and techniques for Robust Design and Development

Course Contents

Unit 1	**Introduction to Product Design and Development**

Topics- Product design and Development definition, Objectives of Product design and development, Engineering Design Process, Engineering Development Process (Gateway System), Product Design Vs Product Development, Features of successful product design and development, Essential Factors for product design, The challenges of product development, ASIMOW Model/Morphology of product design, Who design and develops product-Concurrent engineering approach/CFT Approach, Reasons for new product failure, Product Life Cycle

Unit 2	Market Survey & Product Specification Finalization
Topics- Product definition, Types of products, Customer Population and Market segmentation-Types of customers and Needs, Customer need Models- Introduction to Kano Model, Triz Method/Altshuller Matrix, Design Thinking, etc. Types of Design information and the Various Sources of information, Product planning and its Phases, Mission statement and Technical Questioning, Technology forecasting and S-curve, Tools for gathering Customer needs, QFD and House of quality	
Unit 3	**Concept Inception, Verification and selection**
Topics- Idea generation and Idea generation approaches-Triz Method, Benchmarking, Brainstorming, Alternate thinking, Reverse Engineering etc, Product Policy of an organization, Selection of Profitable Concept- SWOT Analysis, Concept Selection Process, Pugh's Concept selection process, Concept Analysis- Marketing aspect, Product characteristics (Functional/ Operational/Durability/Aesthetic/Ergonomic Aspects), Economic analysis, Production aspect, functional Modelling and decomposition- Functional analysis system technique, Subtract and operate procedure	
Unit 4	**Concept Exploration & Development**
Topics-Solid Modelling of part and assembly, Product architecture, Digital product design of part and assembly with respect to Engineering drawing definition, Classification of engineering drawing, Elements of production drawing, Bill of material, Types of dimensions, Arrangement of dimensions, Principles of dimensioning, Limits, Fits and Tolerances, Geometric Tolerances, Datum System, Design for Assembly, Design for manufacturing, Design for processes, Product design Steps, Introduction of Ergonomics in product design, Design Review/Part Print Analysis	
Unit 5	**Design Verification and Validation**
Topics-FEA-CFD-MBD-FSI, Simulation driven design, Additive manufacturing, Policy and Homologation certification by National and International agencies, Introduction to Break Even analysis and Production capacity planning, Make VS buy Decision, Business case Preparation, Facility tooling and gauges design and Development- Vendor Development, Letter of Intent, Purchase order, Product costing, Product Testing and Validation, Introduction to Production part approval process tools (PPAP)	

Unit 6	**Robust Design and Development**

Tools and Techniques for Robust design and Development- Advance Product Quality Planning, Design Failure Mode Effect Analysis, Value Analysis and Value Engineering, Product Life cycle management and Product data Management etc.

Case studies on-

1. Teamcenter application in Product design and Development
2. DFMEA (Minimum Three parts)
3. Process Flow Chart (Minimum Three Parts)
4. Part Print analysis (Minimum Three Parts)

Text Books:

1. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
2. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000.
3. How Products are made by Jocqueline L. Longe
4. Creating Innovative products Using Total Design by Don Clausing and Ron Andrade
5. Metrics and Case Studies For Evaluating engineering designs by Jay Alan Moody
6. Understanding Engineering Design by Richard Birmingham
7. Designing for quality by Robert H. Lochner
8. New Product development by Barclay Z. Dann P. Holroyd
9. Developing an Ergonomics Processes by Alison Heller

References Books:

1. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education Inc.
2. Grieves, Michael, Product Lifecycle Management McGraw Hill
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub.
2. 4. Karl Ulrich, product design and development, TMH.

402045B: Experimental Methods in Thermal Engineering

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Basics of Physics. Fundamentals of Thermodynamics, Fluid Mechanics & Heat transfer.

Course Objectives:

1. To introduce the theory and experimentation in thermal engineering - Problem solving approaches, types of engineering experiments, computer simulation and physical experimentation.
2. To enhance the knowledge of various measuring instruments, techniques and importance of error and uncertainty analysis.
3. To give the exposure to measurement of pressure, flow velocity, measurement of temperature, optical methods of measurement.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **IDENTIFY** the suitable instrument for measuring parameters as per performance characteristics

CO2. **ANALYZE** experimental data by using different statistical techniques and estimate error

CO3. **DISTINGUISH** different methods of temperature measurements and thermal radiation

CO4. **CLASSIFY** various pressure measurement instruments and their comparison

CO5. **EXPLAIN** different flow measurement methods and flow visualization techniques

CO6. **APPLY** knowledge of modern engineering experimentation, including calibration, data acquisition, analysis and interpretation using different AI and ML techniques

Course Contents

Unit 1 — Measuring instruments

Basics of measuring instruments: Fundamental elements of a measuring instrument, Calibration, System response, Importance of measurement and experimentation, Selection of measuring system

Characteristics of instruments: Elements of Measuring Instruments Performance characteristics - Static & Dynamic characteristics, Response of general form of instrument, Random and transient input, Instrument loading under static and dynamic condition, Transducer and sensor used for thermal systems

Unit 2	Design of Experiments

Analysis of Experimental Data: Analysis of experimental data, Causes and type of experimental errors, data reduction techniques, statistical analysis of experimental data, Statistical distributions, probability distributions and curve fitting, Regression analysis, Co-relations

Uncertainty Analysis: Nomenclature, Precision Vs Accuracy, Errors in measurement, Sampling. (**Numerical on Uncertainty analysis)**

Design of Experiments: Factorial Design, Taguchi Method, Response Surface Design **(Case studies of experimental work)**

Unit 3	Temperature, Heat flux and Radiation measurements

Temperature and Heat flux measurement: Overview of thermometry, Thermoelectric temperature measurement, Hg-in-glass thermometer, RTD (Resistance Temperature Detector), thermistor, thermocouple, thermopile, liquid-crystal thermography, optical pyrometer. Themo well, Issues in Heat flux measurements. Thermos profile of heat exchanger. Non-contact type temperature Measurements

Thermal radiation measurements: Detection of thermal radiation, Radiation Thermometry, Measurement of emissivity, Reflectivity and transmissivity measurements, Solar radiation measurements.

Unit 4	Pressure measurements

Different pressure measurement instruments and their comparison, Types of Sensors used in Pressure Measurement, Manometers, bourdon tube pressure gauge, diaphragm gauge, bellow gauge, McLeod gauge, Pirani gauge and ionization gauge. Transient response of pressure transducers. Pressure measurements in combustions. Applications of Pressure measurements. (**Numerical on Pressure measurements)**

Unit 5	Flow measurements and Visualization techniques

Flow measurements: Introduction to Flow Measurement, Positive displacement flow meters, Flow obstruction methods, Magnetic flow meters, LDA (Laser Doppler Anemometry), Other methods. Applications of flow measurements.

Flow visualization techniques: Shadowgraph, Schlieren and interferometer. Other methods. Ultrasonic flow measurement. Flow measurements techniques used to validate CFD results. Micro channel flow measurement. Velocity measurement based on thermal effect.

Unit 6	DAS and AIML

Data Acquisition System (DAS) and Signal analysis: General Data Acquisition System, Signal conditioning, storage, Data transmission, - A/D & D/A conversion - Data storage and Display

AI & ML (Artificial Intelligence & Machine Learning) Applications: Introduction to AI / ML.

Approaches of AI/ ML. Predication of Measurement Parameter using ML Approaches such as Regression/ Classification. Finding Statistical Parameter such as ANOVA (Analysis of Variance), Correlation.

Books and other resources

Text Books:

1. Holman, J.P., “Experimental methods for engineers”, Tata McGraw hill 7th Edition, 2007
2. E.O. Doebelin, Measurement systems, Application and Design, 5 th edition, Tata McGraw-Hill, 2008
3. Beckwith & Buck : Mechanical Measurements
4. Willard, Mertt, Dean,Settle : Instrumental Methods of analysis

References Books:

1. Morris A.S, “Principles of Measurements and Instrumentation”, 3 Edition, Butterworth-Heinemann, .
2. Prebrashensky V., “Measurement and Instrumentation in Heat Engineering”, Vol.1, MIR Publishers, .
3. T.G. Beckwith, J.H. Lienhard V, R. D. Marngoni, Mechanical Measurements, 5 th edition, Pearson Education, 2010
4. D.C. Montgomery, Design and Analysis of Experiments, John Wiley, New York.
5. Introduction to Machine learning, Nils J.Nilsson
6. Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly

402045C: Additive Manufacturing					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite: Manufacturing processes, Engineering metallurgy, Solid mechanics

Course Objectives

1. To know the principle, methods, possibilities and limitations as well as environmental hazards of Additive Manufacturing technologies.
2. To get familiar with the characteristics of the different materials used in Additive Manufacturing technologies
3. To explore the potential of additive manufacturing technologies in real life applications.

Course Outcomes

On completion of the course, learner will be able to

CO1. **USE** and **CLASSIFY** the fundamentals of Additive Manufacturing Technologies for engineering applications.

CO2. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using light-based photo-curing, LASER based technologies and **STUDY** their applications, benefits.

CO3. **IDENTIFY** and **CATEGORIZE** the methodology to manufacture the products using extrusion-based deposition, inkjet-based technologies and **STUDY** their applications, benefits.

CO4. **SYNTHESIZE, RECOMMEND** and **DESIGN** the suitable material and process for fabrication and build behavior of verities of product.

CO5. **DESIGN** and **CONSTRUCT** the AM equipment's for appropriate applications and the input CAD model.

CO6. **DEVELOP** the knowledge of additive manufacturing for various real-life applications.

Course Contents

Unit 1 Introduction to Additive Manufacturing

Introduction to AM, Historical Development, Additive v/s Conventional Manufacturing, Role of AM in Product development cycle, Rapid prototyping, Relevance of AM in Industry 4.0, Current industry and manufacturing trends driving AM, AM Process-Chain, Reverse engineering, Advantages, Types of materials, Classification of AM Processes (Process-based, material form based, application-based - direct and indirect processes and Micro- and Nano-additive processes), Process Planning for Additive Manufacturing

Unit 2	Light and LASER based Techniques
Introduction, Process and mechanism, Materials, Process Physics, Parameters, Benefits, Drawbacks, Limitations and Applications of **Light-Based Photo-curing**: Stereolithography (SLA), Digital Light Processing (DLP), Direct Laser Writing (DLW), Continuous Liquid Interface Production (CLIP) **Laser-Based Melting**: Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Selective Laser Melting (SLM), Electron-Beam Melting (EBM), Laser Blown Powder, Laser Wire Deposition, Laser Engineered Net Shaping (LENS), 3D Laser Cladding	
Unit 3	**Extrusion and energy based Techniques**
Introduction, Process and mechanism, Materials, Process Physics, Parameters, Benefits, Drawbacks, Limitations and Applications of **Extrusion-Based Deposition**: Fused Deposition Modeling (FDM), Fused Filament Fabrication (FFF), Direct Ink Writing (DIW), Robocasting, Bio-printing **Inkjet(droplet)-Based Deposition and Fusion**: Multi-jet Modeling (MJM), Polyjet Printing, Nanoparticle Jetting, Binder Jetting, Multi-Jet Fusion, Color-jet Printing (CJP), Energy Deposition Techniques: Plasma/TIG/MIG/Arc Deposition, Electron Beam-based DED, Direct Metal Deposition (DMD)	
Unit 4	**Materials and Design for AM**
Introduction, Materials: Metals, Polymers, Ceramics & Bio-ceramics, Composites, Hierarchical Materials, Biomimetic Materials, Shape-Memory Alloys, 4D Printing & Bio-active materials, Material selection, **AM Material Specific Process Parameters**: Processes, Heat or Chemical Treatments, Phase Transformations, Process Selection for various applications, DfAM: Process specific strategies, Rules and Recommendations, **Quality considerations and Post-Processing techniques**: Requirements and Techniques, Support Removal, Sanding, Acetone treatment, Polishing, Heat treatments, Hot isostatic pressing, Materials science, Surface enhancement Techniques and its Material Science Analysis of AM’s error sources	
Unit 5	**Hardware and Software for AM**
Construction of Basic AM Machines: Equipment Layout and sub-system Design, Construction, Working, Equipment Topology/Layout Frame Designs, 3D Printer Design Considerations (Filament, Frame, Build Platform, Extruder Design, Nozzles, Print Bed, Heated build/Base Plate, Heater, Dispenser, Optical system, Cooling system, Gas Recirculation System, Laser controller, Gas Filtration, Inert Gas Cooling system, Powder Handling System, Loading/unloading System, Moving Parts and end stops, Sensors, Actuators, Motors and Control Electronics, Power supply, Machine Tool Peripheral), Raw Material Manipulation **Software and Controller**: Types of In-fill, Types of slicing, Software Integration (with Process, Slicing, etc), Control system (PLC and safety PLC, micro control/ Microcontroller, Micro-processor control), CAD Software and Controller Interfacing, CURA Software, Relevant G/M Codes, Standard firmware (Merlin Software, etc), In-process Monitoring, Calibration	

Unit 6	Case Studies, Application and Special Topics

Case Studies and Application of AM: 3D printing in prominent industries (Aerospace, Electronics, Defense, Automotive, Construction, Architectural, Machine-Tools), Other industrial applications (Health-Care, Personalized Surgery, Bio-medical Applications, Assistive Devices, Food-Processing, Food & Consumer Applications, Art, Fashion, Jewelry, Toys & Other Applications, etc)

Special Topics: 4D/5D Printing, Bio-printing, Bio-materials, scaffolds and tissue and Organ Engineering, Mass Customization and Future trends.

Books & Other Resources

Text Books

1. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015 2.
2. Amit Bandyopadhyay, Susmita Bose, "Additive manufacturing", CRC Press, Taylor & Francis Group, 2016 3.
3. Ian Gibson, David W. Rosen, Brent Stucker "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing" Springer, 2010

Reference Books

1. L. Lu, J. Y. H. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid Prototyping", Springer, 2001
2. Andreas Gebhardt and Jan-Steffen Hötter, "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing" Hanser Publishers, Munich, 2016.
3. Ben Redwood, FilemonSchöffer& Brian Garret, "The 3D Printing Handbook: Technologies, design and applications", 3D Hubs B.V. 2017
4. Ehsan Toyserkani, Amir Khajepour, Stephen F. Corbin, "Laser Cladding", CRC Press, 2004
5. Andreas Gebhardt, "Understanding Additive", Hanser Publishers, Munich, 2011
6. Ben Redwood, Filemon Schöffer & Brian Garret, "The 3D Printing Handbook – Technologies, Design and Applications" Part One:3D Printing Technologies and Materials, 3D Hubs, 2017
7. Chee Kai, Kah Fai, Chu Sing, 'Rapid Prototyping: Principles and Applications", 2nd Ed., 2003
8. D. T. Pham and S.S. Dimov, "Rapid Manufacturing" Springer, 2001
9. Rupinder Singh J. Paulo Davim, "Additive Manufacturing - Applications and Innovations" CRC Press Taylor& Francis Group, 2019
10. . I. Gibson, D. W. Rosen, B. Stucker, "Additive Manufacturing Technologies" Springer, 2010
11. L. Jyothish Kumar, Pulak M. Pandey, David Ian Wimpenny, "3D Printing and Additive Manufacturing Technologies" Springer, 2019

Web References

1. NPTEL Course on Fundamentals of Additive Manufacturing Technologies by Prof. SajanKapil, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. Introduction to Additive Manufacturing, https://www.youtube.com/watch?v=LCQoi10cG To NPTEL IIT Kanpur, "Rapid Manufacturing", Dt. Janakarajan Ramkumar Prof. Amandeep Singh, https://onlinecourses.nptel.ac.in/noc20_me50/preview

402045D: Operations Research					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Mathematics, Theory of Probability, Statistics, Basic Industrial Functions and Business Environment.

Course Objectives:

1. To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
2. To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes

On completion of the course, learner will be able to

CO1. **EVALUATE** various situations of Games theory and Decision techniques and **APPLY** them to solve them in real life for decision making.

CO2. **SELECT** appropriate model for queuing situations and sequencing situations and **FIND** the optimal solutions using models for different situations.

CO3. **FORMULATE** various management problems and **SOLVE** them using Linear programming using graphical method and simplex method.

CO4. **FORMULATE** variety of problems such as transportation, assignment, travelling salesman and **SOLVE** these problems using linear programming approach.

CO5. **PLAN** optimum project schedule for network models arising from a wide range of applications and for replacement situations find the optimal solutions using appropriate models for the situation.

CO6. **APPLY** concepts of simulation and Dynamic programming

Course Contents

Unit 1	**Introduction to OR, Theory of Games and Decision Analysis**

Introduction to OR: Origin of Operations Research, Definition, Evolution and Classification of Quantitative methods, Operations Research Techniques and Methodology, Advantages and Limitations, Scope and Applications of OR

Theory of Games: Introduction, Classification of Games**,** Two-person Zero Sum Games, Solution of 2 x 2 Game with no Saddle Point, Dominance in Games, Subgame Method to Solve (2 x n or m x 2) Mixed Strategy Games, Graphical Method to Solve (2 x n or m x 2)

Games **Decision Analysis:** Introduction, Decision Under Certainty, Decision Under Risk, Decision Under Uncertainty (Maximin, Minimax, Maximax, Minimin Criterions, Hurwicz Criterion, Laplace Criterion, Savage or MiniMax Regret Criterion), Decision Tree.	
Unit 2	**Queuing Theory and Sequencing Model**
Queuing Theory: Introduction, Elements of Queuing, Characteristics of Waiting Lines, Service discipline, Service Mechanism, Terminology and Kendall's Notation of Queuing system, Single Channel systems M/M/1: FCFS/∞/ ∞ and M/M/1: FCFS/N/ ∞ **Sequencing Models:** Solution of Sequencing Problem - Processing of n Jobs Through Two Machines, Processing of n Jobs Through Three Machines, Processing of Two Jobs Through m Machines, Processing of n Jobs Through m Machines	
Unit 3	**Linear Programming**
Introduction, Formulation of LPP, LPP by Graphical Method, Solution of LPP by Simplex Method, Big M Method and Two-phase method (Limited to 2 variables only), Conversion of Primal to Dual problems	
Unit 4	**Transportation and Assignment Model**
Transportation Model: Introduction**,** Formulation of Transportation problem, Methods to Find Basic Feasible Solution (Vogel's Approximation Method (VAM), Least Cost Method (LCM), North West Corner Rule (NWCR)), Unbalanced Transportation Problem, Degeneracy in Transportation Problem (Theoretical treatment only), Optimality Test- Modified Distributed Method **Assignment Model:** Introduction, Mathematical Formulation of Assignment Problem Difference between Transportation and Assignment problem Assignment Problem, Hungarian Method, Balanced and Unbalanced Assignment problem, Maximization in Assignment Problems, Travelling Salesman Problem (Mathematical Formulation and Numerical)	
Unit 5	**Project Management**
Network Models: Fulkerson's Rule, Concept and Types of Floats, CPM and PERT, Crashing Analysis and Resource Scheduling **Replacement Analysis:** Replacement of Items that Deteriorate, Replacement of Items that Fail Suddenly	
Unit 6	**Simulation and Dynamic Programming**
Simulation: Introduction, Simulation Definition, Types of Simulation, Steps of Simulation, Advantages and Disadvantage of simulation, Stochastic Simulation and Random numbers, Monte Carlo simulation, Random number Generation **Dynamic Programming:** Introduction, Dynamic Programming Model, Applications of Dynamic Programming Model to Shortest Route problems, Bellman Optimality Principle, Resource Allocation problem by Dynamic Programming	

Books and other resources
Text Books: 1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991 2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India, 2010. 3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut, 2015. 4. L.C.Jhamb, Quantative Techniques Vol. I &II, Everest Publication, 2007. 5. Manohar Mahajan, Operation Research, Dhanpatrai Publication, 2006. 6. V. K. Kapoor, Operations Research: Quantitative Techniques for Management, Sultan Chand Publications, 2013.
References: **1.** Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India, 2011. **2.** Ravindran, ―Engineering optimization Methods and Applications‖, 2nd edition, Wiley, India **3.** Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey, **4.** Operations Research - An introduction, Hamdy A Taha, Pearson Education, 2010
Web References: 1. https://nptel.ac.in/courses/110106062 2. https://nptel.ac.in/courses/111107128 3. https://www.digimat.in/nptel/courses/video/110106062/L01.html 4. https://archive.nptel.ac.in/courses/112/106/112106134/

402045E: Augmented Reality and Virtual Reality					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Programming and Problem Solving, Engineering Graphics, Solid Modeling and Drafting, Numerical & Statistical Methods, Mechatronics, Artificial Intelligence &Machine Learning, Computer Aided Engineering

Course Objectives:

1. Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR
2. Review the Geometric Modeling Techniques
3. Review the Virtual Environment
4. Discuss and Examine VR/AR Technologies
5. Use of various types of Hardware and Software in Virtual Reality systems
6. Simulate and Apply Virtual/Augmented Reality to varieties of Applications

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** fundamental Computer Vision, Computer Graphics and Human-Computer Interaction Techniques related to VR/AR
CO2. **UNDERSTAND** Geometric Modeling Techniques
CO3. **UNDERSTAND** the Virtual Environment
CO4. **ANALYZE** and **EVALUATE** VR/AR Technologies
CO5. **APPLY** various types of Hardware and Software in Virtual Reality systems
CO6. **DESIGN** and **FORMULATE** Virtual/Augmented Reality Applications

Course Contents

Unit 1 **Introduction to Virtual Reality (VR)**

Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark

Unit 2 **Computer Graphics and Geometric Modelling**

The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection

Unit 3	Virtual Environment

Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices)
Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system
Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft

Unit 4	Augmented Reality (AR)

Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating ARsystems

Unit 5	Development Tools and Frameworks

Human factors: Introduction, the eye, the ear, the somatic senses
Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems
Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML

Unit 6	AR / VR Applications

Introduction, Engineering, Entertainment, Science, Training, Game Development

Books and other resources

Text Books:

1. Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896
2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494
3. Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell, ISBN: 9781118976135
4. LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson, ISBN: 9780134034324
5. Fowler, A., (2019), "Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#," Apress, ISBN: 9781484246672
6. Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), "Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications," Springer, ISBN: 9783030941017

References Books:

1. Craig, A. B., (2013), “Understanding Augmented Reality, Concepts and Applications,” Morgan Kaufmann, ISBN: 9780240824086
2. Craig, A. B., Sherman, W. R., Will, J. D., (2009), “Developing Virtual Reality Applications, Foundations of Effective Design,” Morgan Kaufmann, ISBN: 9780123749437
3. John Vince, J., (2002), “Virtual Reality Systems, “ Pearson, ISBN: 9788131708446
4. Anand, R., “Augmented and Virtual Reality,” Khanna Publishing House
5. Kim, G. J., (2005), “Designing Virtual Systems: The Structured Approach”, ISBN: 9781852339586
6. Bimber, O., Raskar, R., (2005), “Spatial Augmented Reality: Merging Real and Virtual Worlds,” CRC Press, ISBN: 9781568812304
7. O'Connell, K., (2019), “Designing for Mixed Reality: Blending Data, AR, and the Physical World,” O'Reilly, ISBN: 9789352138371
8. Sanni Siltanen, S., (2012), “Theory and applications of marker-based augmented reality,” Julkaisija –Utgivare Publisher, ISBN: 9789513874490

Web References:

1. Manivannan, M., (2018), “Virtual Reality Engineering,” IIT Madras, https://nptel.ac.in/courses/121106013
2. Misra, S., (2019), “Industry 4.0: Augmented Reality and Virtual Reality,” IIT Kharagpur, https://www.youtube.com/watch?v=zLMgdYI82IE
3. Dube, A., (2020), “Augmented Reality - Fundamentals and Development,” NPTEL Special Lecture Series, https://www.youtube.com/watch?v=MGuSTAqlZ9Q
4. http://cambum.net/course-2.htm

402046: Data Analytics Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs.**	**Practical**	**1**	**Term Work**	**50**

Prerequisites: Engineering Mathematics**,** Artificial Intelligence & Machine Learning, Numerical and Statistical Methods, Fundamental of Mechanical Engineering

Course Objectives:

1. To explore the fundamental concepts of data analytics.
2. To understand the various search methods and visualization techniques.
3. To apply various machine learning techniques for data analysis.

Course Outcomes:

On completion of the course, the learner will be able to

CO1: **UNDERSTAND** the basics of data analytics using concepts of statistics and probability.

CO2: **APPLY** various inferential statistical analysis techniques to describe data sets and withdraw useful conclusions from acquired data set.

CO3: **EXPLORE** the data analytics techniques using various tools

CO4: **APPLY** data science concept and methods to solve problems in real world context

CO5: **SELECT** advanced techniques to conduct thorough and insightful analysis and interpret the results

Course Contents

Preamble:

The motivation behind the data analytics lab for mechanical engineers is to make them competent to learn data-driven decision-making involving predictive, prescriptive, descriptive, and diagnostic analytics. Data analytics offers a new paradigm of bottom-up versus top-down modelling and solving supported by the traditional physics-based approach. An engineer involved in traditional modelling (e.g., developing a finite analysis or a reliability model) looks at the problem of interest and in essence, fits in the model he/she was trained to use. An engineer equipped with data science knowledge gathers historical data and uses data-mining tools to build the model of interest. If needed, he/she can further optimize this data-driven model with tools such as evolutionary computation algorithms.

Possible approaches:

Predictive Analytics:
Predictive analytics involves the use of mathematical methods and tools such as machine learning, data mining, statistical analysis, and predictive models. It is used to:

- Identify anomalies in the process, which help in preventive maintenance.
- Estimate the demand for product, raw material etc.: based on historical data and current

scenario.

- Forecast possible outcomes based on data obtained from the process.

Prescriptive Analytics:

Prescriptive analytics is used to identify ways in which an industrial process can be improved. While predictive analytics tells when could a component/asset fails, prescriptive analytics tells what action you need to take to avoid the failure. So, you can use the results obtained from prescriptive analysis to plan the maintenance schedule, review your supplier, etc. Prescriptive analytics also helps you manage complex problems in the production process using relevant information.

Descriptive Analytics:

The core purpose of descriptive analytics is to describe the problem by diagnosing the symptoms. This analytics method also helps discover the trends and patterns based on historical data. The results of a descriptive analytics are usually shown in the form of charts and graphs. These data visualization tools make it easy for all the stakeholders, even those who are non-technical to understand the problems in the manufacturing process.

Diagnostic Analytics:

Diagnostic analytics is also referred to as root cause analysis. While descriptive analytics can tell what happened based on historical data, diagnostic analytics tells you why it happened. Data mining, data discover, correlation, and down and drill through methods are used in diagnostic analytics. Diagnostic analytics can be used to identify cause for equipment malfunction or reason for the drop in the product quality.

TERM WORK:

A] Experiments (Any 6)

Sr. No.	Data Domain	Objective	Methodology	Data type
1	Thermal / Heat Transfer / HVAC / Fluid Mechanics / Fluid Power	Predictive / Prescriptive / Descriptive / Diagnostic (but not limited to)	Statistical / mathematical /numerical/computational/intelligent (but not limited to)	Numeric or image based or data in any suitable form
2	Solid Mechanics / Design			
3	Machining / Manufacturing			
4	Automation & Robotics			
5	Maintenance / Reliability / Condition Monitoring			
6	Quality Control			
7	Materials and Metallurgy			
8	Energy Conservation and Management			
9	Industrial Engineering, Estimation, and Costing			
10	Automotive technology			

B] List of Assignments (Any Three)

The survey of methods used for data analysis in the data domain mentioned above **(Any Three)** and discussion on any case studies.

Guidelines for selection of data domain, source, size, etc.:

- The data domain must be selected from various fields of mechanical engineering such as (but not limited to) thermal, heat power, design, manufacturing, automotive, HVAC, condition monitoring, process industry, solid and fluid mechanics, quality, materials and metallurgy, automation & robotics, energy conservation and management, ERP, Industrial engineering, estimation, and costing, etc.

- The volume of data should be considerably larger size in view of extracting meaningful insights, such as hidden patterns, unknown correlations, trends, and customer preferences through tools such as machine learning, deep learning, reinforcement learning, etc. Though the data size cannot be bluntly defined or there is no threshold, however, the data gathered from small trials/experimentation to analyse the input-output relationship should not be considered such as a trial on an external gear pump for studying its characteristics considering limited range of parameters for few trials. The appropriate data size must be selected as per the relevant data domain to yield a reliable model. For example, in the case of vibration-based condition monitoring based on numeric data, the size of data gathered depends on the sampling frequency of data acquisition and ranges from 5 kHz to 20 kHz or even more than that as per the data domain. Same for image data, the minimum number of images with appropriate resolution should be selected w.r.t data domain to yield a robust model.
- The data collected through real-time experiments is preferred however in case of no resources/facility available, data collected through simulation, survey, etc. can also be considered. The benchmark datasets made available by standard technical/academic/research/commercial/professional societies and organizations are also allowed.
- The standard instrumentation is preferred for performing experiments and data collection; however, the use of open-source hardware for building in-house low-cost data acquisition systems is also recommended.
- The choice of programming language and software depends on the data domain and the provision of the methodology used for its processing. Any standard programming language and data analytics software can be used.
- The approach mentioned above (but not limited to) should be considered while defining the problem and objectives, selecting the data domain, and deciding the methodology. The methodology can be statistical, mathematical, numerical, computational, or intelligent.

Books and Other Resources

Text Books:

1. Brunton, S. L., & Kutz, J. N. (2022). Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press.
2. Dunn, P. F., & Davis, M. P. (2017). Measurement and data analysis for engineering and science. CRC press.
3. Roy, S. S., Samui, P., Deo, R., & Ntalampiras, S. (Eds.). (2018). Big data in engineering applications (Vol. 44). Berlin/Heidelberg, Germany: Springer.
4. Middleton, J. A. (2021). Experimental Statistics and Data Analysis for Mechanical and

Aerospace Engineers. Chapman and Hall/CRC.

5. Brandt, S. (1970). Statistical and computational methods in data analysis.
6. Robinson, E. L. (2017). Data analysis for scientists and engineers. In Data Analysis for Scientists and Engineers. Princeton University Press.
7. Araghinejad, S. (2013). Data-driven modeling: using MATLAB® in water resources and environmental engineering (Vol. 67). Springer Science & Business Media.
8. Niu, G. (2017). Data-driven technology for engineering systems health management. Beijing, China: Springer.

References Books:

1. Zsolt Nagy, "Artificial Intelligence and Machine Learning Fundamentals", Packt Publishing, 2018, ISBN: 978-1-78980-165-1
2. Hastie, Trevor, Robert Tibshirani, Jerome H. Friedman, and Jerome H. Friedman. The elements of statistical learning: data mining, inference, and prediction. Vol. 2. New York: springer, 2009.
3. Zaki, Mohammed J., Wagner Meira Jr, and Wagner Meira. Data mining and analysis: fundamental concepts and algorithms. Cambridge University Press, 2014.
4. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a Term Work in the form of Journal.

Important Note:

Term Work of the Student shall be evaluated based on the completion of experiments, group assignments and case studies. Continuous evaluation by the faculty shall be done for the award of the credit associated with the course.

402047: Project (Stage I)					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**4 Hrs./Week**	**Practical**	**2**	**Term Work**	**50 Marks**
				Oral	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Laboratory works, Audit Courses

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
5. To get visibility in industry to Project and Project group

Course Outcomes:

On completion of the course the learner will be able to;

CO1. Implement systems approach.

CO2. To conceptualize a novel idea / technique into a product.

CO3. To think in terms of a multi-disciplinary environment.

CO4. To take on the challenges of teamwork, and document all aspects of design work.

CO5. To understand the management techniques of implementing a project.

Course Contents

Project work in the seventh semester is an integral part of the TW work. The project work shall be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society.

Project work shall be based on any of the following:

1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
2. Experimental verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.

4. Study projects are strictly allowed.

Project Lab

1. There has to be a **Project Lab** in the department.
   a. It consists of necessary tools required to do a project.
   b. Previous projects and their components.
   c. Common measuring instruments.
   d. Previous years' project reports.
   e. Project related books and Publications.
   f. Proper linkage with central workshop and various laboratories.
   g. Safety measures.

2. All the project activities must be handled with a digital platform which is developed in the department according to the policies laid down by the institution. Respective authority levels created to maintain the transparency and confidentiality.

Books and other resources

References Books:

- Dissertations and Project Reports: A Step by Step Guide by Dr Stella Cottrell.

Web References:

1. SWAYAM-NPTEL Course.
2. MOOCs'Courses.

Guidelines for Project Execution:

At the end of the 6th Semester

1. Students will make groups according to their suitability.
2. Department faculty will float prospective Project Titles through Project Coordinator.
3. Department will take care of a list of titles at least two times of the groups.
4. Students will interact with guides for scope and outline of the project.
5. Maximum of two groups will be given to a guide.
6. Guide and Project groups will be finalized at the end of sixth semester so that project work can be started at the start of Seventh semester.

During the 7th Semester

1. Project work is expected to be done in the Project Lab.
2. Projects must be executed in association with industrial experts/facilities.
3. Progress of project work is monitored regularly on weekly project slots/project day.
4. Regular interval presentations are to be arranged to review and assess the work.
5. Project work is monitored and continuous assessment is done by guide and authorities.

Term Work:

- The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.
- Recommended performance measure parameters may Include-Problem definition and scope

of the project, Literature Survey, Appropriate Engineering approach used, Exhaustive and Rational Requirement Analysis,

- Comprehensive Implementation - Design, modeling, documentation, Usability, Optimization considerations (Time, Resources, Costing), Thorough Testing, Project Presentation and Demonstration (ease of use and usability), Social and environment aspects.
- The term work under project submitted by students shall include

1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project group for

   a. Searching suitable project work

   b. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up the project.

   c. Brief report of feasibility studies carried to implement the conclusion.

   d. Rough Sketches/ Design Calculations

   e. Synopsis

- The group should submit the synopsis in the following form.

   i. Title of Project

   ii. Names of Students

   iii. Name of Guide

   iv. Relevance

   v. Present Theory and Practices

   vi. Proposed work

   vii. Expenditure

   viii. References

- The synopsis shall be signed by each student in the group, approved by the guide (along with external guide in case of sponsored projects) and endorsed by the Head of the Department
- Presentation: The group has to make a presentation in front of the faculty of department at the end of semester.

Examination Scheme:

- During university examination Internal examiner (preferably the guide) and External examiners jointly, evaluate the project work.
- During the process of monitoring and continuous assessment & evaluation the individual and team performance is to be measured.
- The project term work shall be evaluated on the basis of reviews. In first semester two reviews are to be taken and evaluated for total 30 marks (15 marks each)
- Review 1 and 2 will be based on synopsis submission (team members, Title of the Project Work, abstract, Problem Definition, work done earlier, Objectives of the Project, Methodology of the Project, Application / Significance of the Project, Duration of the Project, Individual Role of the Student, References, sponsored etc.)
- The final presentation shall be taken in front of external examiner and to be evaluated for 40 marks
  - 10 marks for presentation for group,
  - 15 marks for quality of the project work.
  - 15 marks for quality of the project report

Project Report
• Stage I report shall be in the booklet form. • Plagiarism check is must, and certificate shall be attached in the report.
References: • References format MUST BE STANDARD – ASME, SAE or IEEE

402048: Computer Integrated Manufacturing					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**
				Oral	**25 Marks**

Prerequisites: knowledge of earlier studied subjects like Solid Modeling and Drafting, Computer Aided Engineering, Industrial Engineering

Course Objectives:

1. **Understand and realize** need of CIM and factory automation.
2. **Learn** to integrate hardware and software elements for CIM.
3. **Generate and Integrate** CNC program for appropriate manufacturing techniques.
4. **Learn** to integrate processes planning, quality and MRP with computers.
5. **Know** about flexible, cellular manufacturing and group technology.
6. **Understand** IOT, Industry-4.0 and cloud base manufacturing.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** CIM and factory automation.
CO2. **UNDERSTAND** the integration of hardware and software elements for CIM
CO3. **APPLY** CNC program for appropriate manufacturing techniques.
CO4. **ANALYZE** processes planning, quality and MRP integrated with computers.
CO5. **INTERPRET** flexible, cellular manufacturing and group technology.
CO6. **ANALYZE** the effect of IOT, Industry-4.0 and cloud base manufacturing.

Course Contents

Unit 1	**Introduction to CIM**

Need of CIM, Introduction, Evolution of CIM,CIM Hardware and software, Role of CIM System, Definition of CIM, automation and types of automation, Reasons for automation, Types of Production, Functions in Manufacturing, CIM wheel, Computerized element of CIM, Advantages of CIM

Unit 2	**Data Integration**

CAD-CAM Integration, Product development through CIM, Design Activities in a networked

environment, Networking in a manufacturing company, hardware elements of networking, CIM Database, Database requirements of CIM, Database management, Database Models, EDM, Product Data Management (PDM), Product life cycle Management(PLM)	
Unit 3	**Computer Aided Manufacturing (CAM)**
Introduction to Computer Aided Manufacturing (CAM), Coordinate system, Working principal of CNC Lathe, Turning Centers, Milling Machine, Machining Centers. Steps in developing CNC part program, Tool and geometric compensations, CNC Lathe and Mill part programming, Canned cycles, subroutine and Do loop, CIM Integrable Machines	
Unit 4	**Computer Aided Process Planning and Quality Control**
Process Planning: Computer Aided Process Planning (CAPP), Benefits of CAPP, Logical steps in Computer Aided Process Planning, Approaches to CAPP, Material Requirement Planning, Capacity Planning, Manufacturing Resource Planning (MRP) - Input, working, outputs and benefits, Concept of dependent demand, structure of MRP system, planning & implementation issues, MRP-II & Enterprise Resource Planning (ERP), Computer Aided Production Scheduling, Control Systems: Shop Floor Control, Inventory Control, Computer Aided Inspection and Quality Control, Manufacturing Execution System(MES)	
Unit 5	**FMS & Cellular Manufacturing**
Introduction Flexible Manufacturing Systems, FMS components, Material handling and storage system, applications, benefits, computer control systems, types of FMS Layout, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. Group Technology(GT), Part Families – Parts Classification and coding, Simple Problems in Opitz Part Coding system – Production flow Analysis, Cellular Manufacturing – Composite part concept – Machine cell design and layout, Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method, Arranging Machines in a GT cell – Hollier Method – Simple Problems	
Unit 6	**Future Smart Factories**
Industry 4.0: Functions, Applications and Benefits. Components of Industry 4.0, Introduction to Industry 5.0, Internet of Things (IoT): IoT applications in manufacturing, Big-Data and Cloud Computing for IoT, IoT for smart manufacturing, influence of IoT on predictive maintenance, Supply-Chain Optimization, Supply-Chain & logistics, Internet of Things and M_2M Communication Technologies **Digital Manufacturing w.r.t. Industry 4.0**: Industrial Automation, Cyber-Physical Manufacturing Systems, Digital Twin Driven Smart Manufacturing, Digital Manufacturing, Assembly and Automation Systems, Scheduling and Cloud Manufacturing, Knowledge Management, Digital Supply Chains, Reconfigurable Manufacturing Systems, Web based Application in Manufacturing	
Books and other resources	
Text Books: 1. Automation, Production system & Computer Integrated manufacturing, M. P. Groover Person	

India, 2007 2nd edition.

2. Principles of Computer Integrated Manufacturing, S. Kant Vajpayee, Prentice Hall India

References Books:

1. Chang, T.C. and Wysk, R.A., 1997. Computer-aided manufacturing. Prentice Hall PTR.
2. Xu, X., 2009. Integrating Advanced Computer-Aided Design, Manufacturing, and Numerical Control. Information Science Reference.
3. Weatherall, A., 2013. Computer integrated manufacturing: from fundamentals to implementation. Butterworth-Heinemann.
4. Nanua Singh, Systems Approach to Computer Integrated Design and Manufacturing, John Wiley Publications.
5. Harrington J, Computer Integrated Manufacturing Krieger Publications 1979.
6. Zeid, CAD/CAM, Tata McGraw Hill.
7. Jha, N.K. "Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.

NPTEL Link:

1. https://youtube.com/playlist?list=PLFW6lRTa1g808_CfYhZKdv2eXplAQiAwS
2. https://nptel.ac.in/courses/112104289
3. https://onlinecourses.nptel.ac.in/noc22_me10/preview
4. https://archive.nptel.ac.in/courses/112/104/112104289/
5. https://archive.nptel.ac.in/noc/courses/noc20/SEM1/noc20-me44/

Link for Virtual Lab: - http://vlabs.iitkgp.ac.in/cim/#

Guidelines for Laboratory Conduction

1. Practical/Tutorial must be conducted in FOUR batches per division only.
2. Minimum 08 numbers of Experiments/Assignments shall be completed.
3. Experiments shall be conducted following 'Case Based Methodology'
4. Open source software, simulation tools may be used wherever required.

Term Work

The student shall complete the following activity as a Term Work:

1. Modelling of Mechanical Component using any 3D CAD software, Preparing CNC part program using any CAM software, and execute it on CNC Turning.
2. Modelling of Mechanical Component using any 3D CAD software, Preparing CNC part program using any CAM software, and execute it on CNC Milling.
3. Generate Bill of Material (BOM) from Assembly and other data using CAD Software.
4. Prepare Computer Aided Process Plan for selected part using variant type of CAPP Software.
5. Use MRP (Material Resource Planning) Software for CIM and Assembly.
6. Generate Part Family Code for a machine components using OPITZ Method
7. Study FMS system from Video clip and identify various elements of FMS and its controlling by computer.
8. Modeling and Simulation of Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources)
9. Machine vision based quality control. (VLab IIT, Kharagpur OR comparable sources)
10. Remote Monitoring and Operation of a Computer Integrated Manufacturing System. (VLab IIT, Kharagpur OR comparable sources)

402049: Energy Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**
				Oral	**25 Marks**

Prerequisites: Thermodynamics, Applied Thermodynamics, Heat Transfer, Turbo machines

Course Objectives:

1. To study the energy scenario, the components of thermal energy based plant, improved Rankine cycle
2. To understand details of steam condensing plant, cooling tower system, analysis of condenser, the environmental impacts and methods to reduce various pollution from energy systems
3. To study layout, component details of diesel engine power plant, hydel and nuclear energy systems
4. To understand components; layout of gas and improved power cycles
5. To learn basic principles of energy management, storage and economics of power generation
6. To study the working principle , construction of renewable energy systems

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **EXPLAIN** the power generation scenario, the layout components of thermal power plant and **ANALYZE** the improved Rankine cycle.

CO2: **ANALYZE** the performance of steam condensers, cooling tower system; RECOGNIZE an environmental impact of energy systems and methods to control the same.

CO3: **EXPLAIN** the layout, component details of diesel engine plant, hydel and nuclear energy systems.

CO4: **ANALYZE** gas and improved power cycles.

CO5: **EXPLAIN** the fundamentals of renewable energy systems.

CO6: **EXPLAIN** basic principles of energy management, storage and economics of power generation.

Course Contents

Unit 1	**Energy Scenario and Thermal Energy based Power Plants**

Energy Scenario: global and Indian energy scenario, role of Government and Private organizations, energy crisis, energy security, energy policy, India's low carbon transition.

Thermal Energy Based Plant: layout of modern thermal energy based plant with different circuits, site selection, classification of coal, coal benefication, selection of coal for thermal power plant, slurry type fuels, in-plant handling of coal, pulverized fuel handling systems, FBC systems, high pressure boilers, improved Rankine cycle: Rankine cycle with only reheating and only regeneration (Numerical Treatment) **,** energy conservation in boilers

Unit 2	Steam Condensers, Cooling Towers and Environmental Impact of Energy System

Steam condensers: need, elements of steam condensing plant, classification, Dalton's law of partial pressure, condenser efficiency, vacuum efficiency, cooling water requirements (Numerical Treatment), air leakage and its effects on condenser performance, air pumps (Numerical Treatment for Air Pump capacity), steam condenser market.

Cooling Towers: need, classification of condenser water cooling systems, classification of cooling pond and cooling towers. environmental effects of cooling towers, next generation cooling towers

Environmental impact of energy system: different pollutants from energy plants, methods to control pollutants: types of scrubbers; ash handling system; dust collections; ESP, carbon credits and footprints, water treatment in thermal energy based plant

Unit 3	Diesel, Hydel, Nuclear Energy systems

Diesel engine power plant: general layout; different systems of DEPP, plant layout of high/medium /low capacity DEPP, performance operating characteristics based on heat rate, advantages; disadvantages; applications; methods of energy conservation

Hydel energy: basics of hydrology, hydrograph, flow duration curve, mass curve (Numerical Treatment), hydel power plant (HPP)- site selection, classification of HPP (Based on head, nature of load, water quantity), criteria for turbine selection, components of HPP- dams; spillways; surge tank and forebay, advantages and disadvantages of HPP.

Nuclear energy: nuclear fission/fusion, elements of NPP, types of nuclear reactor (PWR, BWR, CANDU, LMCR, GCR, Fast Breeder) nuclear fuels, moderators, coolants, control rod and shielding, nuclear waste disposal, nuclear power development programme of India**.**

Unit 4	Gas and Improved Power cycle

Gas turbine power plant: components, general layout of GTPP, open & closed cycle gas turbine plant, Brayton cycle analysis for thermal efficiency, work ratio, maximum & optimum pressure ratio, methods to improve thermal efficiency of GTPP: only inter-cooling; only reheating & only regeneration cycle (numerical treatment),

Improved cycle based Power Plant: gas and steam combined cycle plant, Cogeneration, introduction to tri-generation, steam power plants with process heating (Numerical Treatment), Integrated Gasification Combined Cycle (IGCC) plant, Kalina (Cheng) Cycle.

Unit 5	Energy Management, Storage and Economics of Power Generation

Energy management and storage: energy management with storage systems, energy demand estimation, energy pricing, thermal energy storage methods.

Power plant instrumentation: layout of electrical equipment, switch gear, circuit breaker, protective devices, measurement of high voltage, current and power.

Economics of power generation: cost of electrical energy, fixed and operating cost [methods to determine depreciation cost] (numerical treatment), load curves, performance and operation characteristics of power plants, load division, all terminologies related to fluctuating load plant, tariff (numerical treatment), analysis of energy bill

Unit 6	Renewable Energy Systems

Solar thermal and photovoltaic energy: solar thermal plant based on flat plate collector;
solar photovoltaic systems, applications, economics and technical feasibility.
Wind Energy: wind availability, basic components of wind mills, performance operating characteristics, wind solar hybrid power plants, Cost economics and viability of wind farm.
Geothermal Energy: typical geothermal field, superheated steam system, flash type, binary cycle plant**,** economics of geothermal energy.
Tidal Energy: components, single basin, double basin systems
Ocean Thermal Energy: working principle, Claude /Anderson /hybrid cycle
Wave Energy: dolphin type wave machines
MHD Power Generation: working principle, open/ close cycle MHD generator
Fuel cell: main components, working Principle
Biomass Energy: biomass gasifier
Hydrogen Energy: principle of hydrogen production, hydrogen storage, applications.

Books and other resources

Text Books:

1. Domkundwar & Arora, Power Plant Engineering, Dhanpat Rai & Sons, New Delhi
2. Domkundwar & Domkundwar- Solar Energy and Non Conventional Sources of Energy, Dhanpat Rai& Sons, New Delhi.
3. R.K.Rajput, Power Plant Engineering, Laxmi Publications New Delhi

References Books:

1. E.I.Wakil, Power Plant Engineering, McGraw Hill Publications New Delhi
2. P.K.Nag, Power Plant Engineering, McGraw Hill Publications New Delhi.
3. R.Yadav , Steam and Gas Turbines ,Central Publishing House, Allahabad.
4. G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers, Delhi
5. S.P.Sukhatme, Solar Energy,Tata McGraw-Hill Publications, New Delhi
6. G R Nagpal, Power Plant Engineering , Khanna Publication

Web References:

1. https://nptel.ac.in/courses/112107291

2. https://nptel.ac.in/courses/112103277
3. https://nptel.ac.in/courses/103103206
4. https://nptel.ac.in/courses/115103123
5. https://cea.nic.in/?lang=en

Term Work

The student shall complete the following activity as a Term Work:

1. Trial on Steam Power Plant to determine
   a) Plant Efficiency, Rankine Efficiency Vs Load
   b) Specific Steam consumption Vs Load
   c) Rate of Energy Input Vs Load
   d) Heat Rate and Incremental heat Rate Vs Load
2. Trial on Diesel Power Plant to determine
   a) Plant Efficiency Vs Load
   b) Total fuel consumption Vs Load
   c) Rate of Energy Input Vs Load
   d) Heat Rate and Incremental heat Rate Vs Load
3. Analysis of HT/LT electricity bill and recommendations for energy saving opportunities.
4. Case study on different control systems in thermal power plant .
   (Review of control principles, Combustion control, pulveriser control, control of air flow, Furnace pressure and feed water, steam temperature control, turbine control, Safety provisions / Interlocks)
5. Design and component selection for solar photovoltaic power plant with net metering.
6. Estimation of annual energy from wind data and component selection for wind mill.
7. Case study on cogeneration in Sugar mill/Paper mill/Cement kiln.
8. Design and performance analysis of steam surface condenser for steam thermal power plant.
9. Design and performance analysis of cooling tower system for steam thermal power plant.
10. Case study on biomass gasification and analysis of properties of syngas.
11. Case study on production of bio-diesel and evaluation of its properties and its use in diesel engine based power plant.
12. Design and performance analysis of Thermal energy storage system.
13. Case study on energy management in conventional/ renewable energy power plant
14. Visit to Thermal Energy Based plant /Co-generation Power plant.
15. Visit to GTPP/Combined Cycle/renewable energy plants.

IMP Notes for Term Work:

1. Eight experiments from No.1 to 15 from above list should be conducted.
2. Experiment No, 1and 2 are compulsory.
3. Any six experiments can be performed 3 to 15.

402050A: Quality & Reliability Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Mathematics, Probability, Statistics

Course Objectives:

1. To analyze and apply Quality & Reliability Tools to solve real-life problems.
2. To plot control charts and calculate process capability.
3. To ascertain System reliability for sustainable product design.
4. To find out FMEA and understand reliability centered Maintenance.

Course Outcomes:

On completion of the course the learner will be able to:

CO1. **UNDERSTAND** basic concepts of quality and **RELATE** various quality tools
CO2. **DEVELOP** analytical competencies to **SOLVE** problems on control charts and process capability.
CO3. **UNDERSTAND** fundamental concepts of reliability**.**
CO4. **EVALUATE** system reliability.
CO5. **IDENTIFY** various failure modes and **CREATE** fault tree diagram.
CO6. **UNDERSTAND** the concept of reliability centered maintenance and **APPLY** reliability tests methods.

Course Contents

Unit 1 — **Introduction to Quality and Quality Tools**

Precision and accuracy, Quality dimensions, Statements, Cost of quality & value of quality, Deming"s cycles & 14 Points, Juran Trilogy approach, Seven Quality Tools, Introduction to N Seven Tools, Quality Circle, 5S, Kaizen, Poka yoke, Kanban, JIT, QMS (ISO 9000, TS16949, ISO14000). Criteria for Quality Award (National & International)

Unit 2 — **Statistical quality control**

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control, Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability (Indices: cp, cpk, ppk), Statistical Process Control and six sigma. Acceptance Sampling: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plans, calculation of sample size, AOQ, Probability of acceptance

Unit 3 — **Fundamental concepts of Reliability**

Reliability definitions, failure, failure density, failure Rate, hazard rate, Mean Time to Failure (MTTF),

Mean Time Between Failure (MTBF), pdf, cdf, safety and reliability, life characteristic phases, modes of failure, areas of reliability, quality and reliability assurance rules, importance of reliability, Uncertainty analysis, Probability theory and probability distributions	
Unit 4	**System Reliability & Allocation Techniques**
Series, parallel, mixed configuration, k- out of n structure, analysis of complex systems, conditional probability method, cut set and tie set method, Redundancy & Types, Reliability allocation or apportionment, reliability apportionment techniques - equal apportionment, AGREE, ARINC, reliability predictions from predicted unreliability, minimum effort method	
Unit 5	**Reliability in Design & Development**
Reliability techniques- Failure mode, effects analysis (FMEA), Failure mode, effects and criticality analysis (FMECA)-Case Studies, RPN, Basic symbols, Ishikawa diagram for failure representation, Fault Tree construction and analysis - case studies, minimal cut & tie set methods	
Unit 6	**Reliability Testing and Management**
Objectives & types of maintenance, Maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability, Reliability Centered Maintenance, Stress strength interaction, Introduction to reliability testing, Testing for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing (HALT)	

Books and other resources

Text Books:

1. L. S. Srinath, Reliability Engineering, EWP , 4th Edition 2011
2. E. Balgurusamy, Reliability Engineering, McGraw Hill Education 2002
3. S. S. Rao, Reliability Based Design, Mc Graw Hill Inc. 1992

References Books:

1. E. E. Lewis, Introduction to Reliability Engineering, John Wiley and Sons.
2. Alessandro Birolini, Reliability Engineering Theory and Practice, Springer.
3. B. S. Dhillon, Maintainability, Maintenance and Reliability for Engineers, CRC press.
4. K. C. Kapoor and L. R. Lubersome, Reliability in Engineering Design Willey Publication.
5. Basu S.K, Bhaduri , Terotechnology and Reliability Engineering, Asian Books Publication.

402050B: Energy Audit and Management					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Engineering Thermodynamics, Applied Thermodynamics, Heat and Mass Transfer, HVAC, Turbomachines

Course Objectives:

1. To impart basic knowledge to the students about current energy scenarios, energy conservation, energy audit and energy management.
2. To inculcate the systematic knowledge and skill in assessing the energy efficiency, energy auditing and energy management.
3. To carry out an energy audit of Institute/Industry/Organisation

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **EXPLAIN** the energy need and role of energy management
CO2. **CARRY OUT** an energy audit of the Institute/Industry/Organization
CO3. **ASSESS** the ENCON opportunities using energy economics
CO4. **ANALYSE** the energy conservation performance of Thermal Utilities
CO5. **ANALYSE** the energy conservation performance of Electrical Utilities
CO6. **EXPLAIN** the energy performance improvement by Cogeneration and WHR method

Course Contents

Unit 1 Energy Scenario and Management

Energy needs of a growing economy, Current and long-term energy scenario - India and World, Concept of energy conservation and energy efficiency, Energy and environment, Need of Renewable energy, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy sector reforms.

Unit 2 Energy Audit

Need of Energy Audit, Types of energy audit, Energy audit methodology, Energy audit instruments, Analysis and recommendations of energy audit, Benchmarking, Energy audit reporting, Introduction to software and simulation for energy auditing, Current Energy Conservation Act and Electricity Act and its features.

Unit 3 Energy Economics

Costing of Utilities (Numerical): Determination of the cost of steam, fuels, compressed air and electricity

Financial Analysis Techniques (Numericals): Simple payback, Time value of money, Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis, Energy performance contracts and role of ESCOs.

Unit 4	**Evaluation of Thermal Utilities**

Energy performance opportunities and assessment of Boilers and Furnaces (Numerical on direct method), Heat exchangers, Cooling towers, DG sets, Fans & blowers, Pumps, Compressors, Compressed air systems and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.

Unit 5	**Evaluation of Electrical Utilities**

Electricity billing, Electrical load management and maximum demand control, penalties, Power factor improvement and benefits, Selection and location of capacitors. Distribution and transformer losses, Harmonics.

Electrical motors: Types, Efficiency, Selection, Speed control, Energy efficient motors

Lamp types and their features, recommended illumination levels, Lighting system performance assessment and efficiency improvement (Numerical), Electricity saving techniques.

Unit 6	**Cogeneration and Waste Heat Recovery**

Cogeneration: Need, applications, advantages, classification, Introduction to Trigeneration

Waste Heat Recovery: Classification, Application, Concept of Pinch analysis, Potential of WHR in Industries, Commercial WHR devices, saving potential, CDM projects and carbon credit calculations.

Case Studies: Energy Audit of Institute/MSMEs/Organization, Guidelines for Energy Manager and Energy Auditor examination conducted by BEE.

Books and other resources

Text Books:

1. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

References Books:

1. Barney L. Capehart, Wayne C. Turner and William J. Kennedy, “Guide to Energy Management”, Seventh Edition, The Fairmont Press Inc., 2012.
2. Craig B. Smith, “Energy Management Principles”, Pergamon Press, 2015.
3. Hamies, “Energy Auditing and Conservation; Methods, Measurements, Management and Case Study”, Hemisphere Publishers, Washington, 1980.
4. Albert Thumann P.E. CEM, William J. Younger CEM, “Handbook of Energy Audit”, The Fairmont Press Inc., 7th Edition.
5. Wayne C. Turner, “Energy Management Handbook”, The Fairmont Press Inc., , Georgia.
6. Abbi Y. A., Jain Shashank, “Handbook on Energy Audit and Environment management”,

TERI, Press, New Delhi, 2006.
7. Anthony L Kohan, “Boiler Operator’s Guide”, Fourth Edition, McGraw Hill
8. Robert L. Loftness, “Energy Hand Book”, Second edition, Von Nostrand Reinhold Company
9. G. G. Rajan, “Optimizing Energy Efficiencies in Industry”, Tata McGraw Hill, 2001
10. Amlan Chakrabarti, “Energy Engineering and Management”, Prentice Hall, India 2011

Web References:

1. www.npcindia.gov.in
2. http://www.bee-india.nic.in
3. www.aipnpc.org (for entire course material along with case studies)
4. https://beeindia.gov.in/sites/default/files/EC%20Guidelines-Final.pdf

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050C: Manufacturing System and Simulation					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding of manufacturing and business processes, industrial engineering principles and concepts.

Course Objective:

1. To help mechanical engineers understand broadly the functioning of manufacturing systems.
2. To describe the role of facilities and support systems.
3. To enable students understand various types of simulations used in manufacturing environment.
4. To acquaint with the methodology of manufacturing simulation using computer software and the repercussions of changes & variability therein, over time.
5. To showcase the areas of simulation applications in manufacturing and allied field.

Course Outcomes

On completion of the course the learner will be able to;

- CO1. **UNDERSTAND** the concepts of manufacturing system, characteristics, type, etc.
- CO2. **UNDERSTAND** the concepts of Facilities, manufacturing planning & control and Support System.
- CO3. **UNDERSTAND** the concepts of manufacturing towards solving productivity related problems.
- CO4. **DEVELOP** a virtual model to solve industrial engineering related issues such as capacity. utilization, line balancing.
- CO5. **BUILDING** tools to view and control simulations and their results.
- CO6. **PLAN** the data representation & Evaluate the results of the simulation.

Course Contents

Unit 1	**Manufacturing System**

Preamble: Industrial Revolutions, Smart manufacturing, Challenges, Digitalization, Manufacturing System, Simulation, Data Analysis & Predictive decision-making, Types and classification of production systems and their characteristics, Introduction to manufacturing systems (manual, worker-machine and automated), Components & classifications, principles of manufacturing systems

Characteristics, requirements and operation of Manufacturing Systems: Custom manufacturing system, Intermittent manufacturing system, Continuous manufacturing system, Flexible manufacturing system, Mass customization, Assembly systems: Manual assembly systems,

Automated assembly systems, Hybrid assembly systems, and Reconfigurable manufacturing systems, Laws of Manufacturing, Manufacturing Systems as a Foundations of World-Class Practices, Performance measures of manufacturing systems and approaches to enhance the performance	
Unit 2	**Facilities and Manufacturing Support System**
Overview, characteristics, principles and requirements of following facilities and manufacturing support systems: **Facilities**: Material Handling Equipment, Quality control approaches, Computer systems to control manufacturing operations, Factory and Plant Layout, Group Technology (GT) & Cellular Layout, Robotics **Manufacturing Planning**: Process Planning, Production Planning, Master Scheduling, Material requirement planning and capacity planning **Manufacturing Control**: Shop floor control, Inventory control, Quality Control and Maintenance strategies **Business Functions**: Business functions and Sequence of information processing activities.	
Unit 3	**Manufacturing Simulation: Introduction**
History of simulation, basic simulation concept, purpose, appropriateness and considerations, advantages and disadvantages of simulation, areas of application, Overview of types of simulations [Discrete event simulation (DES), System dynamics (SD), Agent-based modeling (ABM), Intelligent simulation using artificial intelligence (AI) techniques, Petri net, Monte Carlo simulation (MCS), Virtual simulation], Steps in simulation study, simulation as a decision making tool	
Unit 4	**Discrete Event Simulation: Introduction**
Problem Formulation: Formulating problem statement, Tools for Developing the Problem Statement, Orientation Process, simulation project objectives, evaluation of simulation project **System Definition**: Discrete versus Continuous, Components and Events to Model, Manufacturing System Processes and Events **Input Data Collection and Analysis**: Sources for input data, collecting input data, deterministic vs. probabilistic input data, discrete vs. continuous input data, random numbers, variables, common input data distributions, analyzing input data	
Unit 5	**Discrete Event Simulation: Model Translation, Validation and Analysis**
Simulation Program Selection: Overview of various simulation software like AutoMod, ProModel, Arena, WITNESS Horizon, Quest, SIMFACTORY, FlexSim etc. Case study on translation to showcase model box, elements, building the model, attributing the data, queuing, material handling and conveyors, etc., output data)	

Verification, and Validation: Verification of Simulation Models, Calibration and Validation of Models, Face Validity, Validation of Model Assumptions, Validating Input-Output Transformations (Using Historical Input Data, Using a Turing Test), Design of Simulation Experiments, What if analysis, Sensitivity Analysis, Predictive decision-making

Interpretation of Outputs: Measures of Performance and their estimation, Analysis of terminating and non-terminating systems

Unit 6	**Discrete Event Simulation: Applications and Case Studies**

Applications: Assembly line balancing (Design and balancing of assembly lines), Capacity planning (Uncertainty due to changing capacity levels, increasing the current resources, improving current operations to increase capacity), Cellular manufacturing (Comparing planning and scheduling in CM, comparing alternative cell formation), Just-in-time (Design of Kanban systems), Scheduling (rules, capacity, layout, analysis of bottlenecks, performance measurement), Production planning and inventory control (Safety stock, batch size, bottlenecks, forecasting, and scheduling rules), Resource allocation (Allocating equipment to improve process flows, raw materials to plants, resource selection), Scheduling (Throughput, reliability of delivery, job sequencing, production scheduling, minimize idle time, demand, order release), Robotics, PLCs, Material Handling Equipments (Electronic Monorail System, Power & Free Conveyors, AGVs,)

Case Studies: 1-2 detailed case studies on above applications

Books and other resources

Text Books:

1. Obi S. C., Introduction to manufacturing systems, Author House, 2013.
2. Banks J. and Carson J.S., Nelson B.L., "Discrete event system simulation", 4th Edition, Pearson., United Kingdom, 2005.
3. Christopher A. Chung, Simulation Modeling Handbook: A Practical Approach, CRC Press, 2004
4. Al-Aomar, R., Williams, E. J., & Ulgen, O. M. (2015). Process simulation using witness. John Wiley & Sons.

References Books:

1. Peiter Mosterman, Discrete-Event Modeling and Simulation: A Practitioner's Approach, Taylor & Francis Group, 2009
2. David Elizandro and Hamdy Taha , Performance Evaluation of Industrial Systems: Discrete Event Simulation in Using Excel/VBA, Second Edition, CRC Press, 2012
3. Evon M. O. Abu-Taieh, Asim Abdel Rahman El Sheikh, Handbook of Research on Discrete Event Simulation Environments: Technologies and Applications, Information science reference, 2010
4. Steffen Bangsow (Ed.), Use Cases of Discrete Event Simulation: Appliance and Research, Springer 2012
5. Byoung Kyu Choi, Donghun Kang, Modeling And Simulation Of Discrete-Event, Systems, John Wiley & Sons, Inc, 2013

6. Ernst G. Ulrich, Vishwani D. Agrawal, Jack H. Arabian, Concurrent And Comparative Discrete Event Simulation, Springer Science+Business Media, 1992
7. Lawrence Leemis, Steve Park, Discrete-Event Simulation: A First Course, Prantice Hall, 2004
8. Theodore T. Allen, Introduction to Discrete Event Simulation and Agent-based Modeling, Springer.

Web References:

1. https://archive.nptel.ac.in/courses/110/106/110106044/
2. https://archive.nptel.ac.in/courses/112/107/112107220/
3. https://www.youtube.com/user/WitnessSimulation/videos
4. https://vimeo.com/lanner
5. https://www.lanner.com/en-gb/insights/customer-stories/
6. https://onlinecourses.nptel.ac.in/noc19_me45/preview

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050D: Engineering Economics and Financial Management					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial		**Tutorial**		**End-Semester**	**70 Marks**

Prerequisites: Understanding of economics & Finance in organizational functions and zeal to learn the subject

Course Objectives:

1. To introduce the concepts of economics & finance in industry.
2. To understand cost analysis and pricing
3. To acquire knowledge on basic financial management aspects and develop the skills to analyze financial statements
4. To understand the budgetary process and control.
5. To understand the international business process and associated financial facets
6. To introduce the entrepreneurial financial aspects.

Course Outcomes

On completion of the course, students will be able to -

- CO1. **UNDERSTAND** the business environment, concepts of economics and demand-supply scenario.
- CO2. **APPLY** the concepts of costing and pricing to evaluate the pricing of mechanical components.
- CO3. **UNDERSTAND** accounting systems and analyze financial statements using ratio analysis
- CO4. **SELECT** and **PREPARE** the appropriate type of budget and understand the controlling aspects of budget.
- CO5. **UNDERSTAND** the international business and trade system functioning
- CO6. **DEMONSTRATE** understanding of financing decisions of new ventures and performance

Course Contents

Unit 1	**Introduction to Business and Economics**

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance

Economics: Significance of Economics, Micro and Macro Economic Concepts, Various terms and

Concepts, Importance of National Income, Inflation, Money Supply in Inflation, Factors of Production, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics **Market Structures:** Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition **Demand and Supply:** Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting. Determinants of Supply, Supply Function & Law of Supply. Utility and Laws of returns	
Unit 2	**Costs and Cost Accounting**
Costs: Standard cost, estimated cost, First cost, Fixed cost, Variable cost, Incremental cost, Differential cost, Sunk and marginal cost, Cost curves, Breakeven point and breakeven chart, Limitations of breakeven chart, Interpretation of breakeven chart, margin of safety, Angle of incidence and multi product break even analysis, Cost Output Decision and Estimation of Cost, Zero Based Costing and numerical **Cost Accounting:** Objectives of cost accounting, elements of cost: material cost, labor cost, and expenses, allocation of overheads by different methods, Costing based on direct and indirect costs, Overheads apportionment and absorption, Different Models of Depreciation. Numerical on costing **Pricing:** Contribution, P/V-ratio, profit-volume ratio or relationship, Types of Pricing, Pricing policies, Pricing methods, Product Life Cycle based Pricing, Price fixation, depreciation and methods of calculating depreciation	
Unit 3	**Financial Accounting**
Accounting, Cost accounting & Management accounting, Various types of business entities, Accounting principles, postulates & meaning of accounting standards, Accounting cycle, Capital and revenue, Revenue, Expenses, Gains & Losses, Types of accounts & their rules, Journal Entries Create ledger, Preparation of Trial Balance, Finalizations, Preparation of Trading & Profit & Loss account, Understanding of Assets & Liabilities **Balance sheet and related concepts** - Profit & Loss Statement and related concepts, Financial Ratio Analysis, Cash flow analysis, Funds flow analysis, Comparative financial statements, Analysis & Interpretation of financial statements, Concept of Ratio Analysis, Preparation of Balance sheet (numerical) **Investments:** Risks and return evaluation of investment decision, Average rate of return, Payback Period, Net Present Value, Internal rate of return	
Unit 4	**Budget and Budgetary Control**
Budgeting and Budgetary Control: Concept of budget, Types and classification of budgets,	

Advantages and limitations, Methods of budgeting

Budgetary Control: objectives, merits and limitations, Budget administration. Functional budgets. Fixed and flexible budgets, Installation of Budgetary Control System, Zero base budgeting, Taxes and Financial Planning, Impact of Taxation and Inflation on Financial Management

Unit 5	**International Business and Finance**

Concept of globalization, factors influencing globalization, concept of international business and motives, international trade, institutional framework in international business, the significance of foreign trade policy, export-import procedures

Definition and function of money, Qualities of a good money, classification of money, value of money, index numbers, appreciation and depreciation of money, Gresham's Law and its limitations, Theory of exchange, barter, stock exchange, Speculation Taxation and Insurance

Balance of Trade and Balance of Payments, Barriers to Trade, Benefits of Trade/Comparative Advantage, Foreign Currency Markets/Exchange Rates, Monetary, Fiscal and Exchange rate policies, Economic Development

Unit 6	**Entrepreneurial Finance**

Sources of Funds for Entrepreneurs and Start Ups: Entrepreneurial Finance Vs. Corporate Finance; Traditional Sources of Funds, Early-Stage Sources of Funds- Incubators, Accelerators, Crowd Funding, Business Angels, Mezzanine Funds, Venture Capitals, Private Equity, LBO, Funding Process - Deal Sourcing, Deal Negotiation, Deal Agreement, Term Sheet

Investment Decisions for Start Ups: Time Value of Money, Types of Investment Decisions, Capital Budgeting Process - Investment Evaluation, Risk Analysis in Capital Budgeting - Risk Adjusted Discount Rate, Certainty Equivalent, Decision Tree, Sensitivity Analysis, Scenario Analysis

Valuation and Measurement of Financial Performance: Pre Money and Post Money Valuation, Factors Influencing Valuation, Valuation Methods, Dilution and Valuation of Equity, Metrics used for Performance Evaluation, Harvesting-Exit Strategies

Books and other resources

Text Books:

1. Hay, Donald A. and Derek J. Morris. Industrial Economics and Organization: Theory and Evidence, 2nd Edition (Oxford: Oxford University Press), 1991.
2. Lall, Sanjaya. Competitiveness, Technology and Skills (Cheltenham: Edward Elgar), 2001. 4. Scherer, F. M. and D. Ross. Industrial Market Structure and Economic Performance, 3rd Edition (Houghton: Mifflin), 1990.
3. Financial Accounting", Dr. Kaustubh Sontakke [Himalaya Publishing House]
4. Chandra, Prasanna (2004). Financial Management: Theory and Practice. New Delhi: TATA McGraw Hill

References Books:

1. Accounting Theory & Practice Prof Jawahar Lal [Himalaya Publishing House]

2. Brearley, Richard A. and Myers, Stewart C. (1988). “Principles of Corporate Finance”, New Delhi: McGraw-Hil
3. Engineering Economics, Tara Chand, Nem Chand and Brothers, Roorkee
4. Engineering Economy, Thuesen, G. J. and Fabrycky, W. J., Prentice Hall of India Pvt. Ltd.
5. Mechanical Estimating and Costing, T. R. Banga and S. C. Sharma, Khanna Publishers, Delhi
6. Industrial Organization and Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publishers, New Delhi
7. Mechanical Estimating and Costing, D. Kannappan et al., Tata McGraw Hill Publishing Company Ltd., New Delhi
8. A Text Book of Mechanical Estimating and Costing, O. P. Khanna, Dhanpat Rai Publications Pvt. Ltd., New Delhi
9. Industrial Engineering and Management, O. P. Khanna, Dhanpat Rai and Sons, New Delhi
10. Financial Management, I. M. Pandey, Vikas Publishing House Pvt. Ltd., New Delhi
11. Engineering Economics, James L. Riggs, David D. Bedworth and Sabah U. Randhawa, Tata McGrawHill Publishing Co. Ltd., New Delhi
12. Engineering Economy, Paul DeGarmo, Macmillan International Inc., New York
13. Entrepreneurial Finance-The Art and Science of Growing Ventures, Edited by Alemany L. and Andreoli, J.J, 2018, Cambridge University Press.
14. Rogers, S and Makonnen, R, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur, 4th Ed., Mc Graw Hill Education, 2020

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1. https://onlinecourses.nptel.ac.in/noc22_ma44/
2. https://onlinecourses.nptel.ac.in/noc22_hs72/
3. https://onlinecourses.nptel.ac.in/noc22_mg63/
4. https://onlinecourses.nptel.ac.in/noc22_mg108/
5. https://onlinecourses.nptel.ac.in/noc22_hs113/
6. https://onlinecourses.nptel.ac.in/noc22_ma44/

402050E: Organizational Informatics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding of design, manufacturing and business processes, industrial engineering principles and concepts and information technology. Manual processes of data / information generation, handling and interpretation / usage.

Course Objectives:

1. To provide a comprehensive grounding in many facets of Organizational Information systems.
2. To describe the role of information technology at various levels of organization.
3. To introduce integrated and co-ordinate network of components required for information system.
4. To enable students understand the Product Data Management (PDM) and Product Lifecycle Management (PLM) spanning product development and beyond.
5. To acquaint with information needs and ERP for manufacturing activities.
6. To introduce manufacturing execution system.
7. To describe the information requirements for successful integration of business activities.

Course Outcomes

Learner will be able to:

- CO1. Demonstrate an understanding of the scope, purpose and value of information systems in an organization.
- CO2. Understand the constituents of the information system.
- CO3. Demonstrate the Understanding of the management of product data and features of various PLM aspects.
- CO4. Relate the basic concepts of manufacturing system and the ERP functionalities in context of information usage.
- CO5. Understand the manufacturing execution system and it's applications in functional areas.
- CO6. Outline the role of the information system in various types of business and allied emerging technologies.

Course Contents

Unit 1	**Information Systems in the Enterprise**

Types of information: operational, tactical, strategic and statutory, Pyramid Diagram, management structure, requirements of information at different levels of management and various functions, Information Quality

The Need for Information Systems: Digital Convergence and the changing Business Environment, Information and Knowledge Economy ,Contemporary Approach to IS and Management Challenges, Information requirements for Industry 5.0

Information Systems in the Enterprise: Types of Information Systems in the Organization-Transaction Processing System (TPS), Decision Support System (DSS), Management Information System (MIS) and Executive Support System (ESS). Functional Perspective of IS; Enterprise Systems; Strategic uses of Information Systems; Economic, Organizational and Behavioral Impacts; IT Impact on Decision Making; Leveraging Technology in the Value Chain; MIS and Core Competencies; Strategic Information Systems (SIS)

Unit 2	**Components of Information System**

Introduction to technical and non-technical components of Information system Hardware, Software and IT Infrastructure: Evolution of IT Infrastructure; Digital Storage; IT Infrastructure Components; Current Trends in Hardware Platforms; Enterprise Software; Groupware

Databases and Data Warehouses: Traditional vs Database approach; Database Models, Introduction to Relational Model, and Object Oriented Model; Relational Operations SQL, Data Modelling; Databases on the Web, Data Warehousing, Advances in Database Technology, Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN

Unit 3	**Product Data and Product Lifecycle Management System**

Product Data Management: Product Data, Product Data Management, Basic Functions of a PDM System, Product Data issues - Access, applications, Archiving, Availability, Change, and Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow

Product Life-cycle Management system: system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of PLM systems. Introduction, modules and features of various PLM software like Arena, TeamCenter, Windchill, Oracle, SAP, Aras etc.

Unit 4	**Manufacturing Information System**

The Evolution from MRP to MRP II to ERP, ERP: Principle, ERP framework, Business Blue Print, Business Engineering V/S Business Process Reengineering (BPR), Introduction to various ERP software like SAP, People soft, Baan and Oracle, Comparison, ERP Modules, their Features and applications, Customization and ERP Implementation, Manufacturing Information Systems in lean manufacturing and industry 5.0 environments, Manufacturing Database Integration.

Unit 5	**Manufacturing Execution System**

Concept, functional hierarchy model, generic activity model of manufacturing operations management, various modules like detailed production scheduling, product definition management and production execution management, Historians, diverse reporting and tracking & tracing, plant dashboard, workflow management, interfaces, integration with ERP, and Plant modules, Advantages

per Functional Area, MES implementation	
Unit 6	**Business Information System**

Electronic Commerce and the Digital Organization: Cross functional Enterprise Information System, Internet based Business Models. B2B, EDI and B2C Models; Role of Intranets/Extranet, Web Enabled Business Management, Strategic Enterprise Systems - Information requirement and systems for SCM, CRM, SRM

Emerging Technologies in IS: Cloud Computing, Artificial intelligence systems; Knowledge based expert system (KBES), Knowledge Management System

Management of Information System: Implementation Processes, Maintenance, Evaluation and Security of Information System, Protection of Information System

Books and other resources

Text Books:

1. Kenneth C. Laudon & Jane P. Laudon. "Management Information Systems". Pearson Publishing
2. W. S. Jawadekar, Management Information Systems, Tata McGraw Hill, 2002
3. Robert Schultheis and Mary Summer, Management Information Systems –The Managers View, TataMcGraw Hill, 2008.
4. Goyal D.P., Management Information Systems –A Managers Perspective, Macmillan Publishers.
5. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
6. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
7. Vaman, ERP in Practice, TMH, 2009
8. Sartori, L.G., "Manufacturing Information Systems", Addison-Wesley Publishing Company
9. Date, C.J.,"An Introduction to Database Systems" Addison Wesley", 8th Edn,. 2003
10. Orlicky, G., "Material Requirements Planning", McGraw-Hill, 1994.
11. Kerr, R., "Knowledge based Manufacturing Management", Addison-Wesley
12. Franjo, C., "Manufacturing Information & Data Systems Analysis, Design & Practice", Butterworth-Heinemann, 2002.
13. Weiming S, "Information Technology for Balanced Manufacturing Systems", Springer, 2006.

References Books:

1. Gupta Uma G., Management Information Systems –A Managers Perspective, Galgotia Publications.
2. Gordon Davis, Management Information System: Conceptual Foundations, Structure and Development, Tata McGraw Hill, 2000.
3. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005.
4. Turban, McLean and Wetherbe, Information Technology for Management –Transforming Organizations in the Digital Economy, John Wiley, 2007.

5. Raymond McLeod and Jr. George P. Schell, Management Information Systems, Pearson Education, 2007.
6. James O Brien, Management Information Systems – Managing Information Technology in the Ebusiness enterprise, Tata McGraw Hill, 2002.
7. Avgerou, C., Ciborro, C., & Land, F. (2004). The social study of information and communication technology: Innovation, actors, and contexts. London: Oxford University Press.
8. Kallinikos, J. (2011). Governing through technology: Information artefacts and social practice. New York: Palgrave Macmillan.
9. Luff, P., Hindamarsh, J., & Heath, C. (2000). Workplace studies: Recovering work practice and informing system design. London: Cambridge University Press.
10. Alex Leon and Mathew Leon: “Data Base Management Systems”, Vikas Publishing House, New Delhi.
11. Mahadeo Jaiswal, Monika Mital: “Management Information System”, Oxford University Press, New Delhi, 2008.
12. Murthy C.S.V.: “Management Information System”, Himalaya Publications, New Delhi, 2008.
13. Panneerselvam R.: “Database Management System”, PHI Private Limited, New Delhi, 2008.
14. Philip J, Pratt, Joseph J. Adamski: “Database Management Systems”, Cengage Learning, New Delhi, 2009.
15. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006.
16. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition
17. Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 2004
18. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
19. C. S. V. Murthy: Management Information System, Himalaya, 2009
20. James A. Obrein: Management Information Systems, TMH, 2009

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1. https://onlinecourses.nptel.ac.in/noc20_mg60/preview
2. https://nptel.ac.in/courses/106105195
3. https://nptel.ac.in/courses/110105148
4. https://onlinecourses.nptel.ac.in/noc19_mg54/preview
5. https://nptel.ac.in/courses/110106146
6. https://www.youtube.com/watch?v=NzyhYxUCjlg

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402050F: Computational Multi Body Dynamics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Systems in Mechanical Engineering, Solid Modeling and Drafting, Kinematics of Machinery, Numerical & Statistical Methods, Computer Aided Engineering, Design of Transmission Systems, Dynamics of Machinery

Course Objectives:

1. Study basic terminology and concepts used in Multibody Dynamics
2. Understand the types of joints, its kinematics and relevant transformations
3. Understand the formulation methods and Formulate problems using Principals of Dynamics
4. Analyze the kinematics and dynamics of rigid Planar inter-connected bodies
5. Analyze the kinematics of rigid spatial inter-connected bodies
6. Analyze the kinematics and dynamics of rigid spatial inter-connected bodies and Recogonize the applications of Multibody Dynamics with applications to machine and structural dynamics

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **APPLY** the basic terminology and concepts used in Multibody Dynamics to solve varieties of motion related applications

CO2. **IDENTIFY and EVALUATE** the types of joints, its kinematics and relevant transformations

CO3. **DISTINGUISH and COMPARE** the formulation methods

CO4. **DERIVE** equations of motion and **EVALUATE** the kinematics and dynamics of rigid Planar inter-connected bodies

CO5. **DERIVE** equations of motion and **EVALUATE** the kinematics of rigid Spatial inter-connected bodies

CO6. **APPLY** MBD tool effectively and **SIMULATE** it to solve and validate practical Multibody Dynamics problems and its solutions

Course Contents

Unit 1	**Introduction to Computational Multi Body Dynamics**

Introduction: Single Body Dynamics Vs Multi Body Dynamics, Machine-Design Approach Vs Control-System Approach, Basic Building Blocks (Bodies, Constraints or Joints, Forces,

Motions, Sensors, Controllers, Reference Frames, Contacts, etc.) **Kinematics:** Angular velocity, matrix representation of angular velocity, simple angular velocity, Differentiation in two reference frames, angular acceleration, velocity and acceleration equations, two points fixed on a rigid body, point moving on a rigid body	
Unit 2	**Joints and Kinematics**
Types of joints (planar and spatial joints), Vector formulation of Constraint equations, Jacobian, Computation of Kinematics, Transformations (body-fixed and space-fixed rotations), Velocity Transformations	
Unit 3	**Basic Principles of Dynamics**
D'Alembert's Principle, Equilibrium and Virtual work, Virtual displacements, generalized forces, workless constraints, Lagrange's equation, Non-holonomic constraints, Lagrange's form of D'Alembert's principle - Jourdain - Kane Method, Generalized Inertia, Mass matrix **Newton-Euler Equations**: Constraint equations, augmented formulation, Lagrange multipliers, embedding technique and amalgamated formulation **Principle of virtual work and Lagrange's Equation**: Kinetic energy, potential energy function, generalized forces on a rigid body, derivation of equations of motion using Lagrange's method	
Unit 4	**Planar Multi Body Dynamics Motion Simulation**
Planar Kinematic Analysis: Joint constraints (Revolute, prismatic, gear and cam pairs, etc), Motion/Force Constraints, The automatic assembly of the systems of equations for position, velocity and acceleration analysis, Iterative solution of systems of non-linear equations, **Dynamics of Planar Systems:** Dynamics of Planar systems, Geometry of masses, computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element, Simple applications of Forward and Inverse Dynamic Analysis	
Unit 5	**Kinematic Analysis of Spatial Systems**
Kinematics of Rigid bodies in Space: Reference frames for the location of a body in space, Euler angles and Euler parameters. Screw motion in space, Velocity, Acceleration and Angular Velocity, Relationship between the Angular Velocity Vector and the time derivatives of Euler parameters, Articulated Rigid Body Dynamics **Dynamic Analysis of Spatial Systems:** Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical, screw, etc). Equations of motion of constrained spatial systems	
Unit 6	**Spatial Multi Body Dynamics Motion Simulation and its Applications**
Computation of spatial generalized forces for external forces. Computation of reaction forces from	

Lagrange's multipliers, Recursive Inverse Dynamics

Survey of Existing Kinematic and Multibody dynamics Simulation software, Varieties of Applications

Books and other resources

Text Books:

1. Nikravesh, P.E., (2019), "Planar multibody dynamics: formulation, programming with MATLAB®, and applications," CRC Press, ISBN: 9781138096127
2. Shabana, A.A., (2020), "Dynamics of Multobody Systems," Cambridge University Press, ISBN: 9781108485647
3. Rao, J.S., (2011), "Kinematics of Machinery Through HyperWorks," Springer, ISBN: 9789400711556
4. Haug, E.J., (1988), "Computer-Aided Kinematics and Dynamics of Mechanical Systems, Volume-I, Basic Methods," Prentice Hall, ISBN: 9780205116690
5. Haug, E.J., (2021), "Computer-Aided Kinematics and Dynamics of Mechanical Systems, Volume-II, Modern Methods," www.researchgate.net

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1. Wittenburg, J., (2012), "Dynamics of Systems of Rigid Bodies," Vieweg+Teubner Verlag, ISBN: 9783322909435
2. Roberson, R.E., Schwertassek, R., (2012), "Dynamics of Multibody Systems," Springer, ISBN: 9783642864667
3. Huston, R.L., (1990), "Multibody Dynamics," Butterworth-Heinemann, ISBN: 9780409900415
4. Schielen, W., (1990), "Multibody Systems Handbook," Springer, ISBN: 9783540519461
5. Rampalli, R., Ferrarotti, G. and Hoffmann, M., (2012), "Why Do Multi-Body System Simulation?," NAFEMS, ISBN: 9781874376545
6. Greenwood, D.T., (1987), "Principles of Dynamics," Pearson, ISBN: 9780137099818
7. Moon, F. C., (2008), "Applied Dynamics with Applications to Multibody and Mechatronic Systems," Wiley-VCH, ISBN: 9783527407514
8. Kane, T.R, Levinson, D.A., (1985), "Dynamics: Theory and Applications," McGraw-Hill, ISBN: 9780070378469
9. de Jalon, J.C., Bayo, E., (2011), "Kinematic and Dynamic Simulation of Multibody Systems," Springer, ISBN: 9781461276012
10. Jazar, R. N., (2011), "Advanced Dynamics: Rigid Body, Multibody, and Aerospace Applications," John Wiley & Sons, ISBN: 9780470398357
11. Nandihal, P., Mohan, A., and Saha, S.K., (2021), "Dynamics of Rigid-Flexible Robots and Multibody Systems," Springer, ISBN: 9789811627972
12. Shah, S., Saha, S.K., and Dutt, J.K., (2012), Dynamics of Tree-type Robotic Systems, Springer, ISBN: 9789400750050

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- https://www.youtube.com/channel/UCN3-GeDjFM4A3muyhsS9mpQ

402051A: Process Equipment Design

Teaching Scheme		Credits		Examination Scheme	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Design of Machine Elements

Course Objectives:

1. Understand the process flow diagrams (PFD) and design codes
2. Understand the content of piping and instrument diagrams (P&ID)
3. Understand the design of Cylindrical and Spherical Vessels and Thick Walled High Pressure Vessels
4. To enable students to apply the requirements of the relevant industry standards to the mechanical design of equipment's used in the process industry and above ground atmospheric storage

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **INTERPRET** the different parameters involved in design of process Equipments.
CO2. **ANALYZE** thin and thick walled cylinder
CO3. **DESIGN** cylindrical vessel, spherical vessel, tall vessels and thick walled high pressure vessels
CO4. **DESIGN** different process Equipments and select pump, compressor etc. and auxiliary services
CO5. **EVALUATE** Process parameters and their correlation
CO6. **APPLY** the concepts of process equipment design for specific applications

Course Contents

Unit 1	Process Design

Basic concepts in process design, block diagrams for flow of processes, material flow balance. Design pressures -–temperatures, design stresses, factory of safety, minimum shell thickness and corrosion allowance, weld joints efficiency, design loading, stress concentration and thermal stresses, failure criteria, optimization technique such as Lagrange's multiplier and golden section method, cost and profitability estimation. Introduction to design codes like IS-2825, ASME-SECT, EIGHT-DIV-II TEMA.API-650, BS-1500 & 1515

Unit 2	Piping design
Process Piping Design: Thin and thick walled cylinder analysis, pre stressing, Piping codes for design, construction and inspection, Piping flow diagrams and pipe work symbols, design of layout of water, steam and compressed air pipes work, Types of couplings	
Unit 3	**Thin and Thick Vessels**
Design of Cylindrical and Spherical Vessels: Types and classes of vessels, types design of end closers, local stresses due to discontinuity or change of shape of vessel, vessel opening compensation, design of standard and non-standard flanges, design of vessels and pipes under external pressure, design of supports for process vessels **Design of Tall Vessels:** Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column **Design of Thick Walled High Pressure Vessels**: Thick walled cylinder analysis, pre stressing of thick cylinders, Design by various theories of failure, construction of these vessels with high strength steel and other special methods.	
Unit 4	**Process Equipment Design**
Process Equipment Design: Storage vessels, reaction vessels, agitation and mixers, heat exchangers, filters and driers, centrifuges. Code practices, selection and specification procedures used in design. Selection of pumps, compressors, electrical equipment's and auxiliary services, safety, etc., pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipe supports	
Unit 5	**Process Control**
Process Control: Processes, Process parameters and their correlations, Fundamentals of process measurements and control modern control devices and other controls of major unit operation and processes.	
Unit 6	**Execution and Application of specific process Equipment Design**
Execution: Planning, manufacture, inspection and erection of process equipment like pressure vessels, chimneys, ducting, heat exchangers, pulverizing equipment, etc. protective coatings, lining of Vessels **Application of specific process Equipment Design:** Fuel pumping stations, fire extinguishers, HVAC, fume extraction systems with IOT and AI	

Books and other resources

Text Books:

1. Process Equipment Design : By Dr. M.V. Joshi, Mc-Millan.
2. Process Equipment Design : By Browell and Young, John Wiley.
3. Plant Design and Economics : Max and TimasulausKalus – McGraw Hill.
4. Industrial Instrumentation servicing Hand Book : Cannel Grady, McGraw Hill.

References Books:

1. Handbook of Instrumentation and Control : Kellen Heward, McGraw Hill
2. Chemical Engineering Handbook: Perry John, McGraw Hill.
3. Chemical Equipment Design: B.C. Bhattacharya.
4. Industrial Pipe Work: D.N.W. Kentish, McGraw Hill.
5. Chemical Engineering: J.M. Coulson, Richardson, Sinnott Vol. VII, Maxwell, McMillan.
6. Pressure Vessel Design Hand Book: H. Bedna.
7. Dryden's outlines of Chemical Technology for the 2: By Roa M. Gopala, Sitting M., East West Press Pvt. Ltd., New Delhi.
8. Applied Process Design for Chemical and Petrochemical, Vol. I, II and III: By E.E. Ludwig, Gulf Publication Co., Houston.
9. Chemical Process Control: An Introduction to Theory and Practice: By Stephanopoulos G., Prentice Hall of India, New Delhi.
10. Chemical Process Equipment Selection and Design: By Stanley M.Walas, Butterworth-Heinemann Series in Chemical Engineering.
11. Process System Analysis and Control: By D.R. Coughanowr, McGraw Hill, New York.
12. Engineering Optimization: Theory and Practice: By Rao S.S., New Age Publishing Co., New Delhi.
13. Optimization of Chemical Processes: By Edgar T.F., Himmelblau D.M., McGraw Hill Book Co., New York.
14. Control Devices, Vol. I and II : Liptak
15. Analysis, synthesis and design of Chemical Processes : Richard Turton, Richard C. Bailie, Wallace B. Whiting, Josheph A. Shaewitz, Prentice Hall Int. Series in Physical and Chemical Science.

Savitribai Phule Pune University

Board of Studies - Mechanical and Automobile Engineering

Undergraduate Program – Final Year Mechanical Engineering (2019 pattern)

402051B: Renewable Energy Technologies					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30**
				End-Semester	**70**

Prerequisites: Systems in mechanical engineering, Applied Thermodynamics, Fluid mechanics, Heat transfer and Energy Engineering

Course Objectives:

1. To understand fundamentals, needs and scopes of renewable energy technologies.
2. To design and applications of solar thermal conversion systems.
3. To explain constructions, working and design of solar photovoltaic system used for domestic applications.
4. To design a wind energy system.
5. To study Wind farm and Solar Photovoltaic grid-connected Systems**.**
6. To describe biomass energy conversion systems.

Course Outcomes:

On completion of the course the learner will be able to;

1. **DESCRIBE** fundaments, needs and scopes of renewable energy systems.
2. **EXPLAIN** performance aspects of flat and concentric solar collectors along with applications.
3. **DESIGN** solar photovoltaic system for residential applications.
4. **DESIGN AND ANALYSIS** of wind energy conversion system.
5. **APPLY** Installation practices of Wind and Solar Photovoltaic Systems for grid connection.
6. **DETERMINE** performance parameters of bio-energy conversion systems.

Course Content

Unit 1	**Introduction to Renewable Energy Technologies**

Scenario of Renewable Energy Generation: Energy (and power) policies in the country, Energy supply and renewable energy programme during different plan periods. Renewable energy use and target in India, JNNSM policies and initiatives

Solar Energy Fundamentals: Solar Radiation and Measurement, Solar constant, Solar angles, day length, angle of incidence on tilted surface, Extra-terrestrial characteristic, Effect of earth atmosphere, Measurement and estimation on horizontal and tilted surfaces (numerical treatment on Solar angles and Measurements), Analysis of Indian solar radiation data and applications, Basics of solar cell, Forming the PN junction solar cells, Photo conversion efficiency, Theoretical limits

Wind Energy Fundamentals: Wind speed, Wind direction, Data measurement and analysis, Variation of wind speed with height and time, Wind potential assessment (numerical treatment), and

wind resources worldwide and in India, wind energy forecast	
Unit 2	**Solar Thermal Systems and Applications**
Solar thermal collectors: Flat plate collectors, Thermal analysis, Heat capacity effect, Testing methods, Evacuated tube collectors (ETC) analysis, its design and application, Numerical on flat plate collectors. **Solar Concentrating Collectors:** types- line and point concentrator, tracking systems, theory of Concentrating collectors, parabolic trough collector, parabolic dish collector, Central receiver systems, concentrated Fresnel linear receiver (CFLR). **Solar thermal Applications:** Solar energy thermal storage, heating and cooling of buildings, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning, solar pond, heliostat, solar furnaces, Solar thermal power generation.	
Unit 3	**Solar Photovoltaic Systems**
Solar Cells and Modules: Classification of Solar cells, First generation: Single crystalline, Poly crystalline, Second Generation: Thin film, Cd-Te, CIGS, Third Generation: Polymer based, DSSC, Perovskites, Hybrid, Quantum Dots, Multi Junction Tandem cells, Inorganic and Hybrid cells, Different losses and mitigation, Factors Affecting Electricity Generated by a Solar cell, types of modules, PV panel and array, solar cell equation, Fill factor and maximum power, Shading and hot-spot formation. **Power Conditioning Equipment**: Inverters, Regulators, Other Devices, System Analysis-Design Procedure, Design Constraints, selection of components, calculation of life cycle costing, payback time and Levelized Energy Cost (LEC) (Numerical treatment on- Designing solar PV system to find power consumption, Size the PV panel, Inverter and battery size, Solar charge controller size and costing for domestic applications only) Recent PV market trends, Benchmark cost of different PV components	
Unit 4	**Wind Energy Systems**
Components of wind turbines, Types of wind turbines- Horizontal axis and Vertical axis **Aerodynamics of wind turbines**: Aerofoil sections and lift and drag coefficients, relative wind velocity, Power extraction from the wind energy, Wind power generation curve, Maximum power and Betz coefficient, Power Coefficient of a wind turbine (C_p), Axial thrust and torque developed by the turbine, Design tip speed ratio and solidity **Design parameters:** Rotor axis rotation: Horizontal or Vertical, Rotor position - upwind and downwind of tower, Rotor Speed - constant or variable, Type of hub: rigid, teetering, hinged blades or gimballed, Number of blades, Tower Structure, Materials used for wind turbine components, calculation of life cycle costing, payback time and Levelized Energy Cost (LEC). Performance	

evaluation of Wind energy system. Note: Numerical on aerodynamics, design parameters and payback estimation.	
Unit 5	**Design of grid connected Wind and Solar Photovoltaic Systems**
Wind Farm: Off-shore and on-shore wind farms, Small wind turbines special considerations and designs, testing, noise issues, Site selection and turbine spacing, rotor selection, ICT based monitoring and control of wind farms, Annual Energy Output (AEO) with numerical treatment, optimal placement of wind turbine in a wind farm, Wind power farm: installation operation and maintenance **Design of Wind Energy Conversion Systems:** Power control**:** stall, variable pitch, controllable aerodynamic surfaces and yaw control. Yaw Control: driven yaw, free yaw or fixed yaw **Design of Solar PV systems**: Site selection for solar photovoltaic plants, choice of module and their techno-economical characteristics, Series and parallel combination of PV array installation and output calculation with numerical treatment**,** off grid, on-grid, standalone system, grid interface. Enhancing array performance: cooling, concentrator, Solar PV tracking, effect of dust on PV and remedies, Installation of electrical and electronic components: array combiner box, inverter, Distribution boxes, safety devices, Maintenance procedure of solar photovoltaic plants, DPR preparation for roof-top and MW scale solar plants	
Unit 6	**Bio Energy Systems**
Bio-mass: Biomass types, Characteristics (Ultimate analysis, Proximate analysis, Calorific value, Physical Properties, Thermodynamic properties, Feedstock Handling Characteristic, Thermo-gravimetric analysis), Biomass estimation, Biomass formulation (Numerical Treatment). **Bio-fuel**: Introduction to bio-fuels, feedstocks for bio-fuel production, bio-diesel, bio-hydrogen, concept of bio-refinery **Thermo-chemical conversion**: Pyrolysis, Liquefaction and Gasification, Gasifier and types. Gas production, environmental effects, Producer gas utilization, Biomass integrated gasification/combined cycles systems (Numerical Treatment). **Bio-chemical Conversion:** Biodegradation, Aerobic Digestion, Anaerobic digestion; Biogas digester types and biogas utilization	
Books and other resources	
Text Books: 1. S P Sukhatme and J P Nayak, Solar Energy: Principles of Thermal Collection and Storage, McGraw-Hill Education, 2017 2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modelling and Applications, Alpha Science, 2002	

3. Rabindra Satpathy, Venkateswarlu Pamuru, Solar PV power: Design, manufacturing and applications from sand to sand to systems.
4. B. H. Khan, Non-Conventional Energy Sources, Second Edition. Tata Mc-Graw Hill.
5. J. F. Manwell, J. G. McGowan and A. L. Rogers., Wind Energy Explained- Theory, Design and Application. John Wiley and Sons Ltd.
6. G. D. Rai, Energy Sources, Khanna Publications.
7. John R. Balfour, Introduction To Photovoltaic System Design (The Art and Science of Photovoltaics), Jones and Bartlett Publishers,
8. Michel C. Allard, Bioenergy Systems, Biological Sources and Environmental Impact, Nova Science Publishers, Inc.; UK ed. edition 2013.
9. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction, Academic Press, Elsevier, 2013.
10. Meisam Tabatabaei, Biogas: Fundamentals, Process, and Operation (Biofuel and Biorefinery Technologies, Springer; 2018.

References Books:

1. G. N. Tiwari, Arvind Tiwari, Handbook of Solar Energy: Theory, Analysis and Applications, Springer, 27-Jun-2016 - Technology & Engineering.
2. S. Yang, H.A. El-Enshasy, N. Thongchul (Eds.), Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuels, Chemicals and Polymers, Wiley, 2013.
3. Handbook of Renewable Energy Springer; 1st ed. 2017.
4. Richard Jemmett, Methane Production Guide - How to Make Biogas. Three simple anaerobic digesters for home construction: Generate your own renewable energy from waste, RW Jemmett; 3rd edition (13 February 2011).
5. Wim Soetaert, Biofuels, Wiley, 2011.

Web Courses:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/103103207
3. https://nptel.ac.in/courses/108108078
4. https://nptel.ac.in/courses/102104057

Web References:

India_2020_Energy_Policy
https://iea.blob.core.windows.net/assets/2571ae38-c895-430e-8b62-bc19019c6807/India_2020_Energy_Policy_Review.pdf

Cost Analysis Of Energy Savings
Link: https://egyankosh.ac.in/bitstream/123456789/47587/1/Unit-3.pdf

National Electricity Plan
https://powermin.gov.in/en/content/national-electricity-plan-0
Report : https://powermin.gov.in/sites/default/files/uploads/NEP-Trans1.pdf

Economic & Financial Evaluation of Renewable Energy Projects
https://pdf.usaid.gov/pdf_docs/PNADB613.pdf
https://energypedia.info/wiki/The_Economics_of_Renewable_Energy

Analyzing The Falling Solar And Wind Tariffs: Evidence From India
https://www.adb.org/sites/default/files/publication/566266/adbi-wp1078.pdf

Mapping India's Energy Subsidies 2020
https://www.iisd.org/system/files/publications/india-energy-transition-2020.pdf

Jawaharlal Nehru National Solar Mission policies and initiatives:
Presentation: https://iitj.ac.in/CSP/material/JNNSM-Final.pdf
Report: https://mnre.gov.in/img/documents/uploads/file_f-1608040317211.pdf

Benchmark costs for Grid-connected Rooftop Solar PV systems:

https://www.yellowhaze.in/mnre-solar-benchmark-cost-2021-22/
Benchmark costs for Grid-connected Rooftop Solar Photo-voltaic systems for the financial year 2021-22
https://mnre.gov.in/img/documents/uploads/file_f-1629353920466.pdf
Installation & Maintenance of Solar Panel
https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on%20Installation%20&%20maintenance%20of%20Solar%20Panel(1).pdf

402051C: Automation and Robotics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Systems in Mechanical Engineering, Programming and Problem Solving, Basic Electronics Engineering, Engineering Mechanics, Solid Modeling and Drafting, Electrical and Electronics Engineering, Kinematics of Machinery, Mechatronics, Design of Transmission Systems

Course Objectives:

1. Introduce the need of Industrial Automation
2. Learn various types of Robots and the functional elements of Robotics
3. Identify and Judge application specific selection of Robot Drive Systems
4. Recognize various types End-effectors and Sensors used in Robotic Automation
5. Study the basic Mathematical Modeling Techniques of Robot
6. Understand the basics of Robot Programming and Robotic Applications

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** the basic concepts of Automation
CO2. **UNDERSTAND** the basic concepts of Robotics
CO3. **IDENTIFY** and **EVALUATE** appropriate Drive for Robotic Applications
CO4. **COMPARE** and **SELECT** End-effectors and Sensors as per Application
CO5. **DEVELOPE** the Mathematical Modeling Approaches of Robot
CO6. **EVALUATE** the fundamentals of robot programming and **CLASSIFY** the Applications

Course Contents

Unit 1	**Introduction to Automation**

Introduction: Automation in Production systems, Automated Manufacturing Systems, Reasons for Automation, Automation Principles and Strategies, USA (Use, Simplify & Automate) Principle, Automation Migration Principle, Types of Automation, Classification by Function/ Transfer Method, Automation using Hydraulic/Pneumatic Systems, Electrical/Electronic Systems and Automated Assembly Systems - Selection criteria, components, applications

Automated Assembly Systems: Types and Configurations, Part Feeding Devices, Part Orientation Devices, Part Conveying Devices, Feed tracks, Escapements and Part placing mechanism, Parts Delivery at workstations, Single-station and Multi-station Assembly Machines

<table>
<tr><td>Unit 2</td><td>Fundamentals of Robot Technology</td></tr>
<tr><td colspan="2">Introduction: History, Definitions specified by Agencies, Classification and Applications, Laws of robotics, Specifications of robots, Flexible automation Vs. Robotics technology, Safety measures in robotics, Role of Robots in Automation

Robot Anatomy and configurations: Cartesian, Cylindrical, Polar, Articulated, SCARA, Pendulum Arm, Multiple Joint Arm, Parallel Manipulator, Work Envelope/Volume, Degree of Freedom associated with Robot Arm & Wrist, Joints & Joint Notification Scheme, Precision of Movement</td></tr>
<tr><td>Unit 3</td><td>Robot Drive Systems</td></tr>
<tr><td colspan="2">Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC - Salient Features, Applications and Comparison of all these Drives, Micro actuators, Selection of drive, Power and Motion Transmission Systems for Robot, Motion Conversion, Determination of Power of motor, Types of Gearbox - Planetary, Harmonic, Cycloidal Gearbox and Gear Ratio, Variable Speed Arrangements</td></tr>
<tr><td>Unit 4</td><td>End-effectors & Sensors in Automation</td></tr>
<tr><td colspan="2">End-effectors/Grippers/Tooling: Introduction, Types, Classification, Construction, Working, Selection and Design Considerations of End-Effectors/Grippers/Tooling Interface used in various Robotic Applications, Active and Passive Compliance

Sensors/Transducers: Introduction, Types, Classification, Construction, Working, Selection and Design Considerations of Transducers, Sensors, Resolvers, Encoders, Switches, Position/Range/Touch/Force/Torque/Safety Sensors and Transduces, Machine Vision System used in various Robotic Applications</td></tr>
<tr><td>Unit 5</td><td>Mathematical Modeling of Serial and Parallel Robots</td></tr>
<tr><td colspan="2">Kinematics: General Mathematical Preliminaries on Vectors & Matrices, Link Equations and relationships, Direct Kinematics, Coordinate and Vector Transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Coordinate System, Inverse Kinematics of two joints/link manipulator, DH Parameters, Jacobian Transformation in Robotic Manipulation, Static Analysis

Dynamics: Direct Dynamics, Mass/Inertia and their Positions of links, Lagrangian/Eularian/Newtonian Approaches for formulation of equations of motion of planar two link/joint manipulator</td></tr>
<tr><td>Unit 6</td><td>Performance and Applications of Robots</td></tr>
<tr><td colspan="2">Robot Performance and Economics: Introduction to Robotic Programming, Types of Robot Programming, Motion Programming, Simulation and Off-line Programming, Programming Examples such as Palletizing, Loading, Unloading, Material Handling, etc., Robot Economics, Functional Safety in Robotic Applications, Social Aspects of Robotics, Industry 4.0

Robots in Manufacturing Applications: Robot-based Manufacturing System, Robot Cell Design</td></tr>
</table>

Considerations and Selection of Robot

Robots in Non-manufacturing Applications: Field And Service Robotics, Mobile Robots, Wheeled, Legged, Tracked, Hybrid Terrestrial Mobile Robots, Unmanned Aerial Vehicle (UAV), Autonomous Underwater Vehicles (AUV), Humanoids, Robotic Assistive Technologies for Rehabilitation of Humans

Books and other resources

Text Books:

1. Groover, M. P., (2016), "Automation, Production Systems, and Computer-integrated Manufacturing," Pearson Education, ISBN: 9789332572492
2. Derby, S. J., (2004), "Design of Automatic Machinery," CRC Press, ISBN: 9780824753696
3. Deb, S. R., Deb, S., (2017), "Robotics Technology and Flexible Automation," McGraw Hill Education, ISBN: 9780070077911
4. Sandler, B. Z., (1999), "Robotics: Designing the Mechanisms for Automated Machinery," Academic Press/Prentice Hall, ISBN: 9780137816002
5. Tsai, L. W., (1999), "Robot Analysis: The Mechanics of Serial and Parallel Manipulators," Wiley-Interscience, ISBN: 9780471325932
6. Nagarajan, R., (2016), "Introduction to Industrial Robotics," Pearson Education India, ISBN: 9789332544802
7. Gupta, A. K., Arora, S. K., Westcott, J. R., (2016), "Industrial Automation and Robotics: An Introduction," Mercury Learning & Information, ISBN: 9781938549304

References Books:

1. Niku, S. B., (2020), "Introduction to Robotics, Analysis, Control, Applications," Wiley, ISBN: 9781119527626
2. Groover, M. P., Weiss, M., Nagel, R. N., Odrey, N. G., R.,Dutta, A., (2017), "Industrial Robotics - Technology ,Programming and Applications," McGraw Hill Education, ISBN: 9781259006210
3. Ray Asfahl, C., (1992), "Robots and Manufacturing Automation," Wiley, ISBN: 9780471553915
4. Koren, Y., (1985), "Robotics for Engineers," McGraw-Hill, ISBN: 9780070353992
5. Saha, S. K., (2017), " Introduction to Robotics," McGraw-Hill Education, ISBN: 9789332902800
6. Mittle, R., Nagrath, I., (2017), "Robotics and Control," McGraw Hill Education, ISBN: 9780070482937
7. Craig, J., (2021), "Introduction to Robotics: Mechanics and Control, Pearson, ISBN: 9781292164939
8. Mike Wilson, M., (2014), "Implementation of Robot Systems: An introduction to robotics, automation, and successful systems integration in manufacturing," Butterworth-Heinemann, ISBN: 9780124047334
9. Spong, M. W., Hutchinson, S., Vidyasagar, M., (2020), "Robot Modeling and Control," Wiley, ISBN: 9781119523994
10. Siegwart, R., Nourbakhsh, I. R., Scaramuzza, D., (2011), "Introduction to Autonomous

Mobile Robots," The MIT Press, ISBN: 9780262015356
Web References: • Pratihar, D. K., (2019), "Robotics,: IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc19_me74/preview • Asokan, T., Ravindran, B., Vasudevan, K., (2020), "Introduction to Robotics," IIT Madras, https://onlinecourses.nptel.ac.in/noc20_de11/preview • www.roboanalyzer.com

402051D: Industrial Psychology and Organizational Behavior					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Understanding psychology as natural science, Infancy and Preschool Years, Diversity and Social Interaction, zeal to contribute for individual, group, social and national development.

Course Objectives:

1. To develop an understanding of the nature, functioning and design of organization as social collectivities.
2. To orient the students to the application of principles of psychology in an industrial and organizational workplace
3. To demonstrate the understanding of job requirement and related fatigue, boredom and ways to handle it.
4. To develop the insights into performance management and understanding related improvement strategies.
5. To have an understanding of human behavior in groups and develop knowledge and skills in leadership, power, communication, negotiation and conflict management.
6. To develop the acumen to understand the organizational culture, change management and organizational development.

Course Outcomes

On completion of the course the learner will be able to;

CO1. **DEMONSTRATE** fundamental knowledge about need and scope of industrial - organizational psychology and behavior.
CO2. **ANALYZE** the job requirement, have understanding of fatigue, boredom and improve the job satisfaction.
CO3. **UNDERSTAND** the approaches to enhance the performance.
CO4. **KNOWLEDGE** of theories of organizational behavior, learning and social-system.
CO5. **UNDERSTAND** the mechanism of group behavior, various aspects of team, leadership and conflict management.
CO6. **EVALUATE** the organizational culture, manage the change and understands organizational development approaches.

Course Content

Unit 1	**Industrial Psychology: Introduction**

Introduction to Industrial Psychology, Brief History of Industrial Psychology, Nature, Scope and Problems, psychology as a science and areas of applications, Individual differences and their

evaluation, Role of heredity and environment, study of behavior and stimulus to response behavior, Types of individual differences, Scientific management and it's limitations **Hawthorne Studies**: Introduction, Hawthorne Studies, Implication of Hawthorne Studies, Criticisms of Hawthorne Studies, Relevance of Industrial psychology in era of Industry 5.0	
Unit 2	**Job Analysis and Industrial Fatigue**
Job Analysis and Evaluation, Employee Selection, Performance Evaluation, training and development **Industrial Fatigue**: Introduction, Concept and Meaning, Types of Industrial Fatigue, Causes of Fatigue, Contents, Fatigue Symptoms, Industrial Studies on Fatigue, Causes and Remedies of Industrial Fatigue, Effects of Industrial Fatigue **Industrial Boredom**: Introduction, Concept and Meaning, Causes and Remedies of Boredom, Effects of Boredom, Reducing Boredom	
Unit 3	**Performance Management**
Performance Management: Introduction, Concept and Meaning, Objectives of Performance Management, Process of Performance Management, Approaches to Performance Development, Methods of Performance Management Relevance of Leadership and supervision, Recruitment, Time and Stress Management, Occupational Health and Safety. Implication of Motivation Theories in Workplace, Factors Influencing Job Satisfaction, Reducing Dissatisfaction	
Unit 4	**Organizational Behavior: Introduction**
Concept of organization & organizational behavior, Organizational structure, factors affecting behavior in organizations, Theories of Organization - Classic Organizational Theory, Human Relations Theory, Contingency Theories, Models and Approaches of Organizational Behavior. Ethics and ethical behavior in organizations, Learning: meaning and definition, process and theories of learning, Understanding a social-system, Organizational Behavior in an Engineering Sector Organization	
Unit 5	**Group Behavior and Interpersonal Relationships**
Group Behavior: Groups: Concept and Classification, Stages of Group Development, Group Structure, Roles and Norms, Premise and Issues. Group Decision-Making: Group vs Individual, Groupthink and Groups Shift, Group Decision Making Techniques and Process **Team work**: meaning, concept, types, creating, an effective team **Leadership**: Functions and approaches; trait, behavioral and contingency models; characteristics of successful leaders; role of power in leadership **Interpersonal Relationships**: Understanding Self and Others, Developing Interpersonal	

Relationships, Transactional Analysis, Johari Window

Conflict Management: Concept, Causes, Types, Stages, Effects, Management of Conflicts

Unit 6	**Organizational Culture, Change Management and Organizational Development**

Organizational Culture: Concept, Dominant Culture, Strong vs Weak Cultures, Creating and Sustaining Culture, Employees Learning of the Culture, Creating a Customer-Responsive Culture.

Organizational Changes: Concept and Forces for Change, Managing Planned Changes, Resistance to Change, Approaches to Manage Organizational Change, Organizational Development, Culture-Boundedness of Managing the Change.

Organizational theory and development:
Organizational Theory: Classical organizational THEORY, Humanistic Theory, Open-System Theory
Organizational development: Need, models of Organizational change, Organizational development interventions

Books and other resources

Text Books:

1. Vikram Bisen and Priya, Indistrial Psychology, New Age Publication, 2010.
2. Michael Aamodt, Organizational/ Industrial Psychology, Wadsworth Cengage Learning, 2010
3. Robbins, S.P. Organizational Behaviour. Prenctice-Hall, latest edition.
4. Spector, P.E. Industrial and Organizational Psychology: Research and Practice. International Student Version. Latest Edition. Wiley.
5. Davis K. & Newstrom J.W., Human Behaviour at work, Mcgraw Hill International, 1985
6. Stephen P. Robbin & Seema Sanghi, Organizational behavior, Pearson, 2011
7. L.M. Prasad, Organizational behavior, S Chand & sons

References Books:

1. Blum M.L. Naylor J.C., Horper & Row, Industrial Psychology, CBS Publisher
2. Luthans Fred, Organizational Behaviour, McGraw Hill International.
3. Morgan C.t., King R.A.,John Rweisz & John Schoples, Introduction to Psychology, McHraw Hill, 1966
4. Schermerhorn J.R.Jr., Hunt J.G &Osborn R.N., Managing, Organizational Behaviour, John Willy
5. Arnold J., Robinson, Iran, T. and Cooper, Cary L, Work Psychology, Macmillan IndiaLtd.
6. Muchincky (2009). Psychology applied to work. New Delhi: Cengage.
7. Griffin, Ricky W: Organizational Behaviour, Houghton Mifflin co., Boston.
8. Ivancevich; John and Micheeol T. Matheson, Organizational Behaviour and Management, Tata McGraw-Hill, New Delhi.
9. Newstrom, John W. and Keith Davis: Organizational Behavior: Human Behavior at Work, Tata McGraw-Hill, New Delhi.
10. Steers Richard m. and J. Stewart black: Organizational Behavior, Hrper Collins college

Publishers, New York.
11. Sukla, Madhukar: Understanding Organizations: Organization Theory and Practice in India, Prentice Hall, New Delhi.

Web References:

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2. http://nptel.ac.in/cour ses/110105034/6
3. http://nptel.ac.in/cour ses/110105034/12
4. http://nptel.ac.in/cour ses/110105034/8
5. http://nptel.ac.in/cour ses/110105034/14
6. http://nptel.ac.in/course s/110105034/23
7. http://nptel.ac.in/course s/110105034/26
8. http://nptel.ac.in/course s/110105034/27
9. http://nptel.ac.in/cour ses/110105034/34
10. http://nptel.ac.in/cour ses/110105034/2
11. http://nptel.ac.in/cour ses/110105034/40

402051E: Electric and Hybrid Vehicle					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mathematics, Physics, Chemistry, Systems in Mechanical Engineering, Basic Electrical Engineering, Electrical and Electronics Engineering, Kinematics of Machinery, Computer Aided Engineering, Design of Transmission Systems

Course Objectives:

1. Introduce the concepts of electric vehicle and allied technologies
2. Learn the concept and types of hybrid electric vehicle
3. Identify and Judge application specific selection of Prime Movers, Energy Storage and Controllers required for e-vehicles
4. Recognize the e-Vehicle Configurations and Understand the Mechanics of vehicle movement
5. Design and Select the body frame with relevant suspension system and Testing of e-Vehicle as per Regulation/Licensing/Approval Organizations
6. Understand the Battery Charging techniques and management

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **UNDERSTAND** the basics related to e-vehicle

CO2. **CLASSIFY** the different hybrid vehicles

CO3. **IDENTIFY** and **EVALUATE** the Prime Movers, Energy Storage and Controllers

CO4. **DISCOVER** and **CATAGORIZE** the Electric Vehicle Configuration with respect to Propulsion, Power distribution and Drive-Train Topologies

CO5. **DEVELOP** body frame with appropriate suspension system and **TESTING** of for e-Vehicles

CO6. **CLASSIFY** and **EVALUATE** Battery Charging techniques and management

Course Contents

Unit 1	**Introduction to Electric and Hybrid Vehicle**

History and evolution of Electric Vehicles, Comparison of Electric with Internal Combustion Engine Vehicles, Limitations of IC Engine Vehicles (ICEV), Exhaust Emission and Global warming, Environmental importance of Hybrid and Electric Vehicles, Overview of EV Challenges, Classification, Overview of EV Technologies, Advantages and Disadvantages, Economic and Environmental impacts of using Electrical Vehicles, Emerging Technologies for Electric Vehicle Drives, Case Studies of Two-Wheeler, Three-Wheeler, and Four-Wheeler Electric Vehicles,

Brief introduction to Autonomous and self-driving Vehicles	
Unit 2	**Hybrid Electric Vehicle**
Classification of HEV: Architecture, Construction, Working, Advantages and Limitations of Conventional and Gridable HEV, Classification of Conventional HEV, Types of Gridable HEV, Tractive force, Power and Energy requirements for standard drive cycles of HEV **Hybrid Electric Drive-Trains:** Basic concept of Hybrid Traction, introduction to various hybrid Drive-Train Topologies, Power flow Control in Hybrid Drive-Train Topologies, Fuel Efficiency Analysis **Control Strategy:** Supervisory Control, Selection of Modes	
Unit 3	**Prime Movers, Energy Storage and Controllers**
Brief introduction to Motors: Classification, Construction, Working, Control, Design criteria, Application and Design Examples, Selection of Motor, Structural Configuration of Motor Layout, Motor Safety and Maintenance, Motor Torque and Power Rating **Brief introduction to Energy Storage Systems:** Classification - Types and Packs, Construction, Working, Comparison and Selection, Principle of Operation, Units of Battery/Fuel Cell Energy Storage, Battery Performance Parameters Estimation, Battery/Cell Modeling, Traction Batteries and their Capacity Calculation and Power Rating for standard drive cycles, Lifetime and Sizing Considerations, Power and Efficiency, Characteristic Curves, Battery Cooling/Thermal Control and Protection, Battery Safety and Maintenance, Auxiliary battery, Hybridization of energy storage devices, Ultra capacitor and Ultra flywheel **Controllers:** Configuration based on power electronics, Torque/Speed Coupling, Speed and Torque Controllers, BCU, MCU, Speed Control for Constant Torque/Power Operation of all electric motors, Control Methods	
Unit 4	**Electric Vehicle Configuration and Mechanics of Vehicle Movement**
Electric Vehicle Configuration with respect to Propulsion and Power distribution: Unicycle, Two-Wheeler (Bicycle, Dicycle, Motorcycle, Scooter, Scooteretts, Mopeds and Underbone), Three-Wheeler, and Four-Wheeler Electric Vehicles, Steering and Propulsion Configuration, Placement of Motors, Battery and Motion Transmission Systems **Electric Drive-Trains:** Basic concept of Electric Traction, introduction to various Electric Drive-Train Topologies, Power flow Control in Electric Drive-Train Topologies, Fuel Efficiency Analysis, Mechanical Differential Vs. Electric Differential **Mechanics of Vehicle Movement:** General description of vehicle movement, Power train Components and Sizing, Wheels and Tires, Load calculation, Torque/Traction Calculations, Power Calculation, Effect of Rolling, Pitch & Yaw on velocity and moments, Rolling resistance and its equation, Aerodynamic Drag/Lift and its equation, Grading resistance, Road	

resistance, Acceleration resistance, Total driving resistance, Dynamic equation, Brake System

Unit 5	Electric Vehicle Design, Manufacturing, Testing & Homologation

Frames and Suspension Design for varieties of Electric Vehicle Configuration: Introduction to Body loads, Driving dynamics and Comfort, Strength and Stiffness of chassis/frames, Types and constructional details of frames, Frame Materials, Frame building Problems, frame components, Front and Rear Suspension Systems, Panel meters and controls on Handle-bar/Dash-board, Body Manufacturing, Aesthetics and Ergonomics Consideration, Retrofitting and its associated Problems

Vehicle Testing & Homologation: Need of vehicle Testing and Homologation, National/International Testing/Regulation/Licensing/Approval Organizations and their Standards (AIS) for e-Vehicles, Hierarchy of Testing, Conformity of Production tests, Crash test, Side Impact Test, Rollover Test, Impact Test, Track Testing

Unit 6	EV Charging Infrastructure Management

Battery Charging: Basic Requirements for Charging System, Charging Methods and Standards, Converters, Charger Architectures, Grid Voltages, Frequencies and Wiring, Charger Functions, Real Power, Apparent Power, and Power Factor, Boost Converter for Power Factor Correction, Examples, Vehicle to Grid operation of EV's

Battery Management Systems: Necessity of Battery Management Systems, Typical Structure of BMSs, Representative Products, Keypoints of BMSs in Future Generation, Hazard/Safety Management

Books and other resources

Text Books:

1. Iqbal Hussein, (2021), "Electric and Hybrid Vehicles: Design Fundamentals," CRC Press, ISBN: 9780367693930
2. Denton, Tom, (2020), "Electric and Hybrid Vehicles," 2nd Ed., Routledge, ISBN:9780367273248
3. John Lowry, James Larminie, (2012), "Electric Vehicle Technology Explained," Wiley, ISBN: 9781119942733
4. Knowles, Don, (2011), "Automotive Suspension & Steering Systems," Cengage learning, ISBN: 9781435481152
5. Malen, Donald E., (2011), "Fundamentals of Automobile Body Structure Design," SAE International, ISBN: 9780768021691
6. R. Krishnan, (2001), "Electric Motor Drives: Modeling, Analysis, and Control," Pearson, ISBN: 9780130910141
7. Mohammad Saad Alam, Reji Kumar Pillai, N. Murugesan, (2021), "Developing Charging Infrastructure and Technologies for Electric Vehicles," IGI Global/ Business Science Reference, ISBN: 9781799868583

References Books:

1. Mehrdad Ehsani, Yimi Gao, Sefano Longo, Kambiz Ebrahimi, (2019), "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design," CRC Press,

ISBN: 9780367137465
2. Tariq Muneer, Mohan Kolhe, Aisling Doyle, (2017), “Electric Vehicles: Prospects and Challenges,” Electric Vehicles: Prospects and Challenges, ISBN: 9780128030219
3. Sandeep Dhameja, (2001), “Electric Vehicle Battery Systems,”, Newnes, ISBN: 9780750699167
4. Bruno Scrosati, Jürgen Garche, Werner Tillmetz, (2015), “Advances in Battery Technologies for Electric Vehicles,” Woodhead Publishing, ISBN: 9781782423775
5. Shunli Wang, Carlos Fernandez, Yu Chunmei, Yongcun Fan, Cao Wen, Daniel-Ioan Stroe, Zonghai Chen, (2021), “Battery System Modeling,” Elsevier, ISBN: 9780323904728
6. Andrea, Davide, (2010), “Battery management systems for large lithium battery packs,”Artech House Publishers, ISBN: 9781608071043
7. Dixon, John C., (2009), “Suspension Analysis and Computational Geometry,” Wiley, ISBN: 9780470510216
8. Day, Andrew J., (2014), “Braking of Road Vehicles,” Butterworth Heinemann, ISBN: 9780123973146
9. Guiggiani, Massimo, (2018), "The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars," Springer, ISBN: 978-3319732190
10. Chen, Yong, (2021), “Automotive Transmissions: Design, Theory and Applications,” Springer, ISBN: 9789811567025
11. Bentley Publishers, (2002), “Bosch Automotive Handbook,” Bentley Publishers, ISBN: 0837610974
12. Prasad, Priya and Belwafa, Jamel E., (2004), “Vehicle Crashworthiness and Occupant Protection,” American Iron and Steel Institute Southfield, Michigan, www.roadsafellc.com
13. Macey, Stuart and Wardle, Geoff, (2008), “H-Point: The Fundamentals of Car Design & Packaging,” designstudio Press, ISBN: 9781933492377
14. Sulabh Sachan, Sanjeevikumar Padmanaban, and Sanchari Deb, (2022), “Smart Charging Solutions for Hybrid and Electric Vehicles,” Scrivener Publishing, ISBN: 9781119768951

Web References:

- Majhi, S. and Kumar, P., (2019), “Introduction to Hybrid and Electric Vehicles,” IIT Guwahati, http://nptel.ac.in/courses/108103009/
- https://evreporter.com/

402052: Mechanical Systems Analysis Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**02 Hrs.**	**Practical**	**01**	**Term Work**	**25 Marks**
				Oral	**25 Marks**

Prerequisites: Systems in Mechanical Engineering, All Mechanical Engineering subjects, Solid Modelling and Drafting, Computer Aided Engineering, Computational Fluid Dynamics, Computational Multi Body Dynamics, Project Based Learning -I,-II, Skill Development, Internship/Mini project, All Electives

Course Objectives:

1. Develop an understanding of the Systems Engineering Process and the range of factors that influence the product need, concept development, system's mathematical modelling, analysis, synthesis, simulation, design, validation, redesign, planning, production, evaluation and use of a system using manual calculation, mathematical modelling, computational tools to automate product development process.
2. Understand the concepts of and use the developed skills in last three and half year of engineering studies for the design, construction, fault-finding, diagnosis, performance analysis, maintenance, modification, and control of technological systems.
3. Acquire knowledge of new developments and innovations in technological systems to be carried forward to next stage of employment after passing your Undergraduate Degree Examination.
4. Develop an understanding of how technologies have transformed people's lives and can be used to solve challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.
5. Gain an awareness of quality and standards, including systems reliability, safety and fitness for the intended purpose.
6. Build yourself to face the challenges of future technologies and their associated Problems.

Course Outcomes:

On completion of the course the learner will be able to;

CO1. **DEVELOP** an understanding of the Systems Engineering Process and the range of factors that influence the product need, problem-specific information collection, Problem Definition, Task Specification, Solution Concept inception, Concept Development, System's Mathematical Modelling, Synthesis, Analysis, final solution Selection, Simulation, Detailed Design, Construction, Prototyping, Testing, fault-finding, Diagnosis, Performance Analysis, and Evaluation, Maintenance, Modification, Validation, Planning, Production, Evaluation and use of a system using manual calculation, computational tools to automate product development process, redesign from customer feedback and control of technological systems.

CO2. **ILLUSTRATE** the concepts and USE the developed skill-set of use of computational tools (FEA, CFD, MBD, FSI, CAE) to automate the complete product development process.

CO3. **EVALUATE** the knowledge of new developments and innovations in technological systems to carry forward to next stage of employment after passing your Undergraduate Degree Examination.

CO4. **APPRAISE** how technologies have transformed people's lives and can be used to **SOLVE** challenges associated with climate change, efficient energy use, security, health, education and transport, which will be coming your ways in the coming future.

CO5. **PRIORITIZE** the concept of quality and standards, including systems reliability, safety and fitness for the intended purpose.

CO6. **INVENT** yourself to face the challenges of future technologies and their associated Problems.

Course Contents

Preamble:

Engineering is the application of science to develop, design, and produce logical and/or physical objects such as buildings, machines, or a computer program to fulfill a desired need or to achieve an objective. So the object or goal of engineering is a design. So Systems Engineering is the engineering of a system - it is the application of science to design a system.

This lab is intended for developing an analysis skill-set with logical reasoning expected by industries to solve their problems during Product (Hardware, Software and Services) Development Process as a part of Company's System Engineering to survive in the open competitive Market, where there is no Textbook available.

TERM WORK:

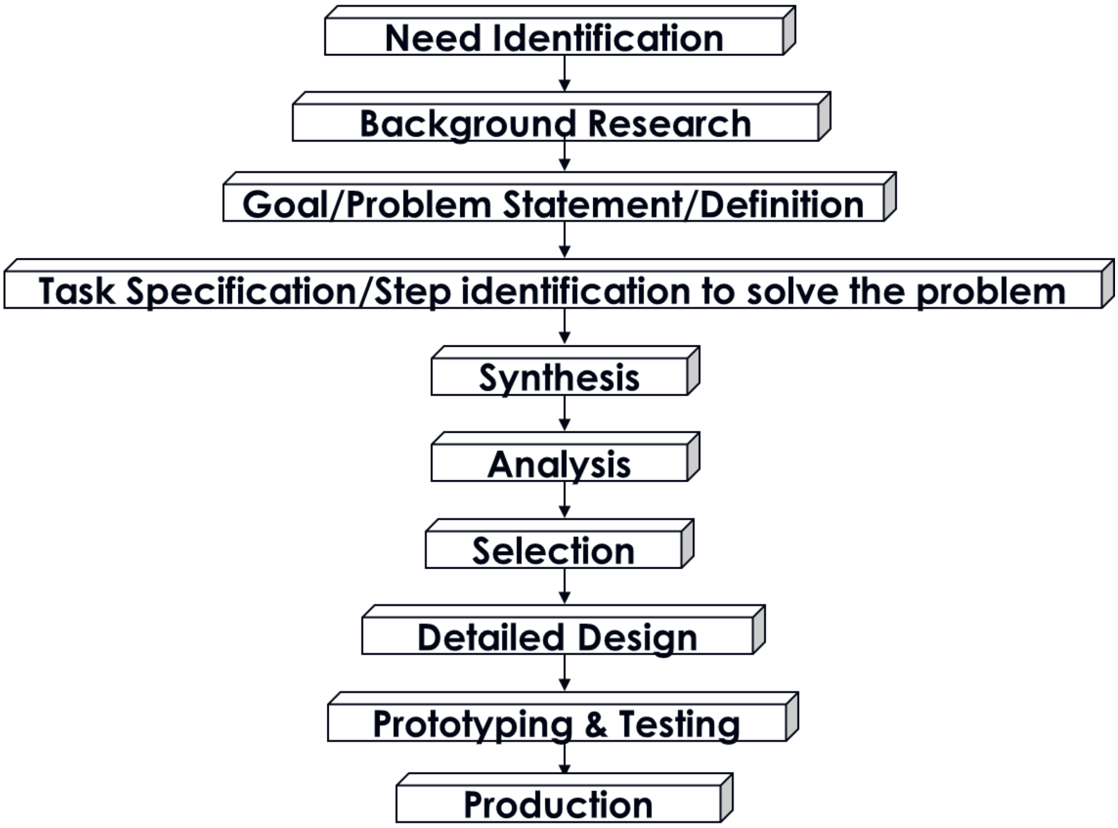
The term work shall consist of following **two parts**, each carry **equal weightage**:

A] Product based Case study

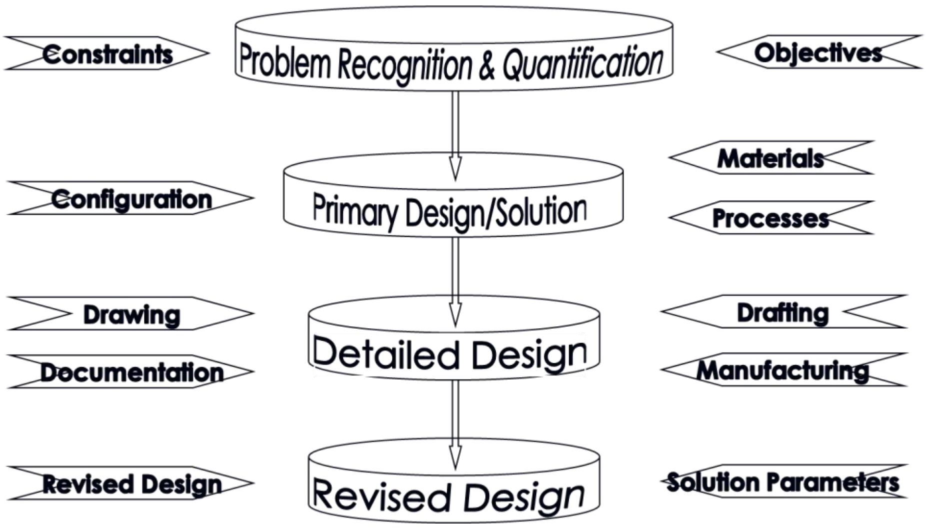
- **Individual student** will take up **one product based system analysis activity** by consultation with associated faculty and followed by development using available and learned computational tool. It will be in the form of Complete Report.

- The product can be but not limited to: any household product, Utility products, Hand/Process Tools/Equipments, Thermal Systems like, Heat exchangers, Mass production jigs/fixtures, robotics and automation products, etc.

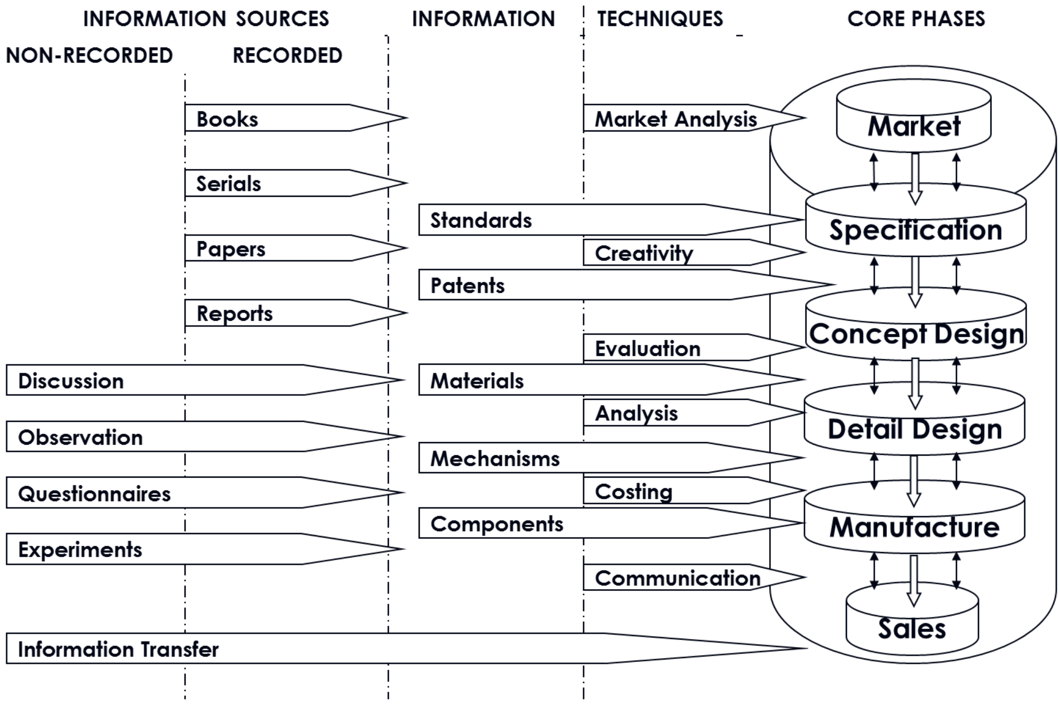
- Product Systems Analysis must follow following approach for developing the final prototype (Hardware, Software and Services).



- The Decision Making Approach with required inputs will be as follows:



- The Resources & flow of Information for System Analysis Activity for Product development must follow:



- **Demonstration by Faculty (guiding role) -** Faculty shall demonstrate complete design, analysis and synthesis of any one mechanical system from need to the end use comprising of deployment of appropriate analysis tool for modelling of the prototype. Philosophy must be told and demonstrated by faculty.

NOTE: This work should not be replication of your Project Work

B] List of Assignments (Any Five from each category)

- Following Assignment must be completely in a Computer Lab using Computational Fluid Dynamics and Multibody Dynamics Open source or Commercial Software:

B1) **CFD Assignments**

1. Numerical simulation and analysis of boundary layer over a flat plate (Blausius Equation)
2. Numerical simulation and analysis of boundary layer for a Developing flow through Pipe
3. Fully developed flow through a pipe
4. CFD Analysis of external flow: Circular Cylinder or Airfoil (NACA 0012)
5. CFD analysis of heat transfer in pin fin.
6. Numerical simulation and analysis of 2D square lid driven cavity.
7. Effect of Reynolds number on the vorticity patterns.
8. Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper. (Mandatory)

B2) **MBD Assignments**

Kinematic and Dynamic analysis of the following Multibody Systems:

1. Four bar mechanism/Slider crank mechanism
2. Cam and follower System
3. Serial Robot Manipulators
4. Parallel Robot Manipulators

5. Mobile Robot
6. Leg Mechanisms/Grippers Mechanisms
7. Automation/ Material Transporting Mechanism
8. Mini project on any practical application. Students should take a problem of their choice and verify the MBD solution with experimental data / research paper. (Mandatory)

Books and other resources

Text Books:

1. National Aeronautics and Space Administration, (2007), "NASA Systems Engineering Handbook," NASA, ISBN: 9780160797477
2. Space & Missile Systems Center, (2004), "SMC Systems Engineering Primer & Handbook: Concepts, Processes, and Techniques," SMC, U.S. Air Force
3. Oliver, D. W., Kelliher, T. P., Keegan, Jr., J. G., (1997), "Engineering Complex Systems With Models and Objects," McGraw-Hill, ISBN: 978-0070481886
4. Bi, Zhuming (2018), "Finite Element Analysis Applications: A Systematic and Practical Approach, Academic Press, ISBN: 9780128099520

References Books:

1. Rao, J.S., (2017), "Simulation Based Engineering in Fluid Flow Design," Springer, ISBN: 9783319463810
2. Tu, J., Yeoh, G-H. and Liu, C., (2018), "Computational Fluid Dynamics: A practical approach," Butterworth-Heinemann, ISBN: 9780081011270
3. Nikravesh, P.E., (2019), "Planar multibody dynamics: formulation, programming with MATLAB®, and applications," CRC Press, ISBN: 9781138096127
4. Rao, J.S., (2011), "Kinematics of Machinery Through HyperWorks," Springer, ISBN: 9789400711556

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a **Term Work Journal** and **Product based Case Study Report**

Important Note:
Term Work of the Student shall be evaluated based on the completion of individual **Product based Case study Report** and **Assignments**. Continuous evaluation by the faculty shall be done for the award of the credit associated with the course. No practical examination shall be conducted for the award of the credit.

402053: Project (Stage II)					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**12 Hrs./Week**	**Practical**	**6**	**Term Work**	**100 Marks**
				Oral	**50 Marks**

Prerequisites: Project Based Learning, Internship/Mini Project, Project (Stage I)

Course Objectives:

1. To provide an opportunity of designing and building complete system or subsystems based on areas where the student likes to acquire specialized skills.
2. To obtain hands-on experience in converting a small novel idea / technique into a working model / prototype involving multi-disciplinary skills.
3. To embed the skill in a group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of the faculty.
4. To encourage creative thinking processes to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision making process.
5. To get visibility in industry to Project and Project group

Course Outcomes:

On completion of the course the learner will be able to;

- CO1. Implement systems approach.
- CO2. To conceptualize a novel idea / technique into a product.
- CO3. To think in terms of a multi-disciplinary environment.
- CO4. To take on the challenges of teamwork, and document all aspects of design work.
- CO5. To understand the management techniques of implementing a project.

Course Contents

Extended part of Project Stage I

Guidelines for Project Execution

1. Refer Project stage I guidelines.

Term Work Evaluation

1. In Project Stage II, two reviews are to be taken for total 80 marks (40 marks each)
2. Review III shall be based on the approximate end of fabrication / design validation etc. in front of an expert panel from the department.

3. Review IV will be third party evaluation by Faculty/Student/Industry person/Alumni
4. Evaluation committee will consist of Guide, One Industry person and One Faculty appointed by the Institution.
5. Students shall be encouraged to publish a research paper/patent/technical note. Their credential shall be considered while term work evaluation.

Examination Scheme

1. Examination committee will consist of Guide, (Strictly) One Industry person and One Faculty appointed by the Institution.
2. Well in advance soft copies of the project shall be shared with examination committee.

Presentation of Project Work

Presentation of work in the form of Project Report (s), Understanding individual capacity, Role & involvement in the project, Team Work (Distribution of work, intrateam communication and togetherness), Participation in various contests, Publications and IPR, Manuals (Project Report, Quick reference, System, Installation guide) among other parameters. Team members with guide information shall be added at the end of the report.

Project Report

1. The report shall be both side print hard bound. A hardbound report shall be made after examination and examiner and guide's expected correction, before that report must be loosely bound.
2. Plagiarism check is must, and certificate shall be attached in the report.
3. A group activity shall be presented in report.
4. Report copies shall be submitted in the department, one for university and one for supervisor.
5. For standardization of the project reports the following format shall be strictly followed.
    a. Page size: Trimmed A4
    b. Top Margin: 1.00 Inches
    c. Bottom Margin: 1.32 Inches
    d. Left Margin: 1.5 Inches
    e. Right Margin: 1.0 Inches
    f. Para Text: Times New Roman 12-point font
    g. Line Spacing: 1.15 Lines
    h. Page Numbers: Right aligned at footer. Font 12 point Times New Roman
    i. Headings: Times New Roman, 14 Points, Boldface 10.

Certificate

1. All students should attach a standard format of Certificate as described by the department.
2. Certificates should be awarded to project groups and not individual students of the group.
3. Certificates should have signatures of Guide, External Examiner, Head of Department and Principal.

Index of Report

1. Title Sheet
2. Certificate (Institution)
3. Certificate (Company, if sponsored by company)
4. Acknowledgement
5. Abstract of the Project
6. List of Figures
7. List of Photographs / Plates
8. List of Tables
9. Table of Contents
10. Introduction
11. Literature Survey / Theory
12. Design / Experimentation / Fabrication / Production / Actual work carried out for the same
13. Observation Results
14. Discussion on Result and Conclusion
15. Student and Guide details. (A common photograph with project)

Savitribai Phule Pune University, Pune

Syllabus for TE Civil Engineering (2019 Pattern)

Implemented from Academic year 2021-22

Board of Studies in Civil Engineering

Faculty of Science and Technology

Savitribai Phule Pune University, Pune TE (Civil Engineering) 2019 Pattern (With effect from Academic Year 2021-22)																
SEMESTER: V																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
301001	Hydrology and Water Resources Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301002	Water Supply Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301003	Design of Steel Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301004	Engineering Economics and Financial Management	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301005	Elective I	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301006	Seminar	--	--	01	--	-	50	--	--	50	--	--	--	--	01	01
301007	Hydrology and Water Resources Engineering **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301008	Water Supply Engineering **Lab**	--	02	--	--	--	--	50	--	50	--	--	01	--	--	01
301009	Design of Steel Structures **Lab**	--	04	--	--	--	--	--	50	50	--	--	--	02	--	02
301010	Elective I **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301011	Audit Course I: Professional Ethics and Etiquettes/ Sustainable Energy Systems	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**15**	**10**	**02**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**02**	**01**	**02**	**01**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade																

Elective I: 301005

S N	Course Code	Course Name
01	301005 a	Advanced Fluid Mechanics and Hydraulic Machines
02	301005 b	Research Methodology and IPR
03	301005 c	Construction Management
04	301005 d	Advanced Concrete Technology
05	301005 e	Matrix Methods of Structural Analysis
06	301005 f	Advanced Mechanics of Structures

SEMESTER-VI																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
301012	Waste Water Engineering	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301013	Design of RC Structures	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301014	Remote Sensing and GIS	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301015	Elective II	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301016	Internship	--	--	--	--	--	100	--	--	100	--	04	--	--		04
301017	Waste Water Engineering **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
301018	Design of RC Structures **Lab**	--	04	--	--	--	--	--	50	50	--		--	02	--	02
301019	Remote Sensing and GIS **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301020	Elective II **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301021	Audit Course II: Leadership and Personality Development/ Industrial Safety	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**10**	**01**	**120**	**280**	**200**	--	**100**	**700**	**12**	**06**	**--**	**03**	**--**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																

Elective II: 301015

S N	Course Code	Course Name
01	301015 a	Advanced Engineering Geology with Rock Mechanics
02	301015 b	Soft Computing Techniques
03	301015 c	Advanced Surveying
04	301015 d	Advanced Geotechnical Engineering
05	301015 e	Architecture and Town Planning
06	301015 f	Solid Waste Management

SEMESTER V

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301001: Hydrology and Water Resource Engineering

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Fluid Mechanics

Course objectives

01 To introduce students to different government organizations and make them aware about precipitation, runoff, runoff hydrographs and streams gauging.
02 To introduce the concept of reservoir planning, capacity of reservoir, economics of reservoir, floods, hydrologic routing and use of Q-GIS software in hydrology.
03 To impart knowledge of irrigation, crop water requirement, canal distribution network, piped distribution network, revenue collection, ground water hydrology, water logging, and drainage and water management.

Course outcomes

On successful completion of this course, the learner will be able to:

01 Understand government organizations, apply & analyze precipitation & its abstractions.
02 Understand, apply & analyze runoff, runoff hydrographs and gauging of streams.
03 Understand, apply & analyze floods, hydrologic routing & Q-GIS software in hydrology.
04 Understand, apply & analyze reservoir planning, capacity of reservoir & reservoir economics.
05 Understand water logging & water management, apply & analyze ground water hydrology
06 Understand irrigation, piped distribution network and canal revenue, apply and analyze crop water requirement.

Course Contents

Unit I: Introduction to Hydrology **(06 Hours)**

Introduction: Hydrological cycle, applications of hydrology, brief introduction of government organizations like IMD, CWPRS, MERI, CDO, Hydrology Project Division, NIH, CWC. Precipitation: Types & forms of precipitation, precipitation measurement, rain gauge network, introduction to real time data transmission weather station and climate change**.** Consistency test, presentation of rainfall data, mass rainfall curves, hyetograph, point rainfall, mean precipitation over an area, arithmetic mean method, Thiessen's polygon, isohyetel method, concepts of depth-area-duration analysis, frequency analysis, frequency of point rainfall, intensity-duration curves, maximum intensity-duration. Abstractions of precipitation:

interception, depression storage, evaporation- elementary concepts, factors affecting, measurement of evaporation, transpiration, evapotranspiration, modified Penman method,- process and measurement, infiltration: introduction, infiltration capacity, infiltrometer, Horton's method and infiltration indices.

Unit II: Run Off **(06 Hours)**

Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff, Runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph theory, S-curve hydrograph, uses and limitations of unit hydrograph, synthetic hydrograph (no numerical on synthetic hydrograph). Stream gauging: selection of site, discharge measurement by velocity-area method, introduction to advance techniques/equipment used in gauge discharge measurements such as radar, current meter, ADCP (acoustic doppler current profiler).

Unit III: Floods **(06 Hours)**

Floods: Estimation of peak flow, rational formula and other methods, flood frequency analysis, design floods, brief introduction of hydrologic design of culverts and bridges. Hydrologic flood routing: Muskingum method, Q-GIS software application in hydrology (watershed delineation).

Unit IV: Reservoir Planning **(06 Hours)**

Introduction, term related to reservoir planning (yield, reservoir planning and operation curves, reservoir storage, reservoir clearance), investigation for reservoir planning, significance of mass curve and demand curves, applications of mass curve and demand curves, fixation of reservoir capacity from annual inflow and outflow, fixation of reservoir capacity using elevation capacity curve and dependable yield, reservoir losses, reservoir sedimentation- Phenomenon, measures to control reservoir sedimentation, density currents Significance of trap efficiency, useful life of reservoir, costs of reservoir, apportionment of total cost, use of facilities method, equal apportionment method, alternative justifiable expenditure method. (no numerical on cost-economics)

Unit V: Ground Water Hydrology **(06 Hours)**

Occurrence and distribution of ground water, specific yield of aquifers, movement of ground water, Darcy's law, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well, tube wells, open wells and their construction. Water logging and Drainage: Causes of water logging, effects of water logging, preventive and curative measures of water logging, land drainage, reclamation of water logged areas, alkaline and saline lands (no derivation of on spacing of drains), Water Management: Distribution, warabandi, rotational water supply system, participatory irrigation management, co-operative water distribution systems

Unit VI: Introduction to Irrigation **(06 Hours)**

Definition, functions, advantages and necessity, methods of irrigation, surface irrigation, subsurface irrigation, micro-irrigation, Water requirements of crops: Soil moisture and crop water relationship, consumptive use of water, principal Indian crops, crop seasons, crop water requirement: crop planning, agricultural practices, calculations of canal and reservoir capacities – duty, delta, irrigation efficiency, Piped distribution network for irrigation (PDN), Introduction, advantages and disadvantages of PDN over conventional canal distribution network and its application. Assessment of canal revenue: Various methods (area basis or crop rate basis, volumetric basis, seasonal basis, composite rate basis, permanent basis or betterment levy basis).

Text Books

01 Engineering Hydrology, K. Subramanyam, Tata McGraw Hill.
02 Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, Khanna Publishers, New Delhi
03 Irrigation Engineering & Hydraulic Structures, Vol-2, S. K. Garg, Khanna Publishers, New Delhi

Reference Books

01 A Textbook of Hydrology, Dr. P. Jaya Rami Reddy, USP Publisher.
02 Irrigation, Water Resources and Water Power Engineering, P. N. Modi, Standard Book House.
03 Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, Standard Publisher
04 Irrigation Engineering, Bharat Singh, Nem Chand & Bros., India
05 Irrigation Engineering, H. M. Raghunath, Wiley
06 Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke-Locate Press

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301002: Water Supply Engineering

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Surveying, Building Planning and Fluid Mechanics

Course objectives
01 To make students understand importance of water infrastructure with respect to needs of various users.
02 To discuss and demonstrate the principles of water treatment plant and layout.
03 To inculcate and impart design principles and working of WTP components
04 To interpret need of contemporary issues in water treatment.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Define identify, describe reliability of water sources, estimate water requirement for various sectors
02 Ascertain and interpret water treatment method required to be adopted with respect to source and raw water characteristics
03 Design various components of water treatment plant and distribution system.
04 Understand and compare contemporary issues and advanced treatment operations and process available in the market, including packaged water treatment plants.
05 Design elevated service reservoir capacity and understand the rainwater harvesting.
06 Understand the requirement of water treatment plant for infrastructure and Government scheme.

Course Contents

Unit I: Basics of Water Supply Engineering **(06 Hours)**
Introduction to water supply scheme: importance of water infra structure and introduction to water infrastructure in India, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes like domestic, industrial, institutional, commercial, fire demand and water system losses, factors affecting rate of demand, population forecasting, including numerical. Quality: physical, chemical, radioactivity and bacteriological characteristics, heavy metals. Standards as per IS 10500-2012.

Unit II: Principles of Water Treatment **(06 Hours)**
Water treatment: principles of water treatment operations and processes, water treatment flow sheets with respect to various sources, criteria for site selection for WTP. Aeration: principle

and concept, necessity, methods, removal of taste and odour, design of aeration fountain. Sedimentation: plain and chemical assisted, principle, efficiency of an ideal settling basin, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank, introduction and design of tube settlers.

Unit III: Design of Water Treatment Plant **(06 Hours)**

Coagulation and flocculation: necessity of coagulation, principle of coagulation, common coagulants alum and ferric salts, introduction to other coagulant aids like bentonite clay, lime stone, silicates and polyelectrolytes etc, introduction to natural coagulants, concept of mean velocity gradient and power consumption, design of flocculation chamber, design of clari-flocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types: rapid, gravity, pressure filter, multimedia and dual media filters, components, under-drainage system, working and cleaning of filters, operational troubles, design of rapid sand gravity filters.

Unit IV: Introduction to Advanced Water Treatment Methods **(06 Hours)**

Disinfection: mechanism, factors affecting disinfection, types of disinfectants, types and methods of chlorination, break point chlorination, bleaching powder estimation. Water softening methods and demineralization: lime-soda, ion-exchange, R. O. and electrodialysis, fluoridation and defluoridation, introduction to advanced water treatment systems (nano technology), introduction to desalination and various methods of desalination

Unit V: Water Distribution System, Rain Water Harvesting and GIS **(06 Hours)**

Water distribution system: system of water supply: continuous and intermittent system, different distribution systems and their components, ESR: design of ESR capacity, wastage and leakage of water: detection and prevention. Rainwater harvesting: introduction, need, methods and components of domestic rainwater harvesting system. Design of roof top rainwater harvesting system, use of GIS and drone technology in water management: source, treatment and distribution

Unit VI: Water Treatment Plant for Infrastructure **(06 Hours)**

Introduction to Packaged WTP in townships, large commercial buildings, educational institutes, necessity (on-site water treatment), WTP for swimming pools, Building plumbing: introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, pressure reducing valves, break pressure tanks, storage tanks, building drainage for high rise buildings, various kinds of fixtures and fittings used for water saving such as water saving aerators, Government of India initiatives such as SMART city mission and AMRUT mission for improvement of infrastructure sector, service level benchmarks in urban infrastructure and introduction to Jal Jeevan Mission and its implication in rural India.

Text Books

01 Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi.
02 Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi.

03 Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd.

Reference Books

01 Environmental Engineering, Peavy and Rowe, McGraw Hill Publications.
02 Optimal Design of Water Distribution Networks, P. R. Bhave, Narosa Publishing House.
03 Rain Water Harvesting: Making Water Every Body‘s business,vCentre for Science and Environment.
04 Environmental Remote Sensing from Regional to Global Scales, Ed. Giles Foody, Wiley
05 Water Supply Engineering, Harold Eaton Babbit & James Joseph Doland, Tata McGraw Hill.
06 Environmental Engineering Laboratory Manual, B. Kotain and Dr. N. Kumarswamy, NEERI, Nagpur.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301003: Design of Steel Structures

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis

Course objectives

01 This course is designed to provide understanding of IS code provisions, fundamentals of structural steel design and its applications for design of various components.
02 Students should be able to understand components of steel structures and its arrangements
03 Student should be able to design beams, columns, column footings, roof trusses, gantry girder and plate girders

Course outcomes

On successful completion of this course, the learner will be able to:

01 Demonstrate knowledge about the types of steel structures, steel code provisions and design of the adequate steel section subjected to tensile force.
02 Determine the adequate steel section subjected to compression load and design of built up columns along with lacing and battening.
03 Design eccentrically loaded column for section strength and column bases for axial load and uniaxial bending.
04 Design of laterally restrained and unrestrained beam with and without flange plate using rolled steel section.
05 Analyze the industrial truss for dead, live and wind load and design of gantry girder for moving load.
06 Understand the role of components of welded plate girder and design cross section for welded plate girder including stiffeners and its connections.

Course Contents

Unit I: Design Philosophy and Tension Members **(06 Hours)**

Types of steel structures, the chemical composition of structural steel, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP:38, IS: 4000-1992, IS 816–1969, maintenance of steel structure and its methods. Philosophy of limit state design for strength and serviceability, the partial safety factor for load and resistance, various design load combinations. Tension member: various cross sections such as solid threaded rod, cable and angle sections limit strength due to yielding, rupture and block shear, design of tension member using single and double angle sections and design of connection.

Unit II: Design of Compression Members and Columns (06 Hours)
Buckling classification, buckling curves, classification of cross, effective length for compression members and columns, design compressive stress, design of compression member of trusses using single and double angle section and design of connections. Design of axially loaded column using rolled steel section, design of built-up column, lacing and battening and its connections.

Unit III: Eccentric Loaded Columns and Column Bases (06 Hours)
Design of eccentrically loaded column providing uniaxial and biaxial bending for section strength, Design of column bases: slab base, gusseted base and moment resistant base for axial load and uni-axial bending

Unit IV: Design of Flexural Members (06 Hours)
Design bending strength, laterally restrained and unrestrained beams, design of laterally restrained beams using single rolled steel section with and without flange plate, curtailment of flange plates, low and high shear, check for web buckling, web crippling and deflection. Design of laterally unrestrained beams using single rolled steel section, check for and deflection

Unit V: Design of Industrial truss and Gantry Girder (06 hours)
Roof truss: assessment of dead load, live load and wind load, design of purlin, design of members of a truss, detailing of typical joints and supports. Design of gantry girder: selection and design of cross section, check for moment capacity, buckling resistance, bi-axial bending, serviceability and fatigue strength.

Unit VI: Design of Welded Plate Girder (06 hours)
Concept of plate girder, components of welded plate girder, intermittent weld, design of cross section, curtailment of flange plates, end bearing, load bearing, and intermediate stiffeners, design of connection between flange & web plate and web plate & stiffeners, check for shear buckling of web, shear capacity of end panel and serviceability condition.

Text Books

01 Limit State Design of Steel Structures, S K Duggal, Tata McGraw Hill Education, New Delhi
02 Design of Steel Structure by Limit State Method as per IS: 800- 2007, Bhavikatti S S, I. K. International publishing house, New Delhi
03 Design of Steel Structures, K. S. Sai Ram, Pearson, New Delhi

Reference Books

01 Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi
02 Limit State Design in Structural Steel, M. R. Shiyekar, PHI, Delhi
03 Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.

04 Limit State Design of Steel Structure, Ramchandra & Gehlot, Scientific Publishers, Pune
05 Analysis and Design: Practice of Steel Structures, Karuna Ghosh, PHI Learning Pvt. Ltd. Delhi
06 Structural Design in Steel, Sarwar Alam Raz, New Age International Publisher
07 Limit State Design of Steel Structure, V L Shah & Gore, Structures Publication, Pune

IS Codes

01 IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi
02 IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
03 IS 875- Part 1 and 2 (1987) and Part 3 (2015): Code of practice for design loads (other than earthquake) for building and structures, Bureau of Indian Standards, New Delhi
04 IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi
05 IS 816-1969: Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi
06 SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi
07 SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301004: Engineering Economics and Financial Management

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites
Fundamental knowledge of Economics and Accounting

Course objectives
01 To apply the knowledge of accounting and financial management in civil engineering projects.
02 To prepare, appraise, evaluate, and approve financial plans and interpret financial data.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand basics of construction economics.
02 Develop an understanding of financial management in civil engineering projects.
03 Prepare and analyze the contract account.
04 Decide on right source of fund for construction projects.
05 Understand working capital and its estimation for civil engineering projects.
06 Illustrate the importance of tax planning & understand role of financial regulatory bodies

Course Contents

Unit I: Construction Economics (06 Hours)
Economics: definition, principles, importance in construction industry, assets, liabilities, balance sheet, numerical on preparation balance sheet, profit & loss account, difference between microeconomics and macroeconomics, basic economic problems along with case studies. Construction economics: structure of construction industry, economics of road and buildings, irrigation and power, ports and aviation.

Unit II: Introduction to Financial Management (06 Hours)
Long- and short-term sources of finance, equity, debt government grants & alternative sources, numerical on calculation of leverage ratio, EBIT & dividend pay-out, financial market & instruments: money, market, secondary market, credit, bill & income security market; goal of financial management, key activities in financial management, role of financing institutes in construction sector: banking institutions, NBFc, housing finance institutions & others.

Unit III: Contract Costing (06 Hours)
Construction financial management, role of financial manager in construction financial management, meaning and features of contract costing, types of contract and contract costing procedure, Contract account: definition, format/specimen of contract account, treatment of

various items in the contract account, methods of recording and reporting site accounts between project office and head office.

Unit IV: Capital Budgeting **(06 Hours)**

Budget, types of budgets, master budgets, cost estimating and budgeting in civil engineering project, definition of capital budgeting, time value of money, simple and compound interest, numerical on computation of interest, rule of 72, process of capital budgeting, techniques of capital budgeting, economic decision making in construction project, depreciation, different methods to calculate depreciation and numerical on it, impact of depreciation in economic decision making.

Unit V: Working Capital **(06 Hours)**

Meaning, types of working capital, components of working capital, operating cycle, factors affecting working capital requirement, working capital management, estimation of working capital, components of working capital in Construction Company, inventory management techniques and financing resources of working capital

Unit VI: Taxation and Financial Regulatory Bodies **(06 Hours)**

Introduction to direct and indirect tax, GST, impact of GST on construction industry, tax exemption for contractors, property tax: types, methods of calculation & numerical on computation of property tax, tax deductions against income from property, corporate tax planning, financial regulatory bodies: role & functions, ICRA (Information and Credit Rating Agency of India), SEBI (Security and Exchange Board of India), IRDA (Insurance Regulatory & Development Authority) and RBI (Reserve Bank of India)

Text Books

01 Engineering Economics Management, Dr. Vilas Kulkarni and Hardik Bavishi, S. Chand Publication

02 Laws for Engineers, Vandana Bhatt and Pinky Vyas, Pro Care Publisher

03 Indian Economy, Gaurav Datt and Ashwani Mahajan, S. Chand Publication

04 Industrial Organization & Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publisher

Reference Books

01 Engineering Economy, Theusen G. J. and Fabrycky W. J., 9th Edition, Prentice-Hall, Inc., New Delhi

02 Finance for Engineers: Evaluation and Funding of Capital Projects, Crundwell F. K., Springer, London.

03 Construction Project Management: Theory and practice, Jha K.N., 2nd Edition, Pearson India Education Services Pvt. Ltd.

04 Financial Management, Khan and Jain, Tata McGraw-Hill Education

05 Construction Management and Accounts, Singh H, Tata McGraw Hill, New Delhi.

06 Engineering Economy, Leland T. Blank and. Anthony Tarquin, McGraw Hill

07 Case studies in Finance, Burner, McGraw Hill

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 a: Elective I: Advanced Fluid Mechanics and Hydraulic Machines

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basic knowledge of Engineering Mechanics, Engineering Mathematics and Fluid Mechanics

Course objectives
01 To study flow over notches and weirs; and the concept of hydraulic jump and losses
02 To state the importance of ideal fluid flow analysis.
03 To study laminar flow between parallel plates.
04 To study unsteady flow through orifice and the concept of water hammer in pipe flow
05 To study impact of free jet on stationary and moving flat and curved vanes
06 To study Pelton wheel, Francis turbine and centrifugal pump from view point of their working principle, work done, efficiency and performance characteristics.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Determine discharge using notches and weirs, and energy loss in hydraulic jump in open channel flow.
02 Describe simple superpositions of basic ideal fluid flows; and determine velocity and shear stress distribution for laminar flow between parallel plates.
03 Understand flow through openings under varying head, and determine rise in pressure due to water hammer effect in pipe flow.
04 Calculate force exerted by free jet on stationary and moving, flat and curved vanes using impulse momentum principle.
05 Design Pelton wheel and Francis turbines and predict their performance characteristics.
06 Estimate performance characteristics of Centrifugal pump

Course Contents

Unit I: Flow Over Notches and Weirs **(06 Hours)**
Classification of notches and weirs, flow over sharp crested rectangular weir/notch, Francis formula, ventilation of weirs, flow over triangular weir/notch, flow over trapezoidal weir/notch, Cipolletti weir, effect on discharge due to error in measurement of head, broad crested weir, submerged weir, proportional weir or sutro weir. Hydraulic Jump: Assumptions in the theory of hydraulic jump, application of momentum equation to hydraulic jump in rectangular channel: Conjugate depths and relations between conjugate depths. Energy dissipation in hydraulic jump, classification of hydraulic jump and its applications

Unit II: Laminar Flow and Hydraulics for High Rise Buildings **(06 Hours)**

Laminar flow between parallel plates: plates at rest, one plate moving and other at rest (Couette flow), laminar flow through porous media. Introduction of high-rise building, importance and significance of plumbing design, list of components in high rise plumbing, provisions for pressure, velocity and discharge as per uniform plumbing code-India (UPC-I), water supply fixture unit (WSFU) and peak water demand of plumbing fixtures, drainage fixture unit (DFU), maximum loads for horizontal fixture branches and building drains or sewers.

Unit III: Unsteady Flow **(06 Hours)**

Introduction to flow through sharp crested circular orifice under constant head, types of unsteady flow, flow through openings under varying head, fluid compressibility, celerity of elastic pressure wave through fluid medium. Water hammer phenomenon, rise of pressure due to water hammer, surge tanks and its function

Unit IV: Impact of Free Jets **(06 Hours)**

Impulse momentum equation, force exerted by jet on stationary and moving flat plate (normal & inclined to the jet), flat plates mounted on periphery of a wheel, force exerted by jet on symmetrical stationary curved vane at centre, on unsymmetrical stationary curved vane tangentially at one of the tips. Force exerted by jet on symmetrical moving curved vane at the centre, symmetrical curved vanes mounted on periphery of a wheel, force exerted by jet on unsymmetrical moving curved vane tangentially at one of the tips, torque exerted on a wheel with radial curved vanes.

Unit V: Hydraulic Turbines **(06 Hours)**

Elements of hydroelectric power plants, heads and efficiencies and classification of turbines Pelton wheel turbine: component parts and its working, work done and efficiencies, working proportions, design, multiple jet Pelton wheel (introduction). Francis turbine: component parts and its working, work done and efficiencies, working proportions, design, draft tube theory, cavitation in hydraulic turbines, governing of turbines. Performance of turbine, prediction of performance in terms of unit quantities and specific quantities, specific speed, characteristic curves, model testing of turbines, selection of turbines

Unit VI: Centrifugal Pumps **(06 Hours)**

Component parts, working, types of centrifugal pumps, work done by impeller, head of pump, losses and efficiencies, minimum starting speed, loss of head due to increased or reduced flow, diameters of impeller and pipes, pumps in series and parallel, suction lift, net positive suction head, cavitation in centrifugal pump, introduction to submersible pumps. Performance centrifugal pump: characteristic curves, specific speed, model testing.

Text Books

01 Hydraulics and Fluid Mechanics including Hydraulics Machines, Dr. P. N. Modi and Dr. S. N. Seth, Standard Book House, Maw Delhi

02 Engineering Fluid Mechanics, Prof. K. L. Kumar, S. Chand & Company Ltd

03 Flow in Open Channels, K Subranmanya, McGraw Hill Education
04 A Text Book of Fluid Mechanics and Hydraulic Machines, Dr. R K Rajput, S Chand and Co Ltd, New Delhi

Reference Books

01 Engineering Fluid Mechanics, Garde and Mirajgaonkar, Scitech
02 A Text Book on Fluid Mechanics and Hydraulic Machines, Sukumar Pati, McGraw Hill, New Delhi
03 A Text Book of Fluid Mechanics and Hydraulic Machines, R K Bansal, Laxmi Publications Pvt. Ltd., New Delhi
04 Fluid Mechanics, Fundamentals and Applications, Yunus A Cengel and John Cimbala, McGraw Hill International, New Delhi
05 Fluid Mechanics by Frank M White, McGraw Hill
06 Fluid Mechanics by Streeter, Wylie and Bedford, McGraw Hill International, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 b: Elective I: Research Methodology and IPR

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 marks End semester exam: 70 marks

Prerequisite
Project based learning, Fundamental of Civil Engineering, Soft and Communication Skills.
Course Objectives
01 The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
02 It will create consciousness of research methodology, which will be useful to develop a research culture in the young minds.
03 Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand a research problem for civil engineering domain.
02 Analyze the available literature for given research problem and illustrate different techniques of literature survey thereby gap identification.
03 Recognize the importance of data collection and investigate the statistical and reliability methods of preliminary data analysis.
04 Explain the important concept of interpretation and develop technical writing and presentation skills.
05 Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.
06 Realize the importance of patents, trademark and copyright and follow research ethics.

Course Contents

Unit I: Introduction to Research **(06 Hours)**
Introduction, meaning of research, objectives of research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research, problems encountered in India for good research, formulation of research hypotheses, search for causation, format for research proposal, funding for the proposal, different funding agencies, and framework for the planning.

Unit II: Literature Survey **(06 Hours)**
Definition of literature and literature survey, significance of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, strategies of literature survey, searching the existing literature, reviewing the selected literature, writing

about the literature reviewed and gap identified. Techniques to frame the objectives and define the problem statement

Unit III: Data Collection and Preliminary Data Analysis **(06 Hours)**
Classification of research data, benefits and drawbacks of research data, collection of primary data, collection of secondary data, selection of appropriate method for data collection, evaluation of data, any case study method. Testing of hypothesis- concepts and testing, review of theory of reliability, hazard models, system reliability. data presentation skills, features of statistical analysis, histogram, bar charts, Pie charts, 2D & 3D plots, interpolation & extrapolation techniques, curve fitting.

Unit IV: Interpretation and Report Writing **(06 Hours)**
Meaning of interpretation, need of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, mechanics of writing a research report, precautions for writing research reports, plagiarism, research ethics, tools for technical writing and presentation, conclusions

Unit V: Intellectual Property Rights **(06 Hours)**
Introduction and significance of intellectual property rights, types of intellectual property rights, copyright and its significance, introduction to patents and its filing, introduction to patent drafting, best practices in national and international patent filing, copyrightable work examples. Initiatives of government and private organization to promote research activities in education sector

Unit VI: Patent Rights **(06 Hours)**
Patents and its basics, patentable items, designs, process of filing patent at national and international level, process of patenting and development, technological research and patents, innovation, patent and copyright international intellectual property, procedure for grants of patents, need of specifications, types of patent applications, provisional and complete specification, patent specifications and its contents, trade and copyright.

Text books

01 Research Methodology Methods & Techniques, C. K. Kothari, 2nd edition, New Age International, New Delhi.

02 Intellectual Property Rights-Law in India, Ramappa, 2nd edition, Asia Law House, Hyderabad.

Reference Books

01 Research Methods in Education, Louis Cohen, Manion, Morrison and Routledge, 8th edition, Taylor & Francis Group- Cambridge University Press India Pvt. Ltd

02 Research in Education, John Best and James Kahn, 8th edition, Prentice Hall of India Pvt. Ltd.

03 Research Methodology: An Introduction for Science and Engineering Students, Stuart Melville and Wayne Goddard, Juta & Co Ltd

04 Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd edition, Pearson Education.
05 Resisting Intellectual Property, Halbert D J, 2nd edition, Taylor and Francis Ltd.
06 Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell and Mark A. Lemley, Stanford Public Law Working Paper No. 2780190, Elsevier Publishers.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 c: Elective I: Construction Management

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 marks End semester exam: 70 marks

Prerequisite

Fundamental of Project Management

Course Objectives

01 To understand various construction activities and evaluating construction projects.
02 To handle all situations with knowledge of various labour laws and financial aspects of construction projects.
03 To know about risk management and value engineering
04 To utilize material and human resources efficiently with managerial skills interpersonal and intrapersonal skills.
05 To apply knowledge of artificial intelligence on construction project

Course Outcomes

On successful completion of this course, the learner will be able to:

01 Understand the overview of construction sector.
02 Illustrate construction scheduling, work study and work measurement.
03 Acquaint various labor laws and financial aspects of construction projects.
04 Explain elements of risk management and value engineering.
05 State material and human resource management techniques in construction.
06 Understand basics of artificial intelligence techniques in civil engineering.

Course Contents

Unit I: Overview of Construction Sector (06 Hours)

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management: necessity, applications, project management consultants: role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities.

Unit II: Construction Scheduling, Work Study and BIM (06 Hours)

Construction project scheduling: definition, objectives factors affecting scheduling, work breakdown structure, project work break down levels, line of balance technique, project monitoring controlling, and introduction to building information modeling (BIM) based on software. Work study (time and motion study): definition, objectives, process of method study, symbols, multiple activity charts, two handed process chart, string diagram.

Unit III: Labour Laws and Financial Aspects of Construction Project (06 Hours)
Need and importance of labour laws, study of some important labour laws associated with construction sector, workman's compensation act 1923, building and other construction workers act 1996, child labour act, interstate migrant workers act, the minimum wages act 1948. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit IV: Risk Management and Value Engineering: **(06 Hours)**
Risk Management: introduction, principles, steps in risk management, risk in construction, origin, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis (examples), decision tree analysis, risk identification, mitigation of project risks, role of insurance in risk management and case study on risk management. Value Engineering: meaning of value, types of value, value analysis, value engineering and its application, energy cost escalation and its impact on infrastructure project.

Unit V: Material Management (06 Hours)
Material: introduction, need, objectives and functions and scope of material management, integrated concept of material management, material management organization, various phases of material flow system, application of each phase, role of material manager, role of material management in construction management and its linkage with other functional areas, inventory control methods, EOQ Model, stores management and control, break even analysis, concept of logistics and supply chain management, role of ERP in material management and material resource information systems.

Unit VI: Human Resource Management (06 Hours)
Human resource: introduction, nature and scope of human resource management, human resource in construction sector, staffing policy and patterns, human resource management process, human resource development process, recruitment & selection, performance evaluation and appraisal, training & development, succession planning, compensation and benefits, career planning, human resources information systems, HR data and analytics, role of ERP in human resource management and human resource information system. Introduction to artificial intelligence technique, basic terminologies and applications in civil engineering: artificial neural network, fuzzy logic and genetic algorithm.

Text Books

01 Construction Management and Planning, B. Sengupta and H. Guha, Tata McGraw Hill Publications.
02 Total Project Management - The Indian Context, P. K. Joy, Mac Millian Publications.
03 Projects: Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata Mc Graw Hill Publications.

Reference Books

01 Civil Engineering Project Management, C. Alan Twort and J. Gordon Rees, Elsevier Publications
02 Principles of Construction Management, Roy Pilcher (Mc Graw Hill)
03 Human Resource Management, Biswajeet Pattanayak, Prentice Hall Publishers.
04 Materials Management, Gopalkrishnan & Sunderasan, Prentice Hall Publications.
05 Labour and Industrial Laws, S. N. Mishra, Central Law Publications.
06 Artificial Neural Network, Veganarayanan, Prentice Hall.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 d: Elective I: Advanced Concrete Technology

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Concrete Technology

Course objectives
01 To provide an advanced understanding on cement chemistry, influence of supplementary cementitious materials, and effect of admixtures on properties of concrete
02 To illustrate the role of fibers and understand the durability properties of concrete
03 To study advanced testing methods on concrete

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand the chemistry of cement and its effect on properties of concrete
02 Apply the knowledge of supplementary cementitious materials to produce sustainable concretes
03 Understand the mechanism of working of admixtures and their effect on properties of concrete
04 Evaluate the characteristic properties of fiber reinforced concrete
05 Understand the durability properties of concrete
06 Interpret the properties of concrete through advance testing methods

Course Contents

Unit I: Cement and Concrete (06 Hours)
Types of cements, Bogue's compounds, structure of a hydrated cement paste, volume of hydrated product, porosity of cement paste, interfacial transition zone in concrete (ITZ), influence of ITZ on properties of concrete, types of elastic moduli, factors affecting elastic modulus of concrete.

Unit II: Supplementary Cementitious Materials (06 Hours)
Fly ash, blast furnace slag, silica fume, rice husk ash, metakaolin, industrial waste or by-products, chemical composition and classification, effect on hydration process of portland cement, effect on workability of concrete, effect on the properties of hardened concrete, effect on durability of concrete.

Unit III: Chemical Admixtures (06 Hours)
Classification of admixtures, chemistry and mechanism, effect of admixtures on plastic properties and hardened properties of concrete, applications, specialty admixtures - viscosity modifying admixtures, corrosion-inhibiting admixtures, shrinkage-reducing admixtures.

Unit IV: Fiber Reinforced Concrete **(06 Hours)**

Types of fibers, matrix, stress transfer mechanism, steel fiber reinforced concrete (SFRC) – types of steel fibers, balling effect, effect on properties of hardened concrete, applications, slurry infiltrated fiber concrete (SIFCON) - fresh and hardened properties of SIFCON, applications, synthetic fiber reinforced concrete – types of synthetic fibers, properties of fibers, effect of fibers on properties of concrete, applications.

Unit V: Durability of Concrete **(06 Hours)**

Plastic shrinkage, autogenous shrinkage, drying shrinkage, mitigation strategies, transport properties of concrete, permeability, corrosion, chloride penetration, carbonation, sulphate attack and acid attack

Unit VI: Testing of Concrete **(06 Hours)**

Ultrasonic pulse velocity method: theory of pulse propagation through concrete, interpretation of results, corrosion: half-cell potential measurement, electrical resistivity method, permeability and absorption tests, concrete cores – core location and size, drilling, testing and interpretation of results, in-situ load testing.

Text Books

01 Concrete Technology, A.R. Santhakumar, Oxford University Press
02 Concrete Technology, Job Thomas, Cengage Publications

Reference Books

01 Properties of Concrete, A. M. Neville, Pearson Education
02 Concrete: Microstructure, Properties, and Materials, P. Kumar Mehta and Paulo J.M. Monteiro, McGraw Hill Education

IS Codes

01 IS 1199 – 1959, Methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi
02 IS 3085 – 1965, Method of test for permeability of cement mortar and concrete, Bureau of Indian Standards, New Delhi
03 IS 14959 – 2001, Method of test determination of water soluble and acid soluble chlorides in mortar and concrete Part 2: Hardened mortar and concrete, Bureau of Indian Standards, New Delhi
04 IS 516 – 1959, Method of tests for strength of concrete, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 e: Elective I: Matrix Methods of Structural Analysis

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Mathematics, Engineering Mechanics and Structural Analysis

Course objectives

01 To understand the structural behavior of beams, plane frames by analyzing using flexibility method of analysis.

02 To generate element/member stiffness matrix, transformation matrix and global/structure stiffness matrix for the skeletal structures and analyze the structure using stiffness method.

03 To develop program algorithm/flowcharts applying the concepts of member approach of stiffness method to analyze skeletal structures and forming base for the study of Finite element method

Course outcomes

On successful completion of this course, the learner will be able to:

01 To understand the structural behavior of bars and trusses and analyze it by using flexibility method of analysis.

02 To understand the structural behavior of beams and plane frames and analyze it by using flexibility method of analysis.

03 To analyze bars, springs and truss by member approach of stiffness matrix method.

04 To analyze beams by member approach of stiffness matrix method and to develop transformation matrix and global/structure stiffness matrix for plane frame and thereby analyze it by member approach of stiffness matrix method.

05 To develop transformation matrix and global/structure stiffness matrix for grid and analyze the grid by structure and member approach of stiffness matrix method.

06 To develop the member stiffness matrix of space truss and space frame and develop the flow chart /algorithm to write the program for analysis of skeletal structures with reference to computer application.

Course Contents

Unit I: Analysis of Trusses and Bars by Flexibility Method (06 Hours)

Review of degree of static indeterminacy for bars and trusses, basic concept of flexibility, flexibility coefficients, selection of redundant, generation of flexibility matrix, analysis of bars and spring assembly and trusses involving not more than two unknowns.

Unit II: Analysis of Beams and Rigid Joined Frame by Flexibility Method (06 Hours)
Review of degree of static indeterminacy for beams and frame, selection of redundant, generation of flexibility matrix, analysis of beams and simple portal frames involving not more than two unknowns.

Unit III: Analysis of Trusses and Bars by Stiffness Method (06 Hours)
Review of degrees of freedom for bars and trusses, basic concept of stiffness, stiffness coefficients, local and global coordinate systems, generation of member stiffness matrix for an axially loaded bar members, formation of overall stiffness matrix, analysis of axially loaded bars, springs by member approach not involving more than three unknowns. Formation of the member stiffness matrices of a truss member considering two degrees of freedom at each node, formation of overall stiffness matrix, analysis of trusses by member approach involving not more than three unknowns

Unit IV: Analysis of Beams and Rigid Joined Frame by Stiffness Method (06 Hours)
Review of degrees of freedom for beam and rigid jointed frames, generation of member stiffness matrix for beam, formation of overall stiffness matrix, load vector, analysis of beams by member approach up to maximum three unknown. Generation of local member stiffness matrix for frame, concept of transformation matrix, formation of transformation matrix for frame member, formation of global member stiffness matrix, analysis of frame by member approach up to maximum three unknown.

Unit V: Analysis of Grid by Stiffness Method (06 Hours)
Review of degrees of freedom for grid member, stiffness matrix method using structure approach for analysis of orthogonal grid structure, member approach: generation of local member stiffness matrix for grid and derivation of transformation matrix for grid member, problems involving not more than three unknowns by structure approach.

Unit VI: 3-D Skeletal Structures and Flowchart for Stiffness Method (06 Hours)
Review of degrees of freedom for space truss and frame, local member stiffness matrix, transformation matrix for space truss member, formation of local member stiffness matrix of space frame element, computer algorithm and flowcharts for generating the element/member, transformation and global/structure stiffness matrices for bars, plane truss, plane frame and grid.

Text Books

01 Structural Analysis - A Matrix Approach, Pandit G S and Gupta S P, Tata McGraw Hill
02 Matrix Methods of Structural Analysis, Meghare and Deshmukh, Charotar Publishing House, Anand.

Reference Books

01 Matrix Analysis of Framed Structures by Weaver W and Gere G M, CBS Publisher, Delhi.

02 Matrix methods of structural analysis, C. K. Wang, International Textbook Co; 2nd edition.

03 Advanced Structural Analysis, Devdas Menon, Narosa Publication.

04 Matrix Methods of Structural Analysis: Theory and Problems, C. Natarajan and P. Revathi, Prentice Hall India Learning Private Limited

05 Matrix Methods of Structural Analysis, Bhavikatti S S, I K international Publishing house

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 f: Elective I: Advanced Mechanics of Structures

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamental of Engineering Mechanics and Mechanics of Structures

Course objectives

01 To learn the concept of moment area and conjugate beam method to find slope and deflection
02 To study different type of stresses in thin and thick cylindrical shells
03 To learn application of influence line diagram to find the forces in the members due to moving load
04 To study the analysis of beams and arches

Course outcomes

On successful completion of this course, the learner will be able to:

01 Apply moment area and conjugate method to find slope and deflection.
02 Evaluate stresses and strain in thin and thick cylinder.
03 Analyze the beam and trusses by influence line diagram.
04 Analyze the beam for moving load by influence line diagram.
05 Understand and analyze beam curved in plan and elevation.
06 Analyze three and two hinged arches for axial thrust, shear and moment.

Course Contents

Unit I: Slope-Deflection by Moment Area and Conjugate Beam Methods (06 Hours)

Moment area method: basic concept, M/EI diagram, slope and deflection of cantilever subjected to moment, point load and uniformly distributed load. Conjugate beam method: basic concept, slope and deflection of beams subjected to moment, point load and uniformly distributed load.

Unit II: Thin and Thick Cylinders (06 Hours)

Thin cylinders: basic concept, circumferential, longitudinal and shear stresses, circumferential, longitudinal and volumetric strain, effect of compressible and non compressible fluid injected under pressure. Thick cylinders: basic concept, thick cylinder subjected to internal and external pressure, derivation of Lame's equation for radial and circumferential stresses, representation of radial and circumferential stresses.

Unit III: Influence Line Diagrams (06 Hours)

Influence line diagram for beams: introduction, influence line diagram for reaction, shear and moment for simple beam, influence line diagram for girder and compound beam and application of influence line diagram. Influence line diagram for trusses: bridge floor system, influence line diagram for truss reaction, member forces, determination of maximum forces and influence line diagram for non parallel chord members.

Unit IV: Rolling Loads **(06 Hours)**

Introduction, maximum shear force and bending moment at any section of beam subjected to uniformly distributed and two point load. Maximum end shear force, shear force at section, bending moment at section and absolute maximum moment, equivalent uniformly distributed load.

Unit V: Beams Curved in Plan and Elevation **(06 Hours)**

Beams curved in plan: Introduction, circular beam loaded with uniformly and supported on symmetrically placed column, simply supported semi circular beam supported on three supported equally spaced, quarter circle beam fixed at one end and free at other end carrying point load at free end. Beams curved in elevation: Introduction, assumptions, expression for flexural stresses in curved beam/ Winkler-Bach theory, different cross section for curved beam

Unit VI: Three and Two Hinged Arches **(06 Hours)**

Three hinged arches: basic concept, linear arch, bending moment: Eddy's theorem, analysis of three hinged circular and parabolic arch subjected to uniformly distributed, Influence line diagram for axial thrust, shear and moment of three hinge arches. Two hinged arches: basic concept, analysis of two hinged circular and parabolic arch subjected to uniformly distributed and point loads respectively considering supports at same level.

Text Books

01 Analysis of Structure, Vol II, V N Vazirani, M M Ratwani and S K Duggal, Sixteenth Edition, Khanna Publisher, Delhi

02 Mechanics of Structures, Vol. I & II, S B Junnarkar and H J Shah, Twenty Fourth Editions, Charotar Publishing House, Pvt Ltd, Anand

Reference Books

01 Strength of Materials, Stephen Timoshenko, Third Edition, CBS Publisher & distributer, New Delhi

02 Theory of Structures Vol I, G S Pandit, S P Gupta and R Gupta, McGraw Hill Education (India) Pvt Ltd, New Delhi

03 Fundamentals of Structural Analysis, Kenneth M Leet, Chia-Ming Uang and Anne M Gilbert, Third edition, McGraw Hill Education (India) Pvt Ltd, New Delhi

04 Strength of materials, Andrew Pytel and Ferdinand L Singer, Fourth edition, Harpercollins College Div

05 Structural Analysis in SI Units, R C Hibbler, Pearson Education

06 Mechanics of Materials, E P Popov, Pearson

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301006: Seminar

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 01 Hours/week	01	Term Work: 50 Marks

Pre-requisites
Fundamentals of Civil Engineering

Course objectives

01 Identify technical / practical problems in the field of civil engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes
On successful completion of this course, the learner will be able to:

01 Appraise the current civil engineering research / techniques / developments / interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The seminar report should contain the following. Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks.

01 Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
02 Literature review from books, journals, conference proceedings, published reports / articles / documents. The literature review should be from published literature in the last five years.
03 Theoretical contents related to the chosen topic and case studies if applicable.
04 Concluding remarks or summary.
05 References

Examination: The students must prepare presentation on seminar topic and present in presence of pair of examiners through a viva-voce examination.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301007: Hydrology and Water Resource Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of a journal containing details of assignments and visit report. Term work marks will be based on continuous assessment.

01 Analysis of rainfall data (double mass curve technique/missing rainfall data).
02 Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods.
03 Video demonstration of suiatable software used in water resources department.
04 Frequency analysis (return period, hydrologic event)
05 Determination of peak flood discharge in a basin using unit hydrograph technique.
06 Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
07 Application of open-source GIS software for delineation of catchment/watershed.
08 Measurement of / video demonstration of evaporation by pan evaporimeter
09 Measurement of / video demonstration of infiltration by infiltrometer
10 Site visit to meteorological station

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301008: Water Supply Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Practical: 50 Marks

Term Work

Term work consists of a journal containing the following experiments, assignments, and site visit report. Note: Sr. No. 01 to 06, 09 and 10 are compulsory and any one from Sr. No. 07 and 08 practical. The practical examination will be based on the term work.

01 Determination of pH of various samples such as drinking water, prepared acidic and alkaline samples, other samples such as soft drink / tea etc
02 Determination of Alkalinity of raw water and other samples such as prepared sample, soft drinks and tea etc.
03 Total hardness and its components in raw water.
04 Determination of chlorides in water
05 Determination of chlorine demand and residual chlorine.
06 Determination of turbidity and optimum dose of alum.
07 Determination of sodium or potassium or calcium using flame photometer.
08 Determination of fluorides or iron contents in water
09 Determination of Most Probable Number (MPN)
10 Exercise on design of water distribution network using any suitable software such as EPANET / tools (total pipe length @ 10 km and minimum 10-12 nodes)
11 Site visit to a water treatment plant

Any two assignment

12 Study of water intake structures.
13 Complete design of WTP using appropriate software/Program/excel spread sheet etc.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301009: Design of Steel Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 04 Hours/week	02	Oral: 50 Marks

Term Work

Term work consists of a journal containing the following design, drawing and site visit report. Oral examination will be based on term work.

01 Four full imperial size hand drawn drawing sheets consists of steel structural detailing of 16 sketches based on the syllabus

02 Design of industrial building including roof truss, purlin, bracings, gantry girder, column, column base and connections. Analysis of truss by using suitable software and cross check manually. Use of spreadsheet may be for design of gantry girder. Three full imperial size hand drawn drawing sheets present the design details.

03 Design of welded plate girder: design of cross section, curtailment of flange plates, stiffeners and connections. One full imperial size drawing sheet used to present the design details using any suitable software.

OR

Design of building including primary and secondary beams, column, column base and connections. Analysis of building by using any suitable software and design manual. One full imperial size drawing sheet used to present the design details using any suitable software.

04 Compulsory two site visits based on industrial steel structure and welded plate girder Report should contain structural details with sketches

Note: For term work, the group size should not be more than five students and each group should have different design data.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 a: Elective I: Advanced Fluid Mechanics and Hydraulic Machines Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of following experiments, assignment, and report of site visit. Term work marks will be based on continuous assessment.

List of experiments

01 Calibration of rectangular notch/Triangular notch/spillway Cipolletti weir
02 Analysis/ Visualization of Laminar Flow between two parallel plates using Heleshaw's apparatus
03 Study of Hydraulic Jump as Energy Dissipater in Rectangular Channel
04 Impact of jet on flat plate and curved vane
05 Characteristics of Pelton / Francis turbine
06 Characteristics of Centrifugal pump

Assignments

01 Laminar flow and hydraulics of high rise buildings (Min. 5 questions with minimum 3 numerical problems)
02 Design of Pelton wheel and Francis Turbine
03 Write a computer program to solve any fluid flow problem from above six units; or demonstration of application of any software (e.g. HEC-RAC, MODFLOW, SUTRA, SWMM, EPANET, etc) to solve fluid flow problem based on above six units

Site visit

01 Site visit report on visit to hydroelectric power plant

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 b: Elective I: Research Methodology and IPR Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

The term work should consist of following assignments. Term work marks will be based on continuous assessment.

01 Literature review: Collect the existing literatures on any research idea in civil engineering and identify the research gap. (Performed in a group of students of not more than three).

02 Report and seminar presentation: Prepare the research proposal based on the earlier identified research gap (report should be checked for plagiarism) and present the idea. (Performed in a group of students of not more than three).

03 Collection of standard format and guidelines of research proposal: Identify the national and international funding agencies and prepare research proposal for any one of the funding agency (in a group of students of not more than five).

04 Prepare a report on different citation styles and referencing styles adopted by different publishers. (Performed by individual student).

05 Write a report on case study of any existing patent/copy right/trademark. (Performed by individual student).

06 Collect the information of any one referred peer reviewed journal and write a report based on abstracting and indexing, H Index, SJR rating, impact factor, aim and scope of the journal, guidelines for paper submission etc. (Performed by individual student).

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 c: Elective I: Construction Management Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of journal containing the following. Term work marks will be based on continuous assessment.

01 Site visit to a construction project to study following documents and preparing a report-
   a. Project cash flow analysis.
   b. Use of ERP software
   c. Work break down structure.
   d. Materials flow system in the project.
02 Scheduling of a construction project using line of balance technique.
03 Assignment on work study on any two construction trades.
04 Prepare project balance sheet, profit and loss account statement for any construction project
05 A case study report on risk management
06 Assignment on EOQ model and its variation.
07 Assignment on application of AI techniques in civil engineering.
08 Seminar on any one topic from above syllabus.
09 Any two-assignment based on software (ERP, SAP, HIT OFFICE or equivalent software)

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 d: Elective I: Advanced Concrete Technology Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of following experiments. Term work marks will be based on continuous assessment.

01 Shrinkage test on cement / concrete: Determine the drying shrinkage of cement/concrete in accordance to IS 1199
02 Permeability test on concrete: Determine the permeability of concrete in accordance to IS 3085
03 Flexure test on fiber reinforced concrete beams: Determine the improvement in toughness of concrete containing fibers (any type of fiber)
04 Optimum dosage of admixture using Marsh cone apparatus: Determine the optimum dosage of plasticizers and superplasticizers for different types of cement
05 Test on chloride penetration in concrete: Determine the chloride content in hardened mortar / concrete in accordance to IS: 14959 (Part 2)
06 Elastic modulus of concrete: Determine the elastic modulus of concrete in accordance to IS: 516
07 NDT on concrete: Perform NDT on concrete using ultrasonic pulse velocity method

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 e: Elective I: Matrix Methods of Structural Analysis Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of following assignments. Every student should have different set of assignments/problems/data on each unit covering all the topics. Term work marks will be based on continuous assessment.

01 **Assignment 1 to 6:** minimum five numerical from each unit.

OR

If available, students can attend any equivalent/similar course on SWAYAM/AICTE/NPTEL/any government technical education site; and solve its assignments.

02 **Assignment 7:** Write computer programs to analyze any two skeletal structures using any programming language.

03 **Assignment 8:** Analyze any two structures from different units using any suitable software.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 f: Elective I: Advanced Mechanics of Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

The term work should consist of following assignments and site visit. Term work marks will be based on continuous assessment.

S N	Contents of term work
01	**Assignment I:** Minimum four numerical to find slope and deflection of beams with varying flexural rigidity by moment area and conjugate beam method.
02	**Assignment II:** Minimum four numerical on thick and thin cylinder with graphical presentation of stresses.
03	**Assignment III:** Minimum four numerical with influence line diagram for simple beam, compound beam, chord member and web member of truss.
04	**Assignment IV:** Minimum four numerical to find maximum shear force and bending moment for two point load, uniformly distributed load smaller than span, uniformly distributed load larger than span and to find equivalent uniformly distributed load.
05	**Assignment V:** Minimum two numerical to find bending stress for beam curved in elevation and two numerical to find maximum shear force and bending moment for the beam curved in plan.
06	**Assignment VI:** Minimum two numerical to analyze three hinged circular and parabolic arch and two numerical to analyze two hinged circular and parabolic arch.
07	**Site visit:** Compulsory site visit for cylinder/curved beams/arches.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301011 a: Audit Course I: Professional Ethics and Etiquettes

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Professional ethics is the underlying concept behind the successful accomplishment of any act of a professional towards achieving the individual and societal goals. These goals should ultimately result in morally, legally, ethically and even culturally acceptable good things for all. Engineers being special group of professionals need to be more conscious of their acts since their duties, rights and responsibilities permeate into the society and the surroundings. To practice professional ethics, understanding of values and concepts are essential.

Course objectives

01 To create awareness on professional ethics and human values.
02 To provide basic familiarity about Engineers as responsible experimenters, research ethics, codes of ethics, industrial standards.
03 To inculcate knowledge and exposure on safety and risk.
04 To expose students to right attitudinal and behavioral aspects.

Course outcomes

On successful completion of this course, the learner will be able to:

01 Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories
02 Understand various social issues, industrial standards, code o ethics and role of professional ethics in engineering field.
03 Follow ethics as an engineering professional and adopt good standards and norms of engineering practice.
04 Apply ethical principles to resolve situations that arise in their professional lives

Course Contents

Unit I: Human Values and Engineering Ethics
Morals, values and ethics, integrity, work ethic, civic virtue, valuing time, cooperation, commitment, empathy, self-confidence, stress management, senses of engineering ethics, Kohlberg's theory, Gilligan's theory, models of professional roles, uses of ethical theories.

Unit II: Research Ethics and Codes of Ethics
Industrial standardization, ethical code and its importance, ethical accountability, law in engineering and engineering as social experimentation.

Unit III: Safety, Responsibilities and Rights
Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk collegiality, collective bargaining, confidentiality, conflicts of interest, professional rights, employee rights, intellectual property rights(IPR), discrimination and utilitarianism.

Unit IV: Professional Etiquette
Etiquette at meetings, public relations office (PRO)s etiquettes, technology etiquette phone etiquette, email etiquette, social media etiquette, video conferencing etiquette, interview

etiquette, dressing etiquettes : for interview, offices and social functions, ethical values: importance of work ethics.

Reference books

01 Ethics in Engineering Practice and Research, Caroline Whitbeck, Cambridge Press
02 Intellectual Property Rights, Prabhuddha Ganguli, Tata Mc-Graw –Hill, New Delhi.
03 Professional Ethics and Etiquette (Mastering Career Skills), Checkmark
04 Professional Ethics And Human Values, A Alavudeen, Firewall

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Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301011 b: Audit Course I: Sustainable Energy Systems

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 01 Hours/week	--	Grade

Course objectives

01 To understand the impact of engineering solutions on a global, economic, environmentaland societal context.

02 To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

Course outcomes

On successful completion of this course, the learner will be able to:

01 To demonstrate an overview of the main sources of renewable energy.

02 To understand benefits of renewable and sustainable energy systems.

Course Contents

Unit I: Introduction and Energy Fundamentals

Sustainable energy systems: issues for the 21^{st} century, the critical challenges for a sustainable energy future, sustainable energy system: definitions, indicators, physics of energy: laws of thermodynamics energy forms and conversion, first and second laws and efficiencies devices: heat engines, refrigerators and heat pumps instantaneous and average power.

Unit II: Introduction to Renewable Energy

Wind energy, wind turbine technologies, wind resources and modeling, energy performance and environmental impacts, economics and economic development impacts, photovoltaic: PV and BIPV technologies, solar resources and modeling, energy performance and environmental impacts, economics and net metering.

Unit III: Biomass Electricity

Biomass technologies, introduction biomass productivity and modeling bio power: MSW, willows/switch grass/poplar, wood waste, bio-mass: transport fuels bio fuels, bio ethanol, biodiesel, algal, jatropha bio fuels and water land use impacts, food Vs fuel, renewable fuels standards.

Unit IV: Building Energy

Technologies and policy, smart buildings, lighting and LEDs, Heating/cooling, technologies

Reference books

01 Sustainable Energy Systems and Applications, İbrahim Dinçer, Calin Zamfirescu, Springer

02 Fundamentals of Renewable Energy Systems, D. Mukherjee, Atlantic

03 An introduction to global warming, John R. Barker and Marc H. Ross Am. J. Phys.

Guidelines for Conduction (Any one or more of following but not limited to)
1. Guest Lectures.
2. Visits to sites
3. Studying reports of case studies

Guidelines for Assessment (Any one of following but not limited to)
1. Written Test
2. Practical Test
3. Presentation
4. Report

SEMESTER VI

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301012: Waste Water Engineering

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Basic Concepts of Engineering Sciences and Mathematics

Course objectives

01 To introduce students about the need of sanitation infrastructure, wastewater treatment, sludge management system and to identify potential of wastewater for recycle and reuse

02 To inculcate an ability to learn the working principle, operation and design of various units of wastewater treatment plant

Course outcomes

On successful completion of this course, the learner will be able to:

01 Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams

02 Design preliminary and primary unit operations in waste water treatment plant

03 Understand theory and mechanism of aerobic biological treatment system and to design activated sludge process

04 Understand and design suspended and attached growth wastewater treatment systems

05 Explain and apply concept of contaminant removal by anaerobic, tertiary and emerging wastewater treatment systems

06 Compare various sludge management systems and explain the potential of recycle and reuse of wastewater treatment

Course Contents

Unit I: Sanitation Infrastructure System (06 Hours)

Sanitation infrastructure and wastewater quantification: wastewater, sources and types, need for safe sanitation, importance of sanitation infrastructure (centralized, decentralized, onsite and offsite sanitation), wastewater collection and conveyance, quantitative estimation of wastewater, sewage, storm water, self-cleansing velocity and non-scouring velocity in sanitary sewer, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Wastewater characteristics: methods of sampling, conventional and emerging contaminants (physical, chemical and biological) in domestic and industrial wastewater (sugar, dairy, distillery), treatability index, effluent discharge standards as per CPCB norms. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation and terminology (without derivation and numerical), application and limitations.

Unit II: Preliminary and Primary Wastewater Treatment (06 Hours)

Treatment: stages, (preliminary, primary, secondary and tertiary treatment), sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber: sources of grit, importance of grit chamber, types, control of velocity, proportional flow weir, parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, importance of removal, methods of oil and grease removal. Equalization and neutralization tanks**:** introduction, application and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, assumptions, efficiency, factors affecting efficiency, design of primary sedimentation tank.

Unit III: Secondary Treatment: Aerobic Suspended Growth (06 Hours)

Aerobic secondary treatment: unit operations and processes for secondary treatment, principle of biological treatment, role of microorganism in wastewater treatment, types of microorganisms, microbial metabolism, microbial growth pattern in batch and continuous system, requirements of microbial growth. Activated sludge process (ASP): Conventional plug flow ASP, biochemical reactions, hydraulic and organic loading, F/M ratio, mean cell residence time, aeration method, oxygen requirement, assumptions, design of ASP, sludge volume index, sludge recycle and rate of return sludge, operational problems and maintenance in ASP, modifications in ASP.

Unit IV: Secondary Treatment: Aerobic Suspended and Attach Growth (06 Hours)

Suspended growth system: oxidation pond: bacteria – algae symbiosis, design of oxidation pond, advantages & disadvantages of oxidation ponds. Aerated lagoons: Principle, advantages & disadvantages of aerated lagoons, design of aerated lagoon. Constructed wetlands, phytoremediation and root zone technology: principle, advantages, disadvantages, applications/attached growth system: trickling filter: principle, different TF media & their characteristics, standard rate and high-rate filters, single stage & two stage filters, design using NRC formula, recirculation, ventilation, under drain system, operational problems, control measures. Rotating biological contactors: Principle, advantages, disadvantages, applications

Unit V: Anaerobic Tertiary and Emerging Treatment (06 Hours)

Anaerobic treatment: septic tank: suitable conditions and situations, biological principle, method of treatment and disposal of septic tank effluent and design of septic tank. Anaerobic lagoon: principle, advantages & disadvantage, applications. Up-flow anaerobic sludge blanket (UASB) reactor: principle, advantages & disadvantage, applications. Tertiary (advanced) treatment: objectives, introduction to nutrients removal processes, adsorption, ion exchange, membrane processes, advanced oxidation processes, disinfection. Emerging wastewater treatment systems: sequencing batch reactor (SBR), membrane bio reactors (MBR), moving bed bio reactor (MBBR), fluidized membrane bio reactor (FMBR), packed bed reactor (PBR), advantages, limitations and applications

Unit VI: Sludge Management System and Reuse of Water (06 Hours)

Sludge management system: primary and secondary sludge, quantity and characteristics, sludge thickening by gravity thickener, sludge centrifugation, introduction to aerobic digestion, principle of anaerobic digestion, stages of digestion, bio – gas production, characteristics & applications, factors governing anaerobic digestion, design of sludge digestor, sludge dewatering, sludge drying beds, sludge incineration, sludge disposal/ reuse, challenges in sludge management. Wastewater recycle and reuse**:** driving factors for recycle and reuse, recycling of grey water, municipal sewage, storm water and industrial effluent, reuse opportunities in municipal, industrial, agricultural sector, regulatory guidelines: WHO, US EPA

Text Books

01 Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition

02 Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited

Reference Books

01 Environmental Engineering, Peavy Rowe, McGraw Hill Education (India) Private Limited

02 Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited

03 Industrial Wastewater Treatment, A. D. Patwardhan, Eastern Economy Edition, PHI Learning Private Limited

04 Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication

05 Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association

IS Codes

01 IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301013: Design of Reinforced Concrete Structures

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites
Fundamentals of Concrete Technology, Engineering Mechanics, Mechanics of Materials and Structural Analysis
Course objectives
01 To provide the students with basic concepts of reinforced concrete structures.
02 To analyze, design and detailing of different component of reinforced concrete structures.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel & concrete.
02 Recognize mode of failure as per LSM and evaluate moment of resistance for singly, doubly rectangular, and flanged sections.
03 Design & detailing of rectangular one way and two-way slab with different boundary conditions
04 Design & detailing of dog legged and open well staircase
05 Design & detailing of singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.
06 Design & detailing of short columns subjected to axial load, uni-axial/bi-axial bending and their footings.

Course Contents

Unit I: Design Philosophies and Analysis **(06 Hours)**
Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.

Unit II: Design of Slab **(06 Hours)**
Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients, design of two way slab: simply supported, continuous and restrained.

Unit III: Design of Staircase and Beams **(06 Hours)**

Design of staircase: dog legged and open well, design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced and flanged), shear, bond and torsion.

Unit IV: Design of Beams **(06 Hours)**

Design of rectangular and flanged cross section continuous beam by using IS code coefficients and moment redistribution method.

Unit V: Design of Column **(06 Hours)**

Assumptions, minimum eccentricity, design of short column for axial load, design of short column subjected to combined axial load and uni-axial/biaxial bending using interaction curves.

Unit VI: Design of Footing **(06 Hours)**

Design of isolated column footing for axial load and uni-axial bending, design of combined footing for two columns: slab type/ slab and beam type rectangular

Text Book

01 Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune

02 Limit State Design of Reinforced Concrete, P. C. Varghese, PHI, New Delhi.

Reference Books

01 Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune.

02 RCC Analysis and Design, Sinha and Roy, S. Chand and Co. New Delhi.

03 Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press.

04 Limit State Analysis and Design, P. Dayaratnram, Wheeler Publishing Company.

05 Comprehensive Design of R.C. Structures, Punmia, Jain and Jain, Standard Book House, New Delhi.

06 Reinforced Concrete Design, S. U. Pillai and D. Menon, Tata McGraw Hill, Delhi.

07 Design of Reinforced Concrete Structures, by M. L. Gambhir, PHI, New Delhi.

IS Codes

01 IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi

02 IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi

03 IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi

04 IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301014: Remote Sensing and Geographic Information System

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
The basic knowledge of Engineering Mathematic, Physics, Surveying, Engineering Geology

Course objectives
01 To comprehend fundamentals and principles of RS and GIS techniques.
02 To enhance students' capacity to interpret images and extract information of earth surface from multi-resolution imagery at multi-scale level.
03 To develop skills of Image processing and GIS
04 To utilize RS and GIS techniques in Engineering Geology and civil engineering.
05 To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
06 To learn buffering and layer analysis for civil engineering applications

Course outcomes
On successful completion of this course, the learner will be able to:
01 Articulate fundamentals and principles of RS techniques.
02 Demonstrate the knowledge of remote sensing and sensor characteristics.
03 Distinguish working of various spaces-based positioning systems.
04 Analyze the RS data and image processing to utilize in civil engineering
05 Explain fundamentals and applications of RS and GIS
06 Acquire skills of data processing and its applications using GIS

Course Contents

Unit 1: Remote Sensing **(06 Hours)**
Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning.

Unit 2: Remote Sensing Satellites and Sensor Characteristics **(06 Hours)**
Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image

interpretation, image interpretation

Unit 3: GPS and GNSS **(06 Hours)**

Introduction to GNSS and Types, IRNSS, GPS, GPS components, differential GPS, types of GPS tracking, application of GNSS in surveying, mapping and navigation

Unit 4: Image Processing and Analysis **(06 Hours)**

Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.

Unit 5: Fundamentals of GIS **(06 Hours)**

Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, thematic layers and layer combinations, difference between drafting software's and GIS, fundamentals of cartography and map design, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.

Unit 6: GIS Data and Applications **(06 Hours)**

GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies: demarcation of dam catchment and command area, application in reservoir sediment analysis, application in land measurement work for land record department, applications of land use and land cover pattern, application in urban planning, applications in irrigation planning and scheduling, application in smart cities planning and development.

Text Books

01 Principals of Remote Sensing, Panda B C, Viva Books Private Limited
02 Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad.

Reference Books

01 Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia
02 Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John Villey
03 Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 a: Elective II: Advanced Engineering Geology with Rock Mechanics

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites
Fundamentals of Engineering Geology, Building Technology, Materials and Civil Engineering Projects like Dams, Tunnels, Reservoirs, Bridges

Course objectives
01 To apply geological principles in various phases of civil engineering projects.
02 To develop ability to carry out independently civil engineering and geological investigations.
03 To choose and compare the site conditions leading to their suitability and to treat geological defects to achieve the economy.
04 To highlight geophysical explorations and their applications in geology.
05 To understand fundamentals of rock mechanics and application part of units.
06 To assess the methods required for geological investigations for tunnels, bridges, and dams.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Illustrate seismic zones, plate tectonics and civil engineering significance of major rock formations of India with their characteristics.
02 Explain soil profile, geo-hydrological characters of various rock formations and necessity of geological studies in water conservation.
03 Apply knowledge of geology in Infrastructural, Urban development and demonstrate importance of national wealth.
04 Validate the suitability of rocks based on mechanical properties, R.Q.D. and geophysical exploration.
05 Explore subsurface Geology for civil engineering projects to suggest foundation treatments for various geological defects and channel erosion.
06 Illustrate the suitability of proposed alignments for tunnels and bridges on the basis of Geological investigations.

Course Contents

Unit I: Seismic Zones of India **(06 Hours)**
Geological map of India with special reference to Maharashtra, distribution and geological characters of major rock formations of India, engineering characters of major rock formations of India, the study of plate tectonics and highlights of seismic zones of India.

Unit II: Soil Profile of India (06 Hours)

Geological process of soil formations: rock weathering conditions favorable for decomposition, disintegration, effect of climate on formation of soil, soil profile of various states in India, residual and transported soils, various water conservation techniques, effect of over exploitation of tube wells, bore wells and dug wells, artificial recharge, rainwater harvesting, watershed development and necessity of geological studies, relevant case studies highlighting the success and failure of these techniques.

Unit III: Role of Geology in Infrastructural Development (06 Hours)

Role of geology in infrastructural and urban development**:** influence of geological factors upon urban development and planning, reclamation of abandoned grounds and mining regions, geological hazards and mitigation, illustrative examples across the world. Geological importance of National wealth as a construction material: field conditions favorable for occurrences and utility of various rock formations for the purpose of construction material, illustrative examples.

Unit IV: Geophysical Explorations and Rock Mechanics (06 Hours)

Geophysical explorations: various methods of geophysical explorations, evaluation and analysis of the data produced during these methods, application of these methods in civil engineering projects. Rock mechanics: general principles of rock mechanics, dependence of physical and mechanical properties of rocks on geological characters, analyzing and evaluating of core recovery, R.Q.D. and joint frequency index, various methods of geo-mechanical classifications of rocks such as Terzahagi, U.S.B.M, R.S.R., Q- system, Deer and Miller, Bieniawaski's geo-mechanical classification (RMR) etc.

Unit V: Geological Subsurface Explorations (06 Hours)

Subsurface explorations for dams, reservoir, percolation tanks: evaluation of various geological methods for subsurface explorations, importance of strength and water tightness of rocks occurring and the proposed project site. Case studies illustrating the success and failure of major projects owing to negligence of geological studies, earthquakes occurring in the areas of dams and RIS theory, geological foundation treatments for civil engineering projects: foundation investigation for assessment of geological defects in rocks and suggesting appropriate remedial measures by various treatments. Erosion of tail channels: geological reasons for selection of site for spillway, causes of erosion of channel, relevant case studies.

Unit VI: Engineering Geological Exploration (06 Hours)

Geological exploration for tunnels: variations in methodology of investigation for different types of tunnels for different purposes, location, spacing, angles and depths of drill holes suitable for different types of tunnels, difficulties introduced in various geological formation and their unfavorable field characters, stand up time of rock masses and limitations of it. Dependence of protective measures such as guniting, rock bolting, shotcreting, steel fiber shotcreting, permanent steel supports, lagging concreting and grouting above permanent steel supports on geological conditions, illustrative case studies. Bridges: investigation for bridge foundation, special techniques, and objectives of investigation for bridge foundation, bridge foundation based on nature & structure of rock, foundation settlements and case studies.

Text Books

01 Engineering Geology, Subinoy Gangopadhyay, Oxford University Press.
02 Introduction to Rock Mechanics, B. P. Verma, Khanna Pub New Delhi

Reference Books

01 Fundamentals of Rock Mechanics, Jaeger J. C., Cook N. and Zimmerman R, Blackwell Scientific Publications.
02 Introduction to Rock Mechanics, Goodman R. E., John Wiley & Sons.
03 Introduction to Geophysical Prospecting, M. B. Dobbrin, McGraw Hill Inc.
04 Environmental Geology, Keller E A, Prentice Hall Publication.
05 Tunnels: Planning, Design, Construction, T. M. Megaw and J. V. Bartlett, Ellis Horwood ltd. John Willey & Sons.
06 Engineering Geology, Vasudev Kanithi, Universities Press

Handbooks and IS Codes

01 P. W. D. Handbook Chapter - 6, Part-II Engineering Geology, Gupte R. B. Government of Maharashtra.
02 Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi. .
03 Handbook of Geological terms, geology and Physical Geology, David page, University of Michigan.
04 Handbook of Geology in Civil Engineering, Robert Fergussion , Legget, Mc- Graw Hill.
05 Geotechnical Engineering Handbook, Robert day, Mc - Graw Hill.
06 IS 4453-1967: Code of practice for Exploration, pits, trenches, drifts & shaft, Bureau of Indian Standards, New Delhi.
07 IS 6926-1973: Code of practice for diamond drilling for site of investigation river valley project, Bureau of Indian Standards, New Delhi.
08 IS 4078-1967: Code of practice for Logging and Storage of Drilling Core, Bureau of Indian Standards, New Delhi.
09 IS 5313-1969: Guide for core drilling observation, Bureau of Indian Standards, New Delhi.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 b: Elective II: Soft Computing Techniques

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Mathematics

Course objectives

01 To make students aware about soft computing techniques
02 To impart knowledge about components and training of ANN
03 To introduce students to important aspects of neural network design
04 To introduce students to neural network types and its application
05 To impart knowledge about working of genetic algorithms and Support vector regressions along with their applications
06 To impart knowledge about working of model tree and random forest along with their applications

Course outcomes

On successful completion of this course, the learner will be able to:

01 Understand AI techniques, soft computing techniques and basic concepts Artificial Neural Network
02 Understand components of ANN, training algorithms and implement the back propagation algorithm
03 Design the feed forward back propagation neural network.
04 Understand types of neural networks and their applications
05 Understand working of genetic algorithm, support vector regressions, model tree and random forest along with their applications
06 Develop models for time series applications using support vector regressions, model tree and random forest.

Course Contents

Unit I: Artificial Neural Networks (06 Hours)

Introduction: hard computing and soft computing, introduction to artificial intelligence (AI) and soft computing, soft computing and data driven techniques, biological neural network, artificial neuron, ANN history and general properties, ANN types according to architecture and neuro-dynamics, ANN Vs empirical, statistical, physical, physics-based models.

Unit II: Components of Neural Network and Training (6 hours)

Components of artificial neuron, methods of computing net information, activation functions (linear, sigmoidal, hyperbolic tangent, hard limiter, soft-lin), perceptron, multi-layered perceptron (MLP), pre-training procedures: data normalization, network initialization, types of training: supervised and un-supervised, network training using supervised training algorithms: standard back propagation algorithm and preliminary information of other algorithms like gradient descent, conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, one step secant algorithm, Levernberg-Marquardt algorithm.

Unit III: Important Aspects of Neural Network Design **(06 Hours)**
Important aspects of artificial network design as network architecture, inputs, outputs, number of hidden layers, number of hidden neurons, stopping criteria, overfitting, validation, testing, normalization and de-normalization, evaluating model performance, data division, performance function, design a FFBP neural network with a short numerical.

Unit IV: Types of Neural networks and it's Applications **(06 Hours)**
Recurrent networks, radial basis function networks, generalized regression neural networks, self-organizing maps (discuss using case studies of each referring to published papers and literature), design of artificial neural network for time series (univariate and multivariate) and cause-effect applications.

Unit V: Genetic Algorithm and Support Vector Regression **(06 Hours)**
Introduction to genetic algorithm, genetic operators along with different parameters, applications of GA in civil engineering, introduction to support vector machines, support vector regression, basics of SVR, application of SVR in temporal and cause effect modeling in civil engineering, design of SVR model for time series applications.

Unit VI: Model Tree and Random Forest **(06 Hours)**
Introduction to model tree: M5 Algorithm, basics of MT and application of MT in temporal and cause effect modeling, design of MT model for time series applications, introduction to random forest, basics of RF and application of RF in civil engineering, design of RF model for time series applications.

Text Books

01 Soft Computing in Water Resources Engineering: Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms, Tayfur G., WIT Press.
02 Neural Network Fundamentals with Graphs, Algorithms and Applications, Bose, N. K. and Liang, P., Tata McGraw-Hill Publication.
03 Decision Trees and Random Forests: A Visual Introduction for Beginners: A Simple Guide to Machine Learning with Decision Trees, Chris S, and Mark K., Blue Windmill Media
04 Genetic Algorithm in search, Optimization and Machine learning, Goldberg, D., Addison Wesley Publishing Company.

Reference Books

01 Neural Networks and Fuzzy systems, Kosko B, Prentice Hall, Englewood Cliffs.
02 Advanced methods in neural computing, Wasserman, P D, Van Nostrand Reinhold
03 Publications in peer reviewed international unpaid journals.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 c: Elective II: Advanced Surveying

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Mathematics and Surveying

Course objectives

01 To understand the advance surveying techniques and instruments.
02 To interpret the advanced surveying measurements.
03 To execute the ground as well as aerial mapping.

Course outcomes

On successful completion of this course, the learner will be able to:

01 Recognize the concept of triangulation for fixing the ground control points.
02 Differentiate most probable values for different measurement and adjust those in a given figure.
03 Summarize the concepts of astronomical and hydrographic surveying.
04 Demonstrate the use of aerial photographs for mapping.
05 Analyze use of modern surveying instruments in the field.
06 Execute GPS and the associated software for different applications in civil engineering.

Course Contents

Unit I: Geodetic Surveying and Trigonometric Leveling (06 Hours)

Geodetic surveying: objectives and methods of geodetic surveying, concept of triangulation, triangulation figures, classification of triangulation survey, concept of well conditioned triangle, selection of stations, inter visibility and height of stations, field work in triangulation, concept satellite station. Trigonometric leveling:-terrestrial refraction, angular corrections for curvature and refraction, axis signal correction, determination of difference in elevation by single observation and reciprocal observations.

Unit II: Theory of Errors and Triangulation Adjustment (06 Hours)

Types of errors, definitions, laws of accidental errors, laws of weights, determination of the most probable values of quantities, theory of least squares, method of normal equations, method of corrections, method of correlates, rules for giving weights and distribution of errors to the field observations. Angle and station adjustment, figure adjustment, adjustment of geodetic quadrilateral, spherical triangle and calculations of spherical excess and sides of spherical triangle.

Unit III: Astronomical and Hydrographic Survey **(06 Hours)**

Astronomical surveying: definitions of astronomical terms, coordinate systems for locating heavenly bodies, geographic, geodetic, geocentric, Cartesian, local and projected coordinates for earth resources mapping, elements of spherical trigonometry, shortest distance between two points on earth, determination of latitude and longitude, determination of azimuth. Hydrographic surveying: objectives of hydrographic survey, shore line and river survey, soundings: equipments to measure sounding, methods to locate sounding, three-point problem and its solution (analytical, mechanical and graphical), determination of MSL using GPS.

Unit IV: Aerial Photogrammetry **(06 Hours)**

Introduction, principle, uses, classification-qualitative and quantitative photogrammetry, types of aerial photographs, definitions, scale of vertical photograph, ground co-ordinates, relief displacement, parallax bar, height from parallax measurements, mirror stereoscope, flight planning, procedure of aerial survey, photomaps and mosaics, digital photogrammetry, drone mapping and photogrammetry.

Unit V: Modern Surveying Instruments and Techniques **(06 Hours)**

Introduction to remote sensing, active and passive remote sensing, developments of remote sensing technology and advantages, different platforms of remote sensing, EM spectrum, interaction of EM radiation with atmosphere, remote sensing applications in flood mapping, definition of GIS, components of GIS, importance of GIS, raster data and vector data, primary and secondary data, applications of GIS. Total station: classification, fundamental quantities measured, parts and accessories, basic measuring and working principle of total station, field procedure for total station survey, sources of errors in total station, care and maintenance of total station, basic principles of electronic distance measuring instrument, reflector-less total station, robotic total station, smart station, LIDAR and GPR.

Unit-VI: GPS Surveying **(06 Hours)**

Geodesy fundamentals, geoid, datum, ellipsoid: definition and basic concepts, coordinate systems, special referencing system, map scale, scale factors, Indian geodetic system, reference surface, geodetic systems, segments of GPS, GPS codes, types of GPS receivers, principle of GPS positioning, GPS data formats. GPS errors sources and GPS accuracy, GPS survey methods, future developments in GPS, DGPS and RTK technique, GPS applications and limitations, advantages of GPS surveying over conventional methods, digital terrain model (DTM): topographic representation of the terrain and generation of DTM on computers using spot heights and contour maps.

Text Books

01 Surveying and Leveling - Part-II and III, T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan, Pune.

02 Surveying Vol. II, S.K. Duggal, Tata McGraw Hill Publishing Company Ltd. New Delhi.

Reference Books

01 Advanced Surveying: Total Station, GPS, GIS & Remote Sensing, Satheesh Gopi, 2/e, Pearson Education, Chennai.

02 Surveying Vol. II & III, B C Punmia, Laxmi Publications, New Delhi.

03 Surveying Vol. II & III, K R Arora, Standard book house, New Delhi.

04 Surveying and Leveling, R Subramanian, Second edition, Oxford University Press, New Delhi.

05 Remote Sensing and Geographical Information Systems, Anji Reddy, BS Publications, Hyderabad.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 d: Elective II: Advanced Geotechnical Engineering

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Mechanics, Fluid Mechanics and Geotechnical Engineering

Course objectives

01 To learn the classification of soil, soil structure, role of water in clay, earth pressure on retaining structures and the design of retaining structures.
02 To study types of triaxial tests and draw the stress paths.
03 To know methods to implement soil stabilization and different ground improvement techniques

Course outcomes

On successful completion of this course, the learner will be able to:

01 Classify the soil and understand the soil structure and role of water in clay.
02 Calculate lateral pressure on retaining structures and carry out design the retaining structures.
03 Interpret the results of triaxial tests under different drainage conditions.
04 Draw the stress paths for different conditions.
05 Select and implement soil stabilization techniques based on field conditions.
06 Explain different ground improvement techniques.

Course Contents

Unit I: Soil Classification, Soil Structure and Clay Minerals (06 Hours)

Soil identification and classification, criteria for classifying soil, classification on the basis of grain size, plasticity, symbolic and graphic presentation, classified soils and engineering properties, USCS, BIS, AASHTO and textural classification systems. Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II: Earth Pressure Theory and Design of Earth Retaining Structures (06 Hours)

Types of earth retaining structures, design of gravity and cantilever retaining walls, bracing system and apparent earth pressure diagram for open cuts, only concept of cantilever sheet pile walls and an anchored sheet pile walls, Reinforced earth retaining wall: general principles, concepts and mechanism of reinforced earth , design consideration of reinforced earth: geotextile, geogrids, metal strips and facing elements, construction: selection of type of retaining structures, construction practice, field observations.

Unit III: Shear Strength of Soil **(06 Hours)**

Shear strength of clay soils: undrained strength from UU test, consolidated undrained strength from CU test, consolidated drained strength from CD test, stress strain and volume change relationship. Shear strength of sands: stress strain and volume change relationship, behavior of saturated sand under drained and undrained conditions, factors affecting angle of shearing resistance, pore pressure parameters and determination.

UNIT-IV: Stress Path **(06 Hours)**

Failure lines in stress path, TSP and ESP, stress path for: isotropic consolidation, one dimensional consolidation, unloading of over consolidated clay, sedimentation. Elastic stress path, Stress path for: triaxial drained and triaxial undrained test. Stress path for field conditions: embankment construction, excavation, failure of infinite and finite slope, undrained slope excavation, stress changes below foundation and near retaining wall

Unit V: Soil Stabilization **(06 Hours)**

Soil stabilization: introduction, objectives, factors affecting stabilization of soils, methods of stabilization: mechanical, cement, lime, bituminous; classification of stabilizing agents and stabilization processes. Lime stabilization: base exchange mechanism, pozzolanic reaction, lime-soil interaction, cement stabilization: mechanism, amount, fly-ash: lime stabilization and soil bitumen stabilization.

Unit VI: Ground Improvement **(06 Hours)**

In-situ ground improvement by compaction piles, dynamic loads, explosion sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation without numerical.

Text Books

01 Basic and Applied Soil Mechanics, Gopal Ranjan and A. S. Rao, New Age Publication.
02 Geotechnical Engineering, Shashi K. Gulati and Manoj Datta, Tata Mc-Grawhill.
03 Soil Mechanics and Foundation Engineering, Dr. B. C. Punmia, Laxmi Publications

Reference Books

01 Principles of Geotechnical Engineering, Braj M. Das, Cengage Learning.
02 Advance Soil Mechanics, Braja Mohan Das, Tata Mc- Graw Hill
03 Physical and Geotechnical properties of soils, Joseph E. Bowels, Tata Mac-Graw Hill.
04 Engineering Principles of Ground Modification, Monfred R Hausmann, Mc Graw Hill Publishing Co.
05 Foundation Analysis and Design, Joseph E. Bowels, Tata Mc-Graw Hill.
06 Ground Improvement Techniques, P. Purushothama Raj, Laksmi Publications, New Delhi.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 e: Elective II: Architecture and Town Planning

Teaching scheme	**Credit**	**Examination scheme**
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Building Technology and Architectural Planning

Course objectives
01 To use principles of architectural planning and understand futuristic need of users.
02 To discuss and demonstrate the concepts of landscaping, urban renewal and sustainable architecture
03 To distinguish and relate planning levels and understand use of act and to develop neighborhood plan
04 To interpret need of civic surveys for DP proposal and value planning agencies and ITS
05 To understand and demonstrate planning strategy with reference to different acts, guidelines, norms.
06 To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning

Course outcomes
On successful completion of this course, the learner will be able to:
01 Apply the principles of architectural planning and landscaping for improving quality of life
02 Understand the confronting issues of the area and apply the acts.
03 Evaluate and defend the proposals.
04 Appraise the existing condition and to develop the area for betterment.

Course Contents

Unit I: Architect and Urban Planning **(06 Hours)**
Principles and elements of architectural composition and its expected outcome, qualities of architecture: user friendly, contextual, eco-friendly, utility of spaces, future growth etc. with case study. Role of urban planner and an architect in planning and designing in relation with spatial organization, utility, demand of the area and supply etc considering situations like disasters / pandemic conditions.

Unit II: Landscaping **(06 Hours)**
Landscaping: objectives, principles, elements, material (soft and hard), styles of landscaping, green roofs and vertical gardens: need, means, outcome, urban renewal process and its impact

on quality of life and livability, importance of sustainable architecture, urban conservation with case study.

Unit 3: Town Planning **(06 Hours)**

Scope, purpose and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, new towns and satellite towns, legislative mechanism for preparation of DP: MRTP Act 1966

Unit 4: Civic Survey **(06 Hours)**

Civic surveys and its utility for DP proposal: like demographic, housing, land use, water supply and sanitation. Planning agencies for various levels of planning and the organizational details with purpose (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA and HUDCO), Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems

Unit 5: Acts **(06 Hours)**

Land acquisition rehabilitation and resettlement Act, 2013, real estate (regulation and development) act 2016 and MAHA-RERA, URDPFI Guidelines (for land use, infrastructure etc.), AMRUT Guidelines (water/sewerage, transport etc.)

Unit 6: Special Township **(06 Hours)**

Special townships: SEZ and CRZ, application of GIS, GPS, remote sensing in Town planning, rural planning: need, strategies, government initiatives

Text Books

01 Town Planning, G. K. Hiraskar, Dhanpat Rai Publications

02 Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books

01 MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai

02 URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India

03 LARR Act 2013: Ministry of law and justice, Government of India

04 Climate Responsive Architecture, Arvind Krishnan, Nick Baker, Simos Yannas and Steve Szokolay, McGraw Hill Education

05 An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 f: Elective II: Solid Waste Management

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Environmental Studies, Engineering Chemistry and Waste Water Engineering

Course objectives

01 To understand problems of solid waste, estimate and characterize the solid waste and apply the knowledge of laws for municipal solid waste management for handling of MSW.

02 To understand government initiatives for management of solid waste, to apply the knowledge of mathematics, science, and engineering for effective solid waste collection systems, for waste collection route optimization and its economics.

03 To understand processing of solid waste, material recovery facility and to design composting systems, maintain and operate composting process for effective organic waste recycling.

04 To understand working of waste to energy system and to design of bio-methnation and incineration system.

05 To design & manage construction and operations of landfill facilities and management of legacy solid waste.

06 To understand management and legal requirements of special waste and reuse, recycle and material recovery from solid waste.

Course outcomes

On successful completion of this course, the learner will be able to:

01 Outline solid waste management systems with respect to its generation rate (quantity), sampling, characteristics and regulatory/legal requirements.

02 Explain and suggest relevant method of storage, collection and transportation of solid waste for the given site condition with justification.

03 Develop understanding of technological applications for processing and material recovery from solid waste with its economics and design composting system for organic waste.

04 Describe the fundamental and technological aspects of waste to energy systems from solid waste and to design anaerobic digester and incineration system.

05 Outline the design, operation, and maintenance of sanitary landfill and management of legacy waste.

06 Explain the functional element for management of special waste and suggest the relevant method of reuse and recycling for the given type of waste in the given situation.

Course Contents

Unit I: Introduction to Solid Waste Management (06 Hours)

Definition, objectives of SWM, impacts of improper SWM: soil, water and air, functional outlines of SWM, sources and types of solid waste. MSW: sampling, refuse analysis, composition, characteristics: physical, chemical, biological and generation rate, factors affecting generation rate, estimation of quantity of solid waste. Sustainable solid waste management for smart cities, role of urban local bodies in waste management, objectives and importance of MSW Rules 2016, rules and regulations of SWM in developed countries.

Unit II: Government Initiatives, Collection & Transportation of Solid Waste (06 Hours)

Swachh survekshan and its impact on the SWM scenario in India, national urban livelihood missions (NULM) and its role in SWM, social entrepreneurship, swachhta & rural engagement cell (SESREC): government of India initiatives, success stories of SWM in India. Integrated solid waste management, storage, different methods of collection, collection systems, transfer and transportation of solid waste, uses of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicles location, optimization of route, measurement and methods of measuring solid waste, economics of solid waste collection and transport.

Unit III: Processing and Transformation of Solid Waste (06 Hours)

Decentralised system Vs centralised system, three tier system, source reduction, segregation and salvage, material recovery facility centres, resource recovery of bye-products, recycling and reuse of solid waste, use of solid waste as raw materials in industry, value added products, recycling and carbon credits, economics of solid waste processing, circular economy in waste management. Theory of composting, processing before composting, types of composting (home composting, vermicomposting, organic waste converter, rotary drum, continuous flow reactor), explain methods: Indore method, Bangalore method, mechanical composting plant, factors governing composting and design of composting system.

Unit IV: Waste to Energy (06 Hours)

Bio-methnation: theory of anaerobic digestion, stages, factors affecting anaerobic digestion, recovery of bio-gas, applications/use of biogas, design of anaerobic digester. Energy content of MSW, estimation of low and high heating value (LHV, HHV), theory and types of incinerators, design of incineration plant. Pyrolysis, refused derived fuel (RDF), plasma gasification: working principle, energy recovery, advantages, limitations and applications, environmental impacts of waste to energy: dioxins, furans, heavy metals etc.

Unit V: Disposal of Solid Waste (06 Hours)

Landfill: Introduction, components of land filling, types of land filling, site selection, acceptable waste, construction techniques, maintenance and precautions, leachate and landfill gas: estimation, management, treatment and disposal/reuse, control of contamination of ground water, operation monitoring, closure and end-use, advantages and disadvantages of secured landfill facility (SLF), design of sanitary landfill, slope stability analysis, concept of bioreactor landfill: principle, types, applications. Legacy waste management or biomining: concept, methods, applications, economics and time duration.

Unit VI: Special Waste Management and Regulations **(06 Hours)**

Sources, collection, transportation, treatment and disposal: biomedical waste, hazardous waste, construction and demolition waste, e-waste, sanitary napkin (flow chart and one case study of each). Slaughter waste management: concept of rendering plants. Objectives and key points of hazardous and other waste management rules, 2016, construction and demolition (C&D) waste management rules - 2016, E-waste management rules - 2016, plastic waste management rules – 2016, reuse and recycling of plastic waste in road construction, case studies of processing and reuse of construction & demolition waste, material recovered from e-waste, introduction to life cycle assessment (LCA) in solid waste management.

Text Books

01 Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated.

02 Solid waste management, Dr. A.D. Bhide

03 Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI.

Reference Books

01 Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore.

02 CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.

03 Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.

04 C for Environmental Scientists and Engineers, Y. Anjaneyulu and Valli Manickam, Wiley Publications.

05 Standard Handbook of Hazardous Waste Treatment and Disposal, Harry Freeman, McGraw-Hill Education, 1998

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301016: Internship

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 04 Hours/week	04	Term Work: 100 Marks

Pre-requisites: Fundamentals of Civil Engineering covered in earlier courses

Course objectives

01 To encourage and provide opportunities for students to get professional/personal experience through internships.
02 To learn to apply the technical knowledge gained from academics /c1assroom learning in real life/industrial situations.
03 To get familiar with various tools and technologies used in industries and their applications.
04 To enable students to develop professional skills and expand their professional network with the development of employer-valued skills like teamwork, communication.
05 To apply the experience gained from industrial internship to the academic course completion project.
06 To nurture professional and societal ethics in students
07 Understand the social, economic and administrative considerations that influence the working environment of industrial organizations

Course outcomes

On successful completion of this course, the learner will be able to:
01 To develop professional competence through industry internship
02 To apply academic knowledge in a personal and professional environment
03 To build the professional network and expose students to future employees
04 Apply professional and societal ethics in their day to day life
05 To become a responsible professional having social, economic and administrative considerations
06 To make own career goals and personal aspirations

CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	1	1	1	2	1	1
CO2	1	2	2	2	3	2	1	1	1	2	2	1
CO3	-	-	-	-	-	1	-	-	2	2	1	1
CO4	2	-	-	-	-	2	2	3	-	1	-	2
CO5	-	-	-	-	-	1	2	1	1	1	2	1
CO6	-	-	-	-	-	1	1	-	2	1	-	1

Guidelines of Internship

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

1. Duration: Internship to be completed after semester V and before commencement of semester VI of at least 4 to 6 weeks. It is to be assessed and evaluated in semester VI.
2. Internship work Identification: Student may choose to undergo Internship at Industry/Govt./NGO/MSME/Rural Internship/Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry [1].

Contacting various companies for Internship and Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination.

Student can take internship work in the form of online/onsite work from any of the following but not limited to:

a. Working for consultancy/ research project
b. Participation at events (technical/business) in innovation related completions like Hackathon
c. Contribution in incubation/innovation/entrepreneurship cell/institutional innovation council/startups cells of institute
d. Learning at departmental lab/tinkering lab/institutional workshop
e. Development of new product/business plan/registration of start-up
f. Participation in IPR workshop/leadership talks/ideal design/innovation/business completion/technical expos
g. Industry/government organization internship
h. Internship through Internshala

i. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship
j. Research internship under professors, IISC, IIT's, research organizations
k. NGOs or social internships, rural internship
l. Participate in open source development
m Development of Physical and/or numerical, mathematical, soft computing model
n Carrying out surveys related to society related but Engineering problems. For example, a survey of solid waste management in a particular area/town/village, survey of water supply network in a locality, town, village etc. , survey of air quality etc.

[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Po1icy.pdf

3. Internship Diary/ Internship Workbook: Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.

Internship diary/workbook and internship report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the institute immediately after the completion of the training. Internship diary/workbook may be evaluated on the basis of the following criteria.

i. Proper and timely documented entries
ii. Adequacy & quality of information recorded
iii. Data recorded
iv. Thought process and recording techniques used
v. Organization of the information

4. Internship Work Evaluation: Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by programme head/cell in-charge/project head/ faculty mentor or Industry Supervisor based on overall compilation of internship activities, sub-activities, level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and evaluation is to be done in consultation with internship supervisor (internal and external) and a supervisor from place of internship.

Recommended evaluation parameters: Post internship internal evaluation 50 Marks and internship diary/workbook and internship report 50 Marks. Evaluation through Seminar Presentation/Viva-Voce at the Institute

The student will present a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria.

Depth of knowledge, communication skills, presentation skills, team work, creativity, planning & organizational skills, adaptability, analytical skills, attitude and behavior at work, societal understanding, ethics, regularity and punctuality, attendance record, log book, student's feedback from external internship supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact industrial supervisor/faculty mentor/TPO for assigning special topics and problems and should prepare the final report on the student's presence physically, if the student is found absent without prior intimation to the department/institute/concern authority/T & P Cell, entire training can be cancelled.

The report shall be presented covering following recommended fields but not limited to:

- ✓ Title/cover Page
- ✓ Internship completion certificate
- ✓ Internship place details: Company background-organization and activities/scope and object of the study/personal observations
- ✓ Index/table of contents
- ✓ Introduction
- ✓ Title/problem statement/objectives
- ✓ Motivation/scope and rationale of the study
- ✓ Methodological details
- ✓ Results/analysis/inferences and conclusion
- ✓ Suggestions/recommendations for improvement to industry, if any
- ✓ Attendance record
- ✓ Acknowledgement
- ✓ List of reference (books, magazines and other sources)

5. Feedback from internship supervisor (external and internal): Post internship, faculty coordinator should collect feedback about student with following recommended parameters.

Technical knowledge, discipline, punctuality, commitment, willingness to do the work, communication skill, individual work, team work and leadership

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301017: Waste Water Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

The term work consists of a journal having details of at least 8 experiments. Experiment No. 12 and the assignments are compulsory. Oral examination based on term work.

List of experiments

01 Determination of dissolved oxygen in a given water and wastewater sample

02 Determination of Bio-Chemical Oxygen Demand in a given wastewater sample

03 Determination of Chemical Oxygen Demand in a given wastewater sample

04 Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample

05 Determination of Sludge Volume Index in a given wastewater sample

06 Determination of Electrical Conductivity in a given wastewater sample

07 Determination of Phosphates by spectrophotometer in a given wastewater sample

08 Determination of Nitrates by spectrophotometer in a given wastewater sample

09 Determination of heavy metals like Cr^{6+} or Zn or Ni or Cd in a given wastewater sample

10 Determination of Kjeldahl nitrogen in a given wastewater sample

11 Visit to domestic / Industrial wastewater treatment plant & its detailed report

12 Computer aided design of Sewage Treatment Plant (STP) OR Effluent Treatment Plant (ETP) of Sugar/ Dairy/Distillery Industry using suitable software (e.g., ASIM, STOAT) or excel sheets

Assignment

01 Brief report on sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.

02 Brief report on a case study of package wastewater treatment plant

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301018: Design of Reinforced Concrete Structures Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 04 Hours/week	02	Oral: 50 Marks

Term work

Term work consists of a journal containing the following design, drawing and site visit report. Oral examination based on term work.

01 Design Project: Design of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings and staircase (first and intermediate flight) with following details.

- i. Minimum plan area of each floor shall be more than 150 m^2
- ii. Design of plinth and ground beams: for each type two simply supported and two continuous.
- iii. Design of all slabs and beams of typical floor (first or second floor)
- iv. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending,
  (c) axial load with biaxial bending, from terrace level to footing along with detailed load calculations.
- v. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending.
- vi. Design any one element by using spread sheet or use of analysis and design by suitable software.
- vii. Four full imperial drawing sheets. Out of which only structural plan drawing sheet shall be drawn by using any drafting software. Schedule of slabs, beams, columns and footing can be prepared by using any drafting software.
- viii. Detailing of reinforcement should be as per SP-34 & IS-13920.

02 Two assignments on design of combined footing along with reinforcement detailing

03 Reports of two site visits. (Building under construction)

Note: For term work, the group size should not be more than five students and each group should have different design data.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301019: Remote Sensing and Geographic Information System Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work shall consist of seven experiments out of which 1 to 6 are compulsory and any one from 7 to 9. Term work marks will be based on continuous assessment.

01 Study of fundamental tools of software for data processing.
02 Import and export data GIS software to the Auto-CAD or Revit software and mention all the necessary steps used.
03 Geo-reference and Geo-tag using Google earth/ base map.
04 Digitize the given part of toposheet using software & attribute (Name, area, length, as per requirements).
05 Generation of thematic maps (contour, drainage, road etc.) in software.
06 Visual image interpretation from aerial photos and/or satellite images.
07 Preparation of DEM to study geomorphoplogical features and nature of slope.
08 Explore utilization of RS and GIS for development of smart city.
09 Land use classification using RS data.

Note: Use open-source software like QGIS, GRASS etc. for performing the experiments.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 a: Elective II: Advanced Engineering Geology with Rock Mechanics Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

The practical journal consists of following experiments and term work marks will be based on continuous assessment.

01 Study of Geological map and seismic zone map of India

02 Study of some parameters of morphometric analysis of river, toposheet will be made available by the college.

03 Study of Soil Profile of any region in India

04 Use of electrical resistivity method for determining depth of bedrock.

05 Computation of RQD & Joint Frequency Index for interpretation of drill hole data

06 Logging of drill cores, preparation of Litho logs and interpretation of drill data, preparing geological cross sections from drill hole data and using them for designing of civil engineering structures representing following case studies.

1. Dipping sedimentary formation.
2. Faulted region.
3. Folded region.
4. Locating spillway.
5. Tunnels in Tectonic areas.
6. Tunnels and open cuts in non-tectonic areas.

07 A compulsory site tour to study geological aspects of an engineering projects and writing a report based on studies carried out during visits.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 b: Elective II: Soft computing Techniques Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of following experiments and term work marks will be based on continuous assessment.

01 Hand Calculation of network output for any given ANN with sigmoidal, hyperbolic tangent and linear activation functions
02 Implementing standard backpropagation algorithm manually or using spreadsheet
03 Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (univariate) with any appropriate Software.
04 Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (multi-variate) with any appropriate Software.
05 Evaluating the performance of ANN developed in Experiment 3 and 4 by varying number of hidden neurons, activation functions, normalization ranges with any appropriate Software.
06 Designing the model in SVR using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by SVR using two different kernels with any appropriate Software.
07 Designing the model in MT using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by MT using variations of pruning and smoothing etc. with any appropriate Software.
08 Designing the model in RF using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by RF using potential parameters and parito charts with any appropriate software.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 c: Elective II: Advanced Surveying Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work shall consist of the any seven practical and any one project from the following. Term work marks will be based on continuous assessment.

List of Practical

01 Measurement of horizontal and vertical angles using 1” theodolite and digital theodolite.
02 Solution of three-point problem using analytical and graphical method.
03 Measurement of air base distance using mirror stereoscope.
04 Measuring the height of a tower using total station.
05 Setting up stakes for marking the foundation of a building on ground using total station.
06 Measurement of distances, angles, gradient and distance between two inaccessible points using total station.
07 Demonstration of the use of unmanned aerial vehicle (UAV).
08 Measuring the GPS coordinates of ground control points in a mapping survey using any GNSS system.

List of projects

01 Preparing a topographic map using total station and appropriate mapping software.
02 Mapping a given area using a differential GPS.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 d: Elective II: Advanced Geotechnical Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of any 10 assignments out of 12 given below and term work marks will be based on continuous assessment.

01 Soil classification by any method using software/programming.
02 Review of five research papers on clay minerals.
03 Design of cantilever and gravity retaining wall for same problem statement and its comparison using software/programming.
04 Site visit report for any type of retaining wall.
05 One numerical each on UU test, CU test and CD test.
06 One numerical on determination of pore pressure parameters using triaxial test.
07 To draw stress path for isotropic consolidation, one dimensional consolidation, triaxial drained and triaxial undrained test.
08 To draw stress path for undrained slope excavation, stress changes below foundation and near retaining wall.
09 Report on a field case study on soil stabilization using lime/cement/flyash.
10 Case Study of sub grade stabilization using fly ash.
11 Explanation of any one ground improvement technique using a case study and field data.
12 Ground improvement technique – A review of stone column method with the case study.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 e: Elective II: Architecture and Town Planning Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

The term work shall consist of a journal from the following. Serial number 1, 2 and 10 are compulsory and any five from remaining. Term work marks will be based on continuous assessment.

01 Study and analysis of development plan with respect to land use, services, infrastructure, street furniture, housing etc. (Group work)
02 Neighborhood planning with its calculation (Group work)
03 Report on contribution of engineers, planners and architects in post-independence India (individual work)
04 Report on any existing new towns or planned towns or satellite towns like new Mumbai, Gandhinagar etc. (in relation with TP aspects inclusive of infrastructure, disaster management etc), (Individual work)
05 Study of salient features of urban renewal schemes (Group work)
06 Study of any existing town planning scheme (Group work)
07 Study of URDPFI OR AMRUT guidelines with a case study (Individual work)
08 Study of special townships or SEZ or CRZ or rural planning strategies (Group work)
09 Study of urban conservation or housing and housing change or ancient sustainable architecture (Group work)
10 E- learning: https://maharera.mahaonline.gov.in with its report (Group work)

Note: For term work, the group size should not be more than five students

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 f: Elective II: Solid Waste Management Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of following experiments/site visit/Assignments. Any 11 out 18 practical, Sr. No. 1 is compulsory, any 6 practical from Sr. No. 2 to 11 and any 4 practical from Sr. No. 12 to 18. Term work marks will be based on continuous assessment.

01 Report of site visit to municipal solid waste management: Housing society/village/town/city/metropolitan
02 Practical/theoretical (from case study) identification of impacts and problems of improper management of municipal solid waste.
03 Practical/theoretical (from case study) sampling methods and characterization study of municipal solid waste: present and future trend, estimation of quantity of refuse.
04 Determine moisture content and volatile solids for organic faction of municipal solid waste by using oven and muffle furnace.
05 Determine carbon/ nitrogen/ phosphorous content of manure produced from composting process or organic faction of municipal solid waste.
06 Determine calorific value of municipal solid waste by using bomb calorimeter.
07 Practical/theoretical (from case study) municipal solid waste generation rate and estimation of quantity of MSW present and future.
08 Practical/theoretical (from case study) optimization of route network for municipal solid waste collection.
09 Design a composting system for organic waste generated from housing society or city.
10 Design an anaerobic digester for organic waste generated from housing society or city.
11 Design of a sanitary landfill system for any city.
12 Estimation of quantity of leachate and landfill gas emission by using free software such as, bio-transform, HELP, GAISM etc.
13 Identify any construction demolition waste problem and suggest appropriate solution.
14 Prepare a report for cost economics of MSW management for village /town /city etc.
15 Prepare a report for management of e-waste/ biomedical waste/ hazardous waste based on case study or field visit.
16 Report on MSW management by NGO/ ULBs for zero waste management concepts.
17 Prepare a report based on filed visit or case study. Use of Smart Technologies in solid waste management sector- sensors for segregation of waste, using of VTS /GPS/ RFID system and reverse vending machine installed at bus station, railway station.
18 Prepare a report based on filed visit or case study for pay as you pollute or extended producer responsibility (EPR) behavioral analysis in solid waste management.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301021 a: Audit Course II: Leadership and Personality Development

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Personality is considered as one of the integral part of an individual's existence, where a student is concerned paying close attention to Personality which is extremely important. To enhance holistic development of students and improve their employability skills

Course objectives

01 To develop inter personal skills and bean effective goal oriented team player.
02 To develop professionals with idealistic, practical and moral values.
03 To develop communication and problem solving skills.
04 Tore-engineer attitude and understand its influence on behavior

Course outcomes

On successful completion of this course, the learner will be able to:

01 Enhanced holistic development of students and improve their employability skills

Course Contents

Unit I: Introduction to Personality and working towards developing it

Definition and basic of personality, analyzing strength & weaknesses, corporate the orison personality development, increasing vocabulary, body language, preparation of self introduction

Unit II: Communication skill and handling attitude

Communication skills, listening, communication barriers, overcoming these barriers, building self esteem and self confidence, working on attitudes .i.e. aggressive, assertive, and submissive

Unit III: Leadership Techniques in Personality development

Introduction to leadership, leadership styles, group dynamics, team building

Unit IV: Stress and time management skills

Interpersonal relationships, analysis of ego states, transactions, and life positions, stress management, causes, impact & managing stress, introduction to conflict management, time management, concept of time management, steps towards better time management

Reference books

01 Soft skills, Career Development Centre‖, Green Pearl Publications
02 Seven Habits of Highly Effective Teens, Sean, Fireside Publishers. New York.
03 How to win Friends and Influence People, Carnegie Dale Simon & Schuster, New York.
04 I am ok, You are ok, Thomas A Harris, Harper and Row, New York
05 Emotional Intelligence, Daniel Coleman, Bantam Book

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301021 b: Audit Course II: Industrial Safety

Teaching scheme	**Credit**	**Examination scheme**
Tutorial: 01 Hours/week	--	Grade

Course objectives

01 Health environment and security covers virtually every important area in administration

Course outcomes

On successful completion of this course, the learner will be able to:

01 Analyze the safety problem with its solution

Course Contents

Unit I: Introduction of safety

Elements of safety programming, safety management, upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

Unit II: Safety Performance Planning Safety Performance

An overview of an accident, it is an accident, injury or incident, the safety professional, occupational health and industrial hygiene, understanding the risk, emergency preparedness and response, prevention of accidents involving hazardous substances.

Unit III: Accident Prevention

What is accident prevention, maintenance and inspection, monitoring techniques, general accident prevention, safety education and training.

Unit IV: Safety Organization

Basic elements of organized safety, duties of safety officer, safe work practices, safety sampling and inspection, job safety analysis (JSA), safety survey, on-site and off-site emergency plan, reporting of accidents and dangerous occurrences.

Reference books

01 Industrial Safety, Health Environment and Security, Basudev Panda, Laxmi Publications

02 Industrial safety and Environment, A. K. Gupta, Laxmi Publication

03 Industrial Safety Management, L. M. Deshmukh, Tata McGraw-Hill

Guidelines for Conduction (Any one or more of following but not limited to)

1. Guest Lectures.
2. Visits to sites
3. Studying reports of case studies

Guidelines for Assessment (Any one of following but not limited to)

1. Written Test
2. Practical Test
3. Presentation
4. Repor

Curriculum
for

Third Year of Computer Engineering
(2019 Course)

(With effect from 2021-22)

http://unipune.ac.in

Faculty of Science and Technology

Savitribai Phule Pune University
Maharashtra, India

http://unipune.ac.in/university_files/syllabi.htm

Third Year of Computer Engineering (2019 Course) (With effect from 2021-22)

Prologue

It is with great pleasure and honor that I share the syllabi for Third Year of Computer Engineering (2019 Course) on behalf of Board of Studies, Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BoS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks,

Dr. Varsha H. Patil
Chairman, Board of Studies (Computer Engineering), SPPU, Pune

links for First and Second Year Computer Engineering Curriculum 2019:

1. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
2. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/First%20Year%20Engineering%202019%20Patt.Syllabus_05.072019.pdf
3. http://collegecirculars.unipune.ac.in/sites/documents/Syllabus2020/SE%20Computer%20Engg.%202019%20%20Patt_03.072020.pdf

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Table of Contents

Savitribai Phule Pune University

Bachelor of Computer Engineering

Home

Program Outcomes (POs)

Learners are expected to know and be able to

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1	**Professional Skills**-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Home

Semester V

Course Code	Course Name	Teaching Scheme (Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
310241	Database Management Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
310242	Theory of Computation	03	-	-	30	70	-	-	-	100	03	-	-	03
310243	Systems Programming and Operating System	03	-	-	30	70	-	-	-	100	03	-	-	03
310244	Computer Networks and Security	03	-	-	30	70	-	-	-	100	03	-	-	03
310245	Elective I	03	-	-	30	70	-	-	-	100	03	-	-	03
310246	Database Management Systems Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
310247	Computer Networks and Security Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310248	Laboratory Practice I	-	04	-	-	-	25	25	-	50	-	02	-	02
310249	Seminar and Technical Communication	-	-	01	-	-	50	-	-	50	-	-	01	01
	Total	**15**	**10**	**01**	**150**	**350**	**125**	**50**	**25**	**700**	**15**	**05**	**01**	**21**
310250	Audit Course 5												**Grade**	
										Total Credit	**15**	**05**	**01**	**21**

310245 **Elective I Options:**

310245(A) Internet of Things and Embedded Systems
310245(B) Human Computer Interface
310245(C) Distributed Systems
310245(D) Software Project Management

310250 Audit Course 5 Options:

310250 (A) Cyber Security
310250 (B) Professional Ethics and Etiquettes
310250 (C) Learn New Skills
310250 (D) Engineering Economics
310250 (E) Foreign Language

Laboratory Practice I

Assignments from **Systems Programming and Operating System** and **Elective I**

Savitribai Phule Pune University

Third Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2021-22)

Home

Semester VI

Course Code	Course Name	Teaching Scheme (Hours/week) $$			Examination Scheme and Marks						Credit Scheme			
		$$ Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
310251	Data Science and Big Data Analytics	04	-	-	30	70	-	-	-	100	03	-	-	03
310252	Web Technology	04	-	-	30	70	-	-	-	100	03	-	-	03
310253	Artificial Intelligence	04	-	-	30	70	-	-	-	100	03	-	-	03
310254	Elective II	04	-	-	30	70	-	-	-	100	03	-	-	03
310255	Internship**	-	-	-	-	-	100 **	-	-	100	-	-	-	04 **
310256	Data Science and Big Data Analytics Laboratory	-	04	-	-	-	50	25	-	75	-	02	-	02
310257	Web Technology Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
310258	Laboratory Practice II	-	04	-	-	-	50	25	-	75	-	02	-	02
	Total	**12**	**10**	-	**120**	**280**	**225**	**50**	**25**	**700**	**12**	**09**	-	**21**
310259	Audit Course 6												**Grade**	
										Total	**12**	**09**	-	**21**

310254 Elective II Options:

310254(A) Information Security
310254(B) Augmented and Virtual Reality
310254(C) Cloud Computing
310254(D) Software Modeling and Architectures

310259 Audit Course 6 Options:

310259(A) Digital and Social Media Marketing
310259(B) Sustainable Energy Systems
310259(C) Leadership and Personality Development
310259(D) Foreign Language
310259(E) Learn New Skills

Laboratory Practice II:

Assignments from **Artificial Intelligence** and **Elective II**.

**** Internship:**

Internship guidelines are provided in course curriculum sheet.

$$ Hours/Week for Theory Course in Third Year of Engineering, Semester VI:

As per the apex bodies' recommendations and guidelines, it is need of the day to train the pre-final year students for the industrial readiness through internship. As per the guidelines of AICTE, the duration of internship is 4-6 weeks after completion of semester V and before commencement of semester VI, so it is apparent that the contact hours of the TE students need to be managed meticulously. It becomes mandatory as per the structure that 4 credits for internship must earned by the students. **Per semester, 15 weeks duration that is suggested ideally by the affiliated university will eventually reduce to fruitful 12 weeks after the implementation of the revised curriculum (2019 Course). With the evaluatory introduction of internship in the structure, we are left with the choice of 4 theory courses in the sixth semester with 12 weeks instead of traditional 15 weeks.** To balance the credits and to achieve the minimum required contact hours, it is the reasonable choice to allot 4 hours / week for each theory course of the sixth semester of Third year of Engineering. The additional one lecture/ week will definitely be instrumental in achieving the largest of minimum contact hours. As such there is no correspondence of weekly load and credits earned, the credit allotted per course remain intact despite of the change. **So it is almost imperative that the commencement of VI Semester need to be approx. 3 weeks beyond the schedule.**

Home

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. The **Program Outcomes (POs)** for Engineering are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @: **CO and PO Mapping Matrix**(Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-'indicates that there is no correlation between the respective CO and PO.

3. **#: Elaborated examples/Case Studies**- For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *: For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.

5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.

6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.

8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed. Use of open source software is appreciated.

9. **Term Work** [1]–Term work is continuous assessment that evaluates a student's progress throughout the semester [1]. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been

achieved. It is recommended to conduct internal monthly mock practical test as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

Home

10. **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

11. **Tutorial** [1] - Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. **Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.**

12. **Audit Course** [1]-The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP'/'PP'' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.
13. UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer[2].

    SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity, and quality. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.[2]

    For more rules, pattern and assessment of semester examination refer[1]
14. ****Internship**:

    Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

[1]http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
[2] https://swayam.gov.in/about

Abbreviations		
TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**TUT: Tutorial**	**Sem: Semester**

Semester V

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310241: Database Management Systems

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Data Structures and Algorithms (210252)

Companion Course: Database Management Systems Laboratory (310246)

Course Objectives:

- To understand the fundamental concepts of Database Management Systems
- To acquire the knowledge of database query languages and transaction processing
- To understand systematic database design approaches
- To acquire the skills to use a powerful, flexible, and scalable general-purpose databases to handle Big Data
- To be familiar with advances in databases and applications

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze and design Database Management System using ER model
CO2: Implement database queries using database languages
CO3: Normalize the database design using normal forms
CO4: Apply Transaction Management concepts in real-time situations
CO5: Use NoSQL databases for processing unstructured data
CO6: Differentiate between Complex Data Types and analyze the use of appropriate data types

Course Contents

Unit I	Introduction to Database Management Systems and ER Model	06 Hours

Introduction, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models. **Database Design and ER Model**: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity-Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting ER and EER diagram into tables.

#Exemplar/Case Studies	Analyze and design database using ER Model for any real-time application and convert the same into tables.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	SQL and PL/SQL	07 Hours

SQL: Characteristics and Advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators. **Tables**: Creating, Modifying, Deleting, Updating.**SQL DML Queries**: SELECT Query and clauses, Index and Sequence in SQL. **Views**: Creating, Dropping, Updating using Indexes, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, SQL Functions, Nested Queries.**PL/SQL**: Concept of Stored Procedures and Functions, Cursors, Triggers, Assertions, Roles and Privileges.

#Exemplar/Case Studies	Implementation of Unit 1 case study using SQL and PL/SQL.

***Mapping of Course Outcomes for Unit II**	CO1, CO2	
Unit III	**Relational Database Design**	**06 Hours**
Relational Model: Basic concepts, Attributes and Domains, CODD's Rules. **Relational Integrity**: Domain, Referential Integrities, Enterprise Constraints. **Database Design**: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.		
#Exemplar/Case Studies	Normalize relational database designed in Unit I.	
***Mapping of Course Outcomes for Unit III**	CO1, CO3	
Unit IV	**Database Transaction Management**	**07 Hours**
Introduction to Database Transaction, Transaction states, ACID properties, Concept of Schedule, Serial Schedule. **Serializability**: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules. **Concurrency Control**: Lock-based, Time-stamp based Deadlock handling. **Recovery methods**: Shadow-Paging and Log-Based Recovery, Checkpoints. **Log-Based Recovery**: Deferred Database Modifications and Immediate Database Modifications.		
#Exemplar/Case Studies	Study of Transaction Management in Postgre SQL	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**NoSQL Databases**	**07 Hours**
Introduction to Distributed Database System, Advantages, Disadvantages, CAP Theorem. **Types of Data:** Structured, Unstructured Data and Semi-Structured Data. **NoSQL Database:** Introduction, Need, Features. **Types of NoSQL Databases:** Key-value store, document store, graph, wide column stores, BASE Properties, Data Consistency model, ACID Vs BASE, Comparative study of RDBMS and NoSQL. **MongoDB** (with syntax and usage): CRUD Operations, Indexing, Aggregation, MapReduce, Replication, Sharding.		
#Exemplar/Case Studies	Use of NoSQL databases for processing unstructured data from social media.	
***Mapping of Course Outcomes for Unit V**	CO5, CO6	
Unit VI	**Advances in Databases**	**07 Hours**
Emerging Databases: Active and Deductive Databases, Main Memory Databases, Semantic Databases. **Complex Data Types:** Semi-Structured Data, Features of Semi-Structured Data Models. **Nested Data Types**: JSON, XML. **Object Orientation:** Object-Relational Database System, Table Inheritance, Object-Relational Mapping. **Spatial Data:** Geographic Data, Geometric Data.		
#Exemplar/Case Studies	Applications of advanced databases in real time environment.	

***Mapping of Course Outcomes for Unit VI**	CO5, CO6

Learning Resources

Text Books :

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled”, Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626

Reference Books :

1. C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, “Database Systems: Concepts, Design and Application”, Pearson Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dierolf, “MongoDB: The Definitive Guide”, O‘Reilly Publications, ISBN: 978-1-449-34468-9
4. Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, “Storing and Managing Big Data - NoSQL, HADOOP and More”, Emereopty Limited, ISBN: 1743045743, 9781743045749
6. Joy A. Kreibich, “Using SQLite”, O'REILLY, ISBN: 13:978-93-5110-934-1
7. Ivan Bayross, “SQL, PL/SQL the Programming Language of Oracle”, BPB Publications ISBN: 9788176569644, 9788176569644
8. Seema Acharya, “Demystifying NoSQL”, Wiley Publications, ISBN: 9788126579969

e-Books :

1. SQL and Relational Theory
   a. (How to Write Accurate SQL code), C.J. Date, O’REILLY Publication
2. SQL A Beginner’s Guide, Andy Oppel, Robert Sheldon, McGraw Hill Publication

MOOCs Courses Links:

- http://www.nptelvideos.com/lecture.php?id=6518

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	2	2	3	1	-	-	-	1	-	-	-	3
CO2	-	2	3	-	-	2	-	-	-	-	-	3
CO3	-	2	3	-	1	-	-	-	-	-	-	3
CO4	2	2	2	2	-	-	-	-	-	1	-	3
CO5	-	2	3	-	-	-	-	-	-	-	1	3
CO6	2	2	-	-	-	-	1	-	2	-	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310242: Theory of Computation

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: --

Course Objectives:

- To introduce the students to basics of Theory of Computation
- To study abstract computing models to provide a formal connection between algorithmic problem solving and the theory of languages
- To understand Grammar, Pushdown Automata and Turing Machine for language processing and algorithm design
- To learn about the theory of computability and complexity for algorithm design

Course Outcomes:

After completion of the course, learners should be able to

CO1: Understand formal language, translation logic, essentials of translation, alphabets, language representation and apply it to design Finite Automata and its variants

CO2: Construct regular expression to present regular language and understand pumping lemma for RE

CO3: Design Context Free Grammars and learn to simplify the grammar

CO4: Construct Pushdown Automaton model for the Context Free Language

CO5: Devise Turing Machine for the different requirements outlined by theoretical computer science

CO6: Analyze different classes of problems, and study concepts of NP completeness

Course Contents

Unit I	Formal Language Theory and Finite Automata	07 Hours

Finite Automata (FA): An informal picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language.
FA without output: Deterministic and Nondeterministic FA (DFA and NFA), epsilon- NFA and inter-conversion. Minimization of DFAs.
FA with output: Moore and Mealy machines -Definition, models, inter-conversion.

#Exemplar/Case Studies	FSM for vending machine, spell checker
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Regular Expressions (RE)	07 Hours

Introduction, Operators of RE, Precedence of operators, Algebraic laws for RE, Language to Regular Expressions, Equivalence of two REs. **Conversions**: RE to NFA, DFA, DFA to RE using Arden's theorem, Pumping Lemma for Regular languages, Closure and Decision properties of Regular languages. Myhill-Nerode theorem.

#Exemplar/Case Studies	RE in text search and replace

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Context Free Grammar (CFG) and Context Free Language(CFL)**	**07 Hours**
Basic Elements of Grammar, Formal Definition of Context Free Grammar, Sentential form, Derivation and Derivation Tree/ Parse Tree, Context Free Language (CFL), Ambiguous Grammar, writing grammar for language. **Simplification of CFG**: Eliminating Є-productions, unit productions, useless production, and useless symbols. **Normal Forms:** Chomsky Normal Form, Greibach Normal Form, Pumping Lemma for CFG, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, Cock-Younger-Kasami Algorithm.		
#Exemplar/Case Studies	Parser, CFG for Palindromes, Parenthesis Match	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Pushdown Automata (PDA)**	**07 Hours**
Introduction, Formal definition of PDA, Equivalence of Acceptance by Final State and Empty stack, Non-deterministic PDA (NPDA), PDA and Context Free Language, Equivalence of PDA and CFG, PDA vs CFLs. Deterministic CFLs.		
#Exemplar/Case Studies	Parsing and PDA: Top-Down Parsing, Bottom-up Parsing simulation showing use of PDA	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Turing Machines (TM)**	**07 Hours**
Turing Machine Model, Formal definition of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Computing function with Turing Machine, Variants of Turing Machines, Halting Problem of TM, Halting vs Looping, A Turing-unrecognizable language, Reducibility, Recursion Theorem. The Model of Linear Bounded Automata.		
#Exemplar/Case Studies	Algorithms using Turing Machine	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Computability and Complexity Theory**	**07 Hours**
Computability Theory: Decidable Problems and Un-decidable Problems, Church-Turing Thesis. **Reducibility**: Undecidable Problems that is recursively enumerable, A Simple Un-decidable problem. **Complexity Classes**: Time and Space Measures, The Class P, Examples of problems in P, The Class NP, Examples of problems in NP, P Problem Versus NP Problem, NP-completeness and NP-hard Problems.		
#Exemplar/Case Studies	Traveling salesman problem, Post Correspondence Problem (PCP)	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languagesand Computation", Addison-Wesley,ISBN 0-201-44124-1
2. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 97881265133454

Reference Books:

1. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, ISBN: 0521424267 97805214242643
2. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, McGrawHill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
3. J.Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-45
4. Kavi Mahesh, "Theory of Computation: A Problem-Solving Approach", Wiley India, ISBN1081265331106
5. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 97811331878137
6. Vivek Kulkarni, "Theory of Computation", Oxford University Press, ISBN 0-19-808458

e-Books :

- https://cglab.ca/~michiel/TheoryOfComputation/TheoryOfComputation.pdf
- https://www.cs.virginia.edu/~robins/Sipser_2006_Second_Edition_Problems.pdf
- http://ce.sharif.edu/courses/94-95/1/ce414-2/resources/root/Text%20Books/Automata/John%20E.%20Hopcroft,%20Rajeev%20Motwani,%20Jeffrey%20D.%20Ullman-Introduction%20to%20Automata%20Theory,%20Languages,%20and%20Computations-Prentice%20Hall%20(2006).pdf

MOOCs Courses Links:

- https://nptel.ac.in/courses/106/104/106104148/
- https://nptel.ac.in/courses/106/104/106104028/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	1	-	-	-	-	-	-	2
CO2	3	3	2	2	1	-	-	-	-	-	-	1
CO3	3	3	2	2	1	-	-	-	-	-	-	1
CO4	3	3	2	2	1	-	-	-	-	-	-	1
CO5	3	3	3	2	1	-	-	-	-	-	-	2
CO6	3	3	3	3	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310243: Systems Programming and Operating System

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Programming and Problem Solving (110005), Data Structures and Algorithms (210252), Principles of Programming Languages (210255), Microprocessor (210254)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To get acquainted with the basics of System Programming
- To acquire knowledge of data structures used in the design of System Software
- To be familiar with the format of object modules, the functions of linking, relocation, and loading
- To comprehend the structures and functions of Operating Systems and process management.
- To deal with concurrency and deadlock in the Operating System
- To learn and understand memory management of Operating System

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze and synthesize basic System Software and its functionality.
CO2: Identify suitable data structures and Design & Implement various System Software
CO3: Compare different loading schemes and analyze the performance of linker and loader
CO4: Implement and Analyze the performance of process scheduling algorithms
CO5: Identify the mechanism to deal with deadlock and concurrency issues
CO6: Demonstrate memory organization and memory management policies

Course Contents

Unit I	Introduction	08 Hours

Introduction to Systems Programming, Need of Systems Programming, Software Hierarchy, Types of software: system software and application software, Machine structure.
Evolution of components of Systems Programming: Text Editors, Assembler, Macros, Compiler, Interpreter, Loader, Linker, Debugger, Device Drivers, Operating System. **Elements of Assembly Language Programming**: Assembly Language statements, Benefits of Assembly Language, A simple Assembly scheme, Pass Structure of Assembler.
Design of two pass Assembler: Processing of declaration statements, Assembler Directives and imperative statements, Advanced Assembler Directives, Intermediate code forms, Pass I and Pass II of two pass Assembler.

#Exemplar/Case Studies	Study of Debugging tools like GDB
*Mapping of Course Outcomes for Unit I	CO1, CO2, CO3

Unit II	Macro Processor and Compilers	06 Hours

Introduction, **Features of a Macro facility**: Macro instruction arguments, Conditional Macro expansion, Macro calls within Macros, Macro instructions, Defining Macro, Design of two pass Macro processor, Concept of single pass Macro processor.
Introduction to Compilers: Phases of Compiler with one example, Comparison of Compiler and Interpreter.

#Exemplar/Case Studies	GNU M4 Macro Processor	
***Mapping of Course Outcomes for Unit II**	CO1, CO2, CO3	
Unit III	**Linkers and Loaders**	**07 Hours**
Introduction, **Loader schemes**: Compile and Go, General Loader Scheme, Absolute Loaders, Subroutine Linkages, Relocating Loaders, Direct linking Loaders, Overlay structure, Design of an Absolute Loader, Design of Direct linking Loader, Self-relocating programs, Static and Dynamic linking.		
#Exemplar/Case Studies	Study the concepts of Class loading in Java.	
***Mapping of Course Outcomes for Unit III**	CO1, CO2, CO3	
Unit IV	**Operating System (OS)**	**07 Hours**
Introduction: Evolution of OS, Operating System Services, Functions of Operating System. **Process Management**: Process, Process States: 5 and 7 state model, Process control block, Threads, Thread lifecycle, Multithreading Model, Process control system calls. **Process Scheduling**: Uni-processor Scheduling, Scheduling: Preemptive, Non-preemptive, Long-term, Medium-term, Short term scheduling. **Scheduling Algorithms**: FCFS, SJF, RR, and Priority.		
#Exemplar/Case Studies	Process management in Linux /Windows/Android Readers-Writers problem	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Synchronization and Concurrency Control**	**07 Hours**
Concurrency: Principle and issues with Concurrency, Mutual Exclusion, Hardware approach, Software approach, Semaphore, Mutex and monitor, Reader writer problem, Producer Consumer problem, Dining Philosopher problem. **Deadlocks**: Principle of Deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, Deadlock recovery.		
#Exemplar/Case Studies	Concurrency Mechanism: Unix/Linux/Windows.	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Memory Management**	**07 Hours**
Introduction: Memory Management concepts**,** Memory Management requirements. **Memory Partitioning**: Fixed Partitioning, Dynamic Partitioning, Buddy Systems Fragmentation, Paging, Segmentation, Address translation. **Placement Strategies**: First Fit, Best Fit, Next Fit and Worst Fit. **Virtual Memory (VM)**: Concepts, Swapping, VM with Paging, Page Table Structure, Inverted Page Table, Translation Look aside Buffer, Page Size, VM with Segmentation, VM with Combined paging and segmentation. **Page Replacement Policies**: First In First Out (FIFO), Last Recently Used(LRU), Optimal, Thrashing.		
#Exemplar/Case Studies	Memory management in Linux /Windows/Android	

***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. John Donovan, "Systems Programming", McGraw Hill, ISBN 978-0--07-460482-3
2. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
3. Silberschatz, Galvin, Gagne, "Operating System Principles", 9th Edition, Wiley, ISBN 978- 1-118-06333-0

Reference Books:

1. Leland Beck, "System Software: An Introduction to Systems Programming", Pearson
2. John R. Levine, Tony Mason, Doug Brown, "Lex & Yacc", 1st Edition, O'REILLY, ISBN 81-7366-062-X
3. Alfred V. Aho, Ravi Sethi, Reffrey D. Ullman, "Compilers Principles, Techniques, and Tools", Addison Wesley, ISBN 981-235-885-4

e-Books :

- https://www.elsevier.com/books/systems-programming/anthony/978-0-12-800729-7
- https://www.kobo.com/us/en/ebook/linux-system-programming-1
- https://www.ebooks.com/en-us/subjects/computers-operating-systems-ebooks/279/
- https://www.e-booksdirectory.com/details.php?ebook=9907

MOOCs Courses Links:

- https://www.udacity.com/course/introduction-to-operating-systems--ud923
- nptel video lecture link: https://nptel.ac.in/courses/106/105/106105214/
- https://www.edx.org/course/computer-hardware-and-operating-systems
- https://onlinecourses.nptel.ac.in/noc19_cs50/preview
- https://www.udemy.com/course/system-programming/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	-	-	-	-	-	-	-	-
CO2	2	2	1	2	-	-	-	-	-	-	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	1
CO5	2	2	1	2	-	-	-	-	-	-	-	1
CO6	2	1	2	1	-	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310244: Computer Networks and Security

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Discrete Mathematics (210241)

Companion Course: Computer Networks and Security Laboratory (310247)

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies
- To learn different techniques for framing, error control, flow control and routing
- To learn different layer protocols in the protocol stacks
- To understand modern network architectures with respect to design and performance
- To learn the fundamental concepts of Network Security

Course Outcomes:

On completion of the course, learners should be able to

CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies

CO2: Illustrate the working and functions of data link layer

CO3: Analyze the working of different routing protocols and mechanisms

CO4: Implement client-server applications using sockets

CO5: Illustrate role of application layer with its protocols, client-server architectures

CO6: Comprehend the basics of Network Security

Course Contents

Unit I	Introduction To Computer Networks	06 Hours

Definition, **Types of Networks**: Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Networks Software, Protocol, Design issues for the Network layers. **Network Models**: The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium. **Network Architectures**: Client-Server, Peer To Peer, Hybrid. **Network Devices**: Bridge, Switch, Router, Gateway, Access Point. **Line Coding Schemes**: Manchester and Differential Manchester Encodings, Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

#Exemplar/Case Studies	Study of Campus wide networking.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Data Link Layer	08 Hours

Introduction, functions. **Design Issues**: Services to Network Layer, Framing.**ARQ strategies**: Error detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. **Flow Control Protocols**: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol.**WAN Connectivity**: PPP and HDLC. **MAC Sub layer**: Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Binary Exponential Back-off algorithm, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.

#Exemplar/Case Studies	Demonstration of DLL protocols on Simulator

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Network Layer**	**08 Hours**
Introduction: Functions of Network layer. **Switching Techniques**: Circuit switching, Message Switching, Packet Switching. **IP Protocol**: Classes of IP (Network addressing), IPv4, IPv6,Network Address Translation, Sub-netting, CIDR. **Network layer Protocols**: ARP, RARP, ICMP, IGMP. **Network Routing and Algorithms**: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. **Routing Protocols**: RIP, OSPF, BGP, MPLS. **Routing in MANET**: AODV, DSR, Mobile IP.		
#Exemplar/Case Studies	Demonstration of Routing Protocols on simulator.	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Transport Layer**	**07 Hours**
Process to Process Delivery, Services, Socket Programming. **Elements of Transport Layer Protocols**: Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control. **Transport Layer Protocols**: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.		
#Exemplar/Case Studies	Demonstration of Transport layer protocols on Simulator.	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Application Layer**	**06 Hours**
Introduction, Web and HTTP, Web Caching, DNS, Email: SMTP, MIME,POP3, Webmail, FTP, TELNET, DHCP, SNMP.		
#Exemplar/Case Studies	Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Security**	**07 Hours**
Introduction, Security services, Need of Security, Key Principles of Security, Threats and Vulnerabilities, Types of Attacks, ITU-T X.800 Security Architecture for OSI, Security Policy and mechanisms, Operational Model of Network Security, Symmetric and Asymmetric Key Cryptography. Security in Network, Transport and Application: Introduction of IPSec, SSL, HTTPS, S/MIME, Overview of IDS and Firewalls.		
#Exemplar/Case Studies	Study of security protocols in Network, Transport and Application Layer using network protocol analyzer. Wireshark	
***Mapping of Course Outcomes for Unit VI**	CO6	
Learning Resources		

Text Books :

1. Fourauzan B.,"Data Communications and Networking",5th Edition,TataMcGraw-Hill,Publications, ISBN:0–07 – 058408 – 7
2. Andrew S. Tanenbaum, “Computer Networks”, 5th Edition, Pearson India, 2012.

Reference Books :

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
3. Douglas E. Comer & M.S Narayanan, "Computer Network & Internet", Pearson Education
4. William Stallings, "Cryptography and Network Security: Principles and Practice", 4th Edition
5. Pachghare V. K., "Cryptography and Information Security", 3rd Edition, PHI,

e-Books :

- https://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf
- http://eti2506.elimu.net/Introduction/Books/Data_Communications_and_Networking_By Behrouz A.Forouzan.pdf
- http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
- https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf

Case Study:

- https://slideplayer.com/slide/6106945
- http://www.worldcolleges.info/sites/default/files/Cisco_-_Ccie_Fundamental_-Network_Design_And_Case_Studies.PDF
- http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php

MOOCs Courses link:

- nptel.ac.in/courses/106/105/106105183
- nptel.ac.in/courses/106/105/106105080
- nptel.ac.in/courses/106/105/106105081
- nptel.ac.in/courses/106/106/106106091
- nptel.ac.in/courses/106/105/106105031
- https://www.mooc-list.com/tags/computer-networking
- https://www.coursera.org/courses?query=computer%20network

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	1	2	2	1	-	-	-	-	1	1
CO2	1	1	1	1	1	-	1	-	-	1	-	-
CO3	3	1	2	1	2	-	-	-	-	-	-	1
CO4	1	2	1	2	2	-	-	-	1	-	1	1
CO5	1	3	-	-	1	-	1	1	-	-	-	-
CO6	1	-	2	1	-	1	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(A): Internet of Things and Embedded Systems

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Digital Electronics and Logic Design (210245)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To learn advances in Embedded Systems and IoT
- To learn methodologies for IoT application development
- To learn the IoT protocols, cloud platforms and security issues in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the fundamentals and need of Embedded Systems for the Internet of Things
CO2: Apply IoT enabling technologies for developing IoT systems
CO3: Apply design methodology for designing and implementing IoT applications
CO4: Analyze IoT protocols for making IoT devices communication
CO5: Design cloud based IoT systems
CO6: Design and Develop secured IoT applications

Course Contents

Unit I	Introduction to Embedded Systems	07 Hours

Definition, Characteristics of Embedded System, Real time systems, Real time tasks. **Processor basics**: General Processors in Computer Vs Embedded Processors, Microcontrollers, Microcontroller Properties, Components of Microcontrollers, System-On-Chip and its examples, Components of Embedded Systems, Introduction to embedded processor.

#Exemplar/Case Studies	Installation of Real Time Operating System
*Mapping of Course Outcomes for Unit I	CO1,CO2

Unit II	Internet of Things : Concepts	07 Hours

Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks. **Physical Design of IoT**: Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog / Digital Conversion. **Logical Design of IoT**: IoT functional blocks, IoT enabling technologies, IoT levels and deployment templates, Applications in IoT.

#Exemplar/Case Studies	Exemplary device: Raspberry Pi / Arduino: Programming: Arduino IDE/ Python, Interfacing. Other IoT Devices.
*Mapping of Course Outcomes for Unit II	CO1,CO2

Unit III	IoT: Design Methodology	07 Hours

IoT Design Methodology: Steps, Basics of IoT Networking, Networking Components, Internet

Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.

#Exemplar/Case Studies	Home Automation using IoT communication models and IoT Communication APIs.
***Mapping of Course Outcomes for Unit III**	CO3,CO4

Unit IV	**IoT Protocols**	**07 Hours**

Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. **IP based Protocols**: MQTT (Secure), 6LoWPAN, LoRa.

#Exemplar/Case Studies	LoRa based Smart Irrigation System.
***Mapping of Course Outcomes for Unit IV**	CO4,CO5

Unit V	**Cloud Platforms for IoT**	**07 Hours**

Software Defined Networking, Introduction to Cloud Storage Models, Communication API. **WAMP**: Auto Bahn for IoT, Xively Cloud for IoT. **Python Web Application Framework**: Django Architecture and application development with Django, Amazon Web Services for IoT, Sky Net IoT Messaging Platform, RESTful Web Service, GRPC,SOAP.

#Exemplar/Case Studies	Smart parking, Forest fire detection
***Mapping of Course Outcomes for Unit V**	CO4, CO5

Unit VI	**Security in IoT**	**07 Hours**

Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. **Key elements of IoT Security**: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT, Challenges in designing IOT applications, Lightweight cryptography.

#Exemplar/Case Studies	Home Intrusion Detection
***Mapping of Course Outcomes for Unit VI**	CO2, CO6

Learning Resources

Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on Approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, "Microcontroller and Smart Home Networks", ISBN: 9788770221566, e-ISBN: 9788770221559
2. Charles Crowell, "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT",ISBN-13 : 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press,ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5
4. David Etter, "IoT Security: Practical guide book", amazon kindle Page numbers, source ISBN: 1540335011.
5. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Second Edition,

Packt Publishing, ISBN: 9781788625821

6. Dr. Shriram K Vasudevan,Abhishek S Nagarajan, RMD Sundaram, “Internet of Things”, Wiley publication, 2nd Edition, ISBN: 9789388991018

e-Books :

- https://www.iotforall.com/ebooks/an-introduction-to-iot
- https://www.qorvo.com/design-hub/ebooks/internet-of-things-for-dummies

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105166/
- https://www.udemy.com/course/a-complete-course-on-an-iot-system-design-and-development/
- https://www.coursera.org/learn/iot
- https://nptel.ac.in/courses/108/108/108108098/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	-	-	-	-	1	-	1	-
CO2	3	2	1	2	1	-	-	-	-	-	-	-
CO3	2	3	3	3	2	3	-	-	2	-	1	-
CO4	1	2	2	2	3	3	-	-	2	1	2	2
CO5	2	2	2	3	3	3	-	-	2	1	2	2
CO6	2	2	1	2	2	2	-	1	1	-	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(B): Human Computer Interface

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Graphics (210244), Software Engineering (210253)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand the importance of HCI design process in software development
- To learn fundamental aspects of designing and implementing user interfaces
- To study HCI with technical, cognitive and functional perspectives
- To acquire knowledge about variety of effective human-computer-interactions
- To co-evaluate the technology with respect to adapting changing user requirements in interacting with computer

Course Outcomes:

On completion of the course, learners should be able to

CO1: Design effective Human-Computer-Interfaces for all kinds of users

CO2: Apply and analyze the user-interface with respect to golden rules of interface

CO3: Analyze and evaluate the effectiveness of a user-interface design

CO4: Implement the interactive designs for feasible data search and retrieval

CO5: Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual reality ,multi-media, World wide web related environments

CO6: Analyze and identify user models, user support, and stakeholder requirements of HCI systems

Course Contents

Unit I	Introduction and Foundation of HCI	07 Hours

Foundation: Human Memory. **Thinking**: Reasoning and Problem Solving, Emotion, Individual Difference, Psychology and design of Interactive systems, The Computer-Text Entry Device, Positioning, Pointing, Display devices, Devices for virtual reality and 3D Interaction, The Interactions-Models of Interaction, Frameworks and HCI, Ergonomics, Interaction styles, Ergonomics, Elements of WIMP Interface, Interactivity, Measurable Human Factors, The context of Interaction. **Importance of User Interface**: Defining user Interface, Brief History of Human-Computer Interface, Good and Poor Design- Importance of good design.

#Exemplar/Case Studies	Paper prototype – Design elements of GUI
*Mapping of Course Outcomes for Unit I	CO1,CO6

Unit II	Human Perspective in Interaction Design Process	07 Hours

Know your user/client: Understanding how people interact with computers, Important human characteristics in Design, Human considerations in design of Business systems, Human Interaction speeds, Performance versus Preference, Methods of gaining an understanding of users, Miller's Law.

Design Guidelines: Navigating the interface, Organizing the display, Getting user's attention, Facilitating data entry. **Principles**: Determine user's skill level, Identify the tasks, Choose an

interaction style, Natural Language, Eight Golden rules of Interface design, Prevent errors, Ensuring Human control while increasing automation. **Theories**: Design-by-level, Stages of action, Consistency, Contextual Theories, Dynamic theories.		
#Exemplar/Case Studies	Registration form design.	
***Mapping of Course Outcomes for Unit II**	CO1,CO2	
Unit III	**Interaction Styles and HCI in Software Process**	**07 Hours**
Design, Process of Interaction Design. **Interaction styles**: Command line, Menu Selection, Form fill-in, Direct Manipulation. **Graphical User Interface:** Popularity of Graphics, Concept of direct manipulation, Advantages, Disadvantages and characteristics of Graphical user interface. **Web User Interface**: Popularity and Characteristics, Merging of Graphical business systems and the Web- Characteristics of Intranet versus Internet, Web page versus application design, Principles for user interface design, Software life cycle, Usability Engineering, Iterative design and prototyping, Design Rationale.		
#Exemplar/Case Studies	Comparison - GUI and Web design with a real time example.	
***Mapping of Course Outcomes for Unit III**	CO1,CO3,CO5	
Unit IV	**Usability Evaluation and Universal Design**	**07 Hours**
User interface design process: Designing for People: Seven commandments, Usability Assessment in the Design process, Common Usability problems, Practical and Objective measures of Usability, Formative and Summative evaluation, Usability specifications for evaluation, Analytic methods, Model based analysis, GOMS model, Empirical methods, Field studies, Usability testing in Laboratory, Controlled experiments, Heuristic Evaluation, Cognitive Walkthrough. **Evaluation framework**: Paradigms and techniques, DECIDE: a framework to guide evaluation, Universal design principles, Multi-modal interaction, Designing for diversity.		
#Exemplar/Case Studies	GOMS model - Adding items to a cart of e-shopping website.	
***Mapping of Course Outcomes for Unit IV**	CO1,CO3	
Unit V	**HCI Paradigms**	**07 Hours**
Paradigms for Interaction: Time sharing, Video display units, Programming toolkits, Personal computing, The metaphor, Direct manipulation, Hypertext, Computer-supported cooperative work, Agent based interfaces. **Ubiquitous Computing**: Sensor-based and context-aware interaction, Data Integrity versus Data immunity, Handling missing data, Data entry and fudge ability, Auditing versus Editing, Retrieval in Physical World, Retrieval in Digital world, Constrained Natural Language output, Five stage search framework, Dynamic queries and faceted search, The social aspects of search. **Pattern Recognition**: Introduction, Examples, Role of Machine Learning, Pattern Recognition Process, Pattern Recognition in HCI.		
#Exemplar/Case Studies	Interface Design- Pattern gesture recognition	
***Mapping of Course Outcomes for Unit V**	CO1,CO3,CO4	
Unit VI	**HCI for Mobile and Handheld devices**	**07 Hours**
Designing for Mobile and other devices: Anatomy of a Mobile app, Mobile form factors, Handheld format apps, Tablet format apps, Mini-tablet format apps, Mobile Navigation, Content, and control idioms- browse controls, Navigation and toolbars, Drawers, Tap-to-reveal and direct manipulation, Searching, Sorting and Filtering, Welcome and help screens, Multi-touch gestures,		

Inter-app integration, Android Accessibility Guidelines.

Other devices: Designing for kiosks, Designing for 10-foot interfaces, Designing for automotive interfaces, Designing for audible interfaces.

#Exemplar/Case Studies	GUI in Python Enlist and evaluate handled devices
***Mapping of Course Outcomes for Unit VI**	CO3,CO5,CO6

Learning Resources

Text Books:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9
3. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, "Designing the User Interface: Strategies for Effective Human- Computer Interaction", 6th Edition, Pearson Education Limited, ISBN 987-1-292-03701-1.

Reference Books :

1. Alan Cooper, Robert Reiman, David Cronin, Christopher Noessel, "About Face: The Essentials of Interaction Design", 4th edition, WILEY, ISBN 978-1-118-76658-3
2. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann Publishers, ISBN 978-1-558-60712-5
3. Wibert O. Galitz,"The Essential Guide to user Interface Design", WILEY India, ISBN: 978-1-265-0280-6
4. Jenifer Tidwell, "Designing Interfaces", O'REILLY, ISBN: 978-1-449-37970-4
5. Julie A. Jacko (Ed), "The Human-Computer Interaction Handbook", 3rd edition, CRC Press, 2012
6. Zou J., Nagy G. (2006) "Human-Computer Interaction for Complex Pattern Recognition Problems"
7. Basu M., Ho T.K. (eds) "Data Complexity in Pattern Recognition. Advanced Information and Knowledge Processing", Springer, London

e-Books :

- http://www.37steps.com/data/pdf/PRIntro_medium.pdf
- https://www.ecse.rpi.edu/~nagy/PDF_chrono/2005_Zou_Nagy_complexity_05.pdf
- https://www.raywenderlich.com/240-android-accessibility-tutorial-getting-started

MOOCs Courses link

- https://www.edx.org/course/human-computer-interaction-i-fundamentals-design-p
- https://www.edx.org/course/human-computer-interaction-ii-cognition-context-cu

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	1	1	1	-	-	1	1	3	1
CO2	2	2	-	1	-	-	-	2	1	-	-	-
CO3	-	1	2	3	-	1	-	1	-	-	1	-
CO4	-	-	-	2	3	1	-	-	1	-	-	-
CO5	3	2	2	-	2	2	2	-	-	2	2	3
CO6	-	1	2	1	2	3	-	1	-	-	-	2

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(C): Distributed Systems

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks and Security(310244)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To learn the fundamentals of Distributed Systems
- To learn types of communication and synchronization in Distributed Systems
- To acquaint with the Distributed File Systems
- To understand consistency and replication in Distributed Systems
- To understand the fault tolerance based Distributed Systems

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze Distributed Systems types and architectural styles
CO2: Implement communication mechanism in Distributed Systems
CO3: Implement the synchronization algorithms in Distributed System applications
CO4: Develop the components of Distributed File System
CO5: Apply replication techniques and consistency model in Distributed Systems
CO6: Build fault tolerant Distributed Systems

Course Contents

Unit I	Introduction	07 Hours

Defining Distributed Systems, Characteristics, Middleware and Distributed Systems. **Design goals**: Supporting resource sharing, Making distribution transparent, Open, Scalable, Pitfalls. **Types of Distributed Systems**: High Performance Distributed Computing, Distributed Information Systems, Pervasive Systems. **Architectural styles**: Layered architectures, Object based architectures, Publish Subscribe architectures. **Middleware organization**: Wrappers, Interceptors, Modifiable middleware. **System architecture**: Centralized, Decentralized, Hybrid, Example architectures – Network File System, Web.

#Exemplar/Case Studies	Case Study of Middleware System that includes Design, Architecture and Application.
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Communication	07 Hours

Introduction: Layered Protocols, Types of Communication, Remote Procedural Call- Basic RPC Operation, Parameter Passing, RPC-based application support, Variations on RPC, Example: DCE RPC, Remote Method Invocation. **Message Oriented Communication**: Simple Transient Messaging with Sockets, Advanced Transient Messaging, Message Oriented Persistent Communication, Examples. **Multicast Communication**: Application Level Tree-Based Multicasting, Flooding-Based Multicasting, Gossip-Based Data Dissemination.

#Exemplar/Case Studies	Apache Kafka Distributed Event Streaming Platform, gRPC Open Source RPC Framework
***Mapping of Course**	CO2

Outcomes for Unit II		
Unit III	**Synchronization**	**07 Hours**
Clock Synchronization: Physical Clocks, Clock Synchronization Algorithms. **Logical Clocks** – Lamport's Logical clocks, Vector Clocks. **Mutual Exclusion**: Overview, Centralized Algorithm, Distributed Algorithm, Token-Ring Algorithm, Decentralized Algorithm .**Election Algorithms**: Bully Algorithm, Ring Algorithm. **Location Systems**: GPS, Logical Positioning of nodes, Distributed Event Matching. **Gossip-Based Contribution**: Aggregation, A Peer-Sampling Service, Gossip-Based Overlay Construction.		
#Exemplar/Case Studies	Design Time Synchronization Mechanism in Distributed Gaming	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Naming and Distributed File Systems**	**07 Hours**
Names, Identifiers, Addresses, Flat Naming, Structured Naming, Attributed Based Naming, Introduction to Distributed File Systems, File Service Architecture. **Case study**: Suns Network file System, Andrew File System.		
#Exemplar/Case Studies	Study of Google File System	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Consistency and Replication**	**07 Hours**
Introduction: Reasons for Replication, Replication as Scaling Technique. **Data-Centric Consistency Models**: Continuous Consistency, Consistent Ordering of Operations. **Client-Centric Consistency Models**: Eventual Consistency, Monotonic Reads, Monotonic Writes, Read Your Writes, Writes Follow Reads. **Replica Management**: Finding the best server location, Content Replication and Placement, Content Distribution, Managing Replicated Objects. **Consistency Protocols**: Continuous Consistency, Sequential Consistency, Cache Coherence Protocols, Example: Caching, and Replication in the web.		
#Exemplar/Case Studies	Study of HDFS Architecture for Data Replication	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Fault Tolerance**	**07 Hours**
Introduction to Fault Tolerance: Basic Concepts, Failure Models, Failure Masking by Redundancy. **Process Resilience**: Resilience by Process Groups, Failure Masking and Replication, Example: Paxos, Consensus in faulty systems with crash failures, some limitations on realizing Fault Tolerant tolerance, Failure Detection. **Reliable Client Server Communication:** Point to Point Communication, RPC Semantics in the Presence of Failures. **Reliable Group Communication:** Atomic multicast, Distributed commit. **Recovery:** Introduction, Check pointing, Message Logging, Recovery Oriented Computing.		
#Exemplar/Case Studies	Study of any Open Source Tool for Building Fault-Tolerant System such as Circuit Breaker/Nginx/HaProxy/Akka	
***Mapping of Course**	CO6	

Outcomes for Unit VI	

Learning Resources

Text Books:

1. Maarten van Steen, Andrew S. Tanenbaum, "Distributed System", Third edition, version 3
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems Concepts and Design", Fifth edition

Reference Books:

1. Christian Cachin, Rachid Guerraoui, Luís Rodrigues, "Introduction to Reliable and Secure Distributed Programming", Springer; 2nd ed. 2011 edition
2. Vijay K. Garg, "Elements of Distributed Computing", Wiley
3. Maarten Van Steen and Andrew S. Tanenbaum, "Distributed Systems", Amazon Digital Services; 3rd edition

e-Books :

- Martin Kleppmann, "Designing Data-Intensive Applications", Oreilly

MOOC Courses links:

- Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/106/106106168/#
- Prof. Rajiv Misra, Cloud computing and Distributed System
- Prof. Rajiv Misra, Distributed System, https://nptel.ac.in/courses/106/104/106104182/

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	1	-	-	-	-	-	1
CO2	3	2	2	2	1	-	-	-	-	1	-	1
CO3	3	2	2	2	1	-	-	-	-	1	-	1
CO4	3	1	2	2	1	-	-	-	-	1	-	1
CO5	3	1	1	1	-	-	-	-	-	-	-	1
CO6	1	1	1	1	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective I
310245(D): Software Project Management

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses: Software Engineering(210253)

Companion Course: Laboratory Practice I (310248)

Course Objectives:

- To understand the fundamentals of Software Project Management
- To investigate software project planning and management tools
- To learn software project scheduling and tracking
- To discuss about the agile project management
- To know people management in software project

Course Outcomes:

On completion of the course, learners should be able to

CO1: Comprehend Project Management Concepts
CO2: Use various tools of Software Project Management
CO3: Schedule various activities in software projects
CO4: Track a project and manage changes
CO5: Apply Agile Project Management
CO6: Analyse staffing process for team building and decision making in Software Projects and Management

Course Contents

Unit I	Introduction to Software Project Management	07 Hours

Project Definition, Project versus Flow type work, Project Lifecycle, Processes and Knowledge Areas in Project Management (PM), Build or Buy decision, Work Breakdown Structure (WBS) and its types, Introduction to PMBOK, Program and Portfolio Management.

#Exemplar/Case Studies	Analysis of a project using PMBOK concepts
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Project Planning and Project Management Tools	07 Hours

Project Planning: Steps for Project Planning, PERT and Gantt Charts, Gantt Project, Microsoft Project and Primavera Project Management Software, Objectives of Activity planning, Project Schedules, Activities, Sequencing and Scheduling, Network Planning Models, Formulating Network Model.

#Exemplar/Case Studies	Create software project plan using any tool.
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Activity based Scheduling	07 Hours

Introduction, Objectives of Activity Planning, Project Schedules. **Activities**: Sequencing and Scheduling, Network Planning Models, Formulating Network Model, Activity relationships (FS,SF,SS,FF), Forward Pass and Backward Pass techniques, Critical Path concept and remedies.

#Exemplar/Case Studies	Apply the critical path technique to the project
***Mapping of Course Outcomes for Unit III**	CO3

Unit IV	Project Tracking and Control	07 Hours

Introduction, Collection of Project data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, Change Control, Software Configuration Management, Managing contracts, Contract Management.

#Exemplar/Case Studies	Analyze the effect of a major requirement change on the schedule
***Mapping of Course Outcomes for Unit IV**	CO4

Unit V	Agile Project Management	07 Hours

Predictive versus Empirical Management, Comparison between Non-Agile and Agile Project, Three stages of Agile Project, Estimation, Scope Management, Roles and Responsibilities, Scheduling and Tracking.

#Exemplar/Case Studies	Analyse the same project using Agile. Create the three stages of the project.
***Mapping of Course Outcomes for Unit V**	CO5

Unit VI	Staffing in Software Projects	07 Hours

Managing People, Organizational behaviour, Best methods of Staff Selection, Motivation, The Oldham, Hackman job characteristic Model, Stress, Health and Safety, Ethical and Professional concerns, Working in Teams, Decision Making, Organizational structures, Dispersed and Virtual Teams, Communications Genres, Communication Plans.

#Exemplar/Case Studies	Analyse a case study for a distributed team and comment
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Sixth Edition, Tata McGraw Hill, New Delhi, 2017
2. Robert K. Wysocki, "Effective Software Project Management", Wiley Publication, 2011

Reference Books :

1. Ken Schwaber, "Agile Project Management", Microsoft Press, 2004
2. Walker Royce, "Software Project Management", Addison-Wesley, 1998
3. Jalote Pankaj, "Software Project Management in Practice", Addison-Wesley Professional,2002
4. PMBOK Guide

e-Books :

- https://www.kornev-online.net/ITIL/Mcgraw.Hill.Software_Project_Management_2nd_Edition.pdf
- http://library.lol/main/B96E3B122326F8D2C6FBD35A5E978422

MOOCs Courses Links:

- https://onlinecourses.nptel.ac.in/noc19_cs70/preview
- Software Project Management By Prof. Rajib Mall & Prof. Durga Prasad Mohapatra | IIT Kharagpur
- Agilealliance.org, Scrum.org, Scrumalliance.org

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO3	-	-	-	-	-	-	-	-	2	-	3	-
CO4	-	-	-	-	-	-	-	-	1	-	3	-
CO5	-	-	2	1	1	-	-	1	2	-	3	-
CO6	-	-	-	-	1	-	-	-	3	1	3	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310246:Database Management Systems Laboratory

Home

Teaching Scheme Practical: 04 Hours/Week	Credit:02	Examination Scheme and Marks Term work: 25 Marks Practical: 25 Marks

Companion Course: Database Management Systems(310241)

Course Objectives:

- To develop Database programming skills
- To develop basic Database administration skills
- To develop skills to handle NoSQL database
- To learn, understand and execute process of software application development

Course Outcomes:

On completion of the course, learners will be able to

CO1: Design E-R Model for given requirements and convert the same into database tables
CO2: Design schema in appropriate normal form considering actual requirements
CO3: Implement SQL queries for given requirements, using different SQL concepts
CO4: Implement PL/SQL Code block for given requirements
CO5: Implement NoSQL queries using MongoDB
CO6: Design and develop application considering actual requirements and using database concepts

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - MYSQL/Oracle, MongoDB, ERD plus, ER Win

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/labs/index.php

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Sr. No.	Group A: SQL and PL/SQL
1.	**ER Modeling and Normalization:** Decide a case study related to real time application in group of 2-3 students and formulate a problem statement for application to be developed. Propose a Conceptual Design using ER features using tools like ERD plus, ER Win etc. (Identifying entities, relationships between entities, attributes, keys, cardinalities, generalization, specialization etc.) Convert the ER diagram into relational tables and normalize Relational data model. Note: Student groups are required to continue same problem statement throughout all the assignments in order to design and develop an application as a part Mini Project. Further assignments will be useful for students to develop a backend for system. To design front end interface students should use the different concepts learnt in the other subjects also.
2.	**SQL Queries:** a. Design and Develop SQLDDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym, different constraints etc. b. Write at least 10 SQL queries on the suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like Insert, Select, Update, Delete with operators, functions, and set operator etc.
3.	**SQL Queries – all types of Join, Sub-Query and View:** Write at least10 SQL queries for suitable database application using SQL DML statements. Note: Instructor will design the queries which demonstrate the use of concepts like all types of Join ,Sub-Query and View
4.	**Unnamed PL/SQLcode block: Use of Control structure and Exception handling is mandatory.** Suggested Problem statement: Consider Tables: 1. Borrower(Roll_no, Name, Date of Issue, Name of Book, Status) 2. Fine(Roll_no, Date, Amt) • Accept Roll_no and Name of Book from user. • Check the number of days (from date of issue). • If days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day and for days less than 30, Rs. 5 per day.

5.	• After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. • Also handles the exception by named exception handler or user define exception handler. **OR** Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 5 to 9. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns, radius and area. Note: Instructor will frame the problem statement for writing PL/SQL block in line with above statement.
6.	**Named PL/SQL Block: PL/SQL Stored Procedure and Stored Function.** Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks899and 825 category is Higher Second Class. Write a PL/SQLblock to use procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class) Note: Instructor will frame the problem statement for writing stored procedure and Function in line with above statement.
7.	**Cursors:(All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)** Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_Roll Call with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped. Note: Instructor will frame the problem statement for writing PL/SQL block using all types of Cursors in line with above statement.
8.	**Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers).** Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. Note: Instructor will Frame the problem statement for writing PL/SQLblock for all types of Triggers in line with above statement.
9.	**Database Connectivity:** Write a program to implement MySQL/Oracle database connectivity with any front end language to implement Database navigation operations (add, delete, edit etc.)
	Group B: NoSQL Databases
1.	**MongoDB Queries:** DesignandDevelopMongoDBQueriesusingCRUDoperations.(UseCRUDoperations, SAVE method, logical operators etc.).
2.	**MongoDB – Aggregation and Indexing:** Design and Develop MongoDB Queries using aggregation and indexing with suitable example using MongoDB.
3.	**MongoDB – Map-reduces operations:** Implement Map reduces operation with suitable example using MongoDB.
4.	**Database Connectivity:** Write a program to implement Mongo DB database connectivity with any front end language to implement Database navigation operations(add, delete, edit etc.)

Group C: Mini Project

1. Using the **database concepts covered in Group A and Group B**, develop an application with following details:
    1. Follow the same problem statement decided in Assignment -1 of Group A.
    2. Follow the Software Development Life cycle and other concepts learnt in **Software Engineering Course** throughout the implementation.
    3. Develop application considering:
        - Front End: Java/Perl/PHP/Python/Ruby/.net/any other language
        - Backend : MongoDB/ MySQL/Oracle
    4. Test and validate application using Manual/Automation testing.
    5. Student should develop application in group of 2-3 students and submit the Project Report which will consist of documentation related to different phases of Software Development Life Cycle:
        - Title of the Project, Abstract, Introduction
        - Software Requirement Specification
        - Conceptual Design using ER features, Relational Model in appropriate Normalize form
        - Graphical User Interface, Source Code
        - Testing document
        - Conclusion.

Note:

- Instructor should maintain progress report of mini project through out the semester from project group.
- Practical examination will be on assignments given above in Group A and Group B only
- Mini Project in this course should facilitate the Project Based Learning among students

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	3	-	3	1	1	1	3	1	-	1
CO2	2	2	3	-	2	-	1	-	3	-	1	-
CO3	-	1	2	-	2	1	-	1	3	-	-	2
CO4	-	1	2	-	2	-	-	-	3	2	1	-
CO5	-	1	2	-	2	-	2	-	3	1	-	1
CO6	2	2	3	-	3	1	-	-	3	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310247:Computer Networks and Security Laboratory

Home

Teaching Scheme	Credit: 01	Examination Scheme and Marks
Practical: 02 Hours/Week		Term work: 25 Marks Oral: 25 Marks

Companion Course: Computer Network and Security(310244)

Course Objectives:

- To learn computer network hardware and software components
- To learn computer network topologies and types of network
- To develop an understanding of various protocols, modern technologies and applications
- To learn modern tools for network traffic analysis
- To learn network programming

Course Outcomes:

On completion of the course, learners will be able to

CO1: Analyze the requirements of network types, topology and transmission media

CO2: Demonstrate error control, flow control techniques and protocols and analyze them

CO3: Demonstrate the subnet formation with IP allocation mechanism and apply various routing algorithms

CO4: Develop Client-Server architectures and prototypes

CO5: Implement web applications and services using application layer protocols

CO6: Use network security services and mechanisms

Guidelines for Instructor's Manual

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Guidelines for Student's Laboratory Journal

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Guidelines for Laboratory /Term Work Assessment

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Guidelines for Oral Examination

Oral examination should be jointly conducted by the internal examiner and external examiner. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementations in term work. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

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Operating System recommended: -64-bit Open-source Linux or its derivative

Programming tools recommended: - Open-Source/C/C++/JAVA

Programming tool like G++/GCC, Wireshark/Ethereal and Packet Tracer

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlab/

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Sr. No.	Group A (Unit I and II): Attempt any two assignments from Sr.No. 1 to 3. Assignments 4 and 5 are compulsory.
1.	Setup a wired LAN using Layer 2 Switch. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrating the PING packets captured traces using Wireshark Packet Analyzer Tool.
2.	Demonstrate the different types of topologies and types of transmission media by using a packet tracer tool.
3.	Setup a WAN which contains wired as well as wireless LAN by using a packet tracer tool. Demonstrate transfer of a packet from LAN 1 (wired LAN) to LAN2 (Wireless LAN).
4.	Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC.
5.	Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in Peer-to-Peer mode.
	Group B (Unit III and IV)
6.	Write a program to demonstrate Sub-netting and find subnet masks.
7.	Write a program to implement link state /Distance vector routing protocol to find suitable path for transmission.
8.	Use packet Tracer tool for configuration of 3 router network using one of the following protocol RIP/OSPF/BGP.
9.	Write a program using TCP socket for wired network for following a. Say Hello to Each other b. File transfer c. Calculator
10.	Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines.
	Group C (Unit V and VI): Assignment Sr. No. 11 is Compulsory and attempt any four from Assignments Sr. No 12 to 17.
11.	Write a program for DNS lookup. Given an IP address as input, it should return URL and vice-versa.
12.	InstallingandconfigureDHCPserverandwriteaprogramtoinstallthesoftwareonremotemachine.

13.	Capture packets using Wireshark, write the exact packet capture filter expressions to accomplish the following and save the output in file: 1. Capture all TCP traffic to/from Facebook, during the time when you log in to your Facebook account 2. Capture all HTTP traffic to/from Facebook, when you log in to your Facebook account 3. Write a DISPLAY filter expression to count all TCP packets (captured under item #1) that have the flags SYN, PSH, and RST set. Show the fraction of packets that had each flag set. 4. Count how many TCP packets you received from / sent to Face book, and how many of each were also HTTP packets.
14.	Study and Analyze the performance of HTTP, HTTPS and FTP protocol using Packet tracer tool.
15.	To study the SSL protocol by capturing the packets using Wireshark tool while visiting any SSL secured website (banking, e-commerce etc.).
16.	Illustrate the steps for implementation of S/MIME email security through Microsoft® Office Outlook.
17.	To study the IPsec (ESP and AH) protocol by capturing the packets using Wireshark tool.

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CO1	1	-	2	-	2	1	1	-	-	1	-	1
CO2	-	3	-	1	1	-	-	1	-	-	-	-
CO3	3	2	1	1	-	-	-	1	-	-	1	1
CO4	-	1	2	1	1	1	-	-	-	-	-	1
CO5	2	3	-	-	1	-	-	-	1	-	-	-
CO6	-	1	3	1	1	-	1	-	2	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310248: Laboratory Practice I

Home

Teaching Scheme	Credit:02	Examination Scheme and Marks
Practical: 04 Hours/Week		Term work: 25 Marks Practical: 25 Marks

Companion Course: Systems Programming and Operating System (310243), Elective I(310245)

Course Objectives:

- To learn system programming tools
- To learn modern operating system
- To learn various techniques, tools, applications in IoT and Embedded Systems /Human Computer Interface/Distributed Systems/ Software Project Management

Course Outcomes:

On completion of the course, learners will be able to

- **Systems Programming and Operating System**
  - **CO1:** Implement language translators
  - **CO2**: Use tools like LEX and YACC
  - **CO3**: Implement internals and functionalities of Operating System
- **Internet of Things and Embedded Systems**
  - **CO4:** Design IoT and Embedded Systems based application
  - **CO5:** Develop smart applications using IoT
  - **CO6:** Develop IoT applications based on cloud environment

OR

- **Human Computer Interface**
  - **CO4:**Implement the interactive designs for feasible data search and retrieval
  - **CO5:**Analyze the scope of HCI in various paradigms like ubiquitous computing, virtual Reality and ,multi-media, World wide web related environments
  - **CO6:**Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems

OR

- **Distributed Systems**
  - **CO4:** Demonstrate knowledge of the core concepts and techniques in Distributed Systems
  - **CO5**: Apply the principles of state-of-the-Art Distributed Systems in real time applications
  - **CO6**: Design, build and test application programs on Distributed Systems

OR

- **Software Project Management**
  - **CO4:**Apply Software Project Management tools
  - **CO5:**Implement software project planning and scheduling
  - **CO6:**Analyse staffing in software project

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Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus. For the elective subjects students should form group of 3-4 students. The faculty coordinator will take care that all the assignment should be assigned to class and minimum two assignments are compulsory for each group.

Programming tools recommended: -

Human computer Interface-GUI in python

Internet of Things and Embedded System- Raspberry Pi/Arduino Programming; Arduino IDE/Python Interfacing. Other IoT devices

Software project management-MS project/Gantt Project/Primavera

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A, B, C) are compulsory

Part I: Systems Programming and Operating System	
Sr. No.	**Group A (Any Two Assignments from Sr. No. 1 to 3)**
1.	Design suitable Data structures and implement Pass-I and Pass-II of a two-pass assembler for pseudo-machine. Implementation should consist of a few instructions from each category and few assembler directives. The output of Pass-I (intermediate code file and symbol table) should be input for Pass-II.

2.	Design suitable data structures and implement Pass-I and Pass-II of a two-pass macro-processor. The output of Pass-I (MNT, MDT and intermediate code file without any macro definitions) should be input for Pass-II.
3.	Write a program to create a Dynamic Link Library for any mathematical operation and writean application program to test it. (Java Native Interface / Use VB or VC++)
	Group B(Any Two Assignments from Sr. No. 4 to 7)
4.	Write a program to solve Classical Problems of Synchronization using Mutexand Semaphore.
5.	Write a program to simulate CPU Scheduling Algorithms: FCFS, SJF (Preemptive), Priority (Non-Preemptive) and Round Robin (Preemptive).
6.	Write a program to simulate Memory placement strategies – best fit, first fit, next fit and worst fit.
7.	Write a program to simulate Page replacement algorithm.
Part II : Elective I	
	Suggested List of Laboratory Experiments/Assignments **(Any Two assignments from each elective subject are compulsory andInstructor will take care that all the assignments should be covered among different batch students)**
	Internet of Things and Embedded Systems
1.	Understanding the connectivity of Raspberry-Pi / Adriano with IR sensor. Write an application to detect obstacle and notify user using LEDs.
2.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, generate alerts using LEDs.
3.	Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.
4.	Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
	Human Computer Interface
1.	Design a paper prototype for selected Graphical User Interface.
2.	Implement GOMS (Goals, Operators, Methods and Selection rules) modeling technique to model user's behavior in given scenario.
3.	Design a User Interface in Python.
4.	To redesign existing Graphical User Interface with screen complexity.
	Distributed System
1.	Implementation of Inter-process communication using socket programming: implementing multithreaded echo server.
2.	Implementation of RPC Mechanism.
3.	Simulation of election algorithms (Ring and Bully).
4.	Implementation of Clock Synchronization: a) NTP b) Lamports clock.
	Software Project Management
1.	**Create Project Plan** ▪ Specify project name and start (or finish) date. ▪ Identify and define project tasks. ▪ Define duration for each project task. ▪ Define milestones in the plan ▪ Define dependency between tasks ▪ Define project calendar. ▪ Define project resources and specify resource type ▪ Assign resources against each task and baseline the project plan

2. **Execute and Monitor Project Plan**
   - Update % Complete with current task status.
   - Review the status of each task.
   - Compare Planned vs Actual Status
   - Review the status of Critical Path
   - Review resources assignation status

3. **Generate Dashboard and Reports**
   - **Dashboard**
     - o Project Overview
     - o Cost Overview
     - o Upcoming Tasks
   - **Resource Reports**
     - o Over-allocated Resources
     - o Resource Overview
   - **Cost Reports**
     - o Earned Value Report
     - o Resource Cost Overview
     - o Task Cost Overview
   - **Progress Reports**
     - o Critical Tasks
     - o Milestone Report
     - o Slipping Tasks

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	3	-	-	-	-	-	-	1
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CO3	1	2	2	2	2	-	-	-	-	-	-	1
CO4	1	2	3	2	-	2	-	-	2	1	2	-
CO5	1	2	2	1	-	2	-	-	3	2	1	-
CO6	2	2	2	1	-	2	-	-	2	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310249: Seminar and Technical Communication

Home

Teaching Scheme	Credit: 01	Examination Scheme and Marks
Tutorial: 01 Hour/Week		Term Work: 50 Marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques
- To explore the latest technologies
- To enhance the communication skills
- To develop problem analysis skills

Course Outcomes:

On completion of the course, learners will be able to

CO1: Analyze a latest topic of professional interest
CO2: Enhance technical writing skills
CO3: Identify an engineering problem, analyze it and propose a work plan to solve it
CO4: Communicate with professional technical presentation skills

Guidelines

- Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.
- The topic must be selected in consultation with the Institute guide.
- Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only.
- Active participation at classmate seminars is essential.
- BoS has circulated the Seminar Log book and it is recommended to use it.

Guidelines for Assessment

Panel of staff members along with a guide would be assessing the seminar work based on these parameters-Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Recommended Format of the Seminar Report

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year and University
- Seminar Approval Sheet/Certificate,
- Abstract and Keywords
- Acknowledgements
- Table of Contents, List of Figures, List of Tables and Nomenclature
- Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/ …..,Discussions and Conclusions ,Bibliography/References
- Plagiarism Check report
- Report Documentation page

Reference Books :

1. Rebecca Stott, Cordelia Bryan, Tory Young, “Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)”, Longman, ISBN-13: 978-0582382435
2. Johnson-Sheehan, Richard, “Technical Communication”, Longman. ISBN 0-321-11764-6
3.Vikas Shirodka, “Fundamental skills for building Professionals”, SPD, ISBN 978-93-5213-146-5

@The CO-PO Mapping Matrix												
PO/CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	-	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
310250: Audit Course 5

Home

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at Institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at Institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations or presentations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentation or Report

Audit Course 5 Options

Audit Course Code	Audit Course Title
310250(A)	Cyber Security
310250(B)	Professional Ethics and Etiquette
310250(C)	Learn New Skills -Full Stack Developer
310250(D)	Engineering Economics
310250(E)	Foreign Language (one of Japanese/ Spanish/ French/ German). Course contents for **Japanese (Module 3)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(A): Cyber Security

Home

Prerequisites: Computer Network and Security (310244)

Course Objectives:
- To motivate students for understanding the various scenarios of cybercrimes
- To increase awareness about the cybercrimes and ways to be more secure in online activities
- To learn about various methods and tools used in cybercrimes
- To analyze the system for various vulnerabilities

Course Outcomes : On completion of the course, learners will be able to

CO 1: Understand and classify various cybercrimes
CO 2: Understand how criminals plan for the cybercrimes
CO 3: Apply tools and methods used in cybercrime
CO 4: Analyze the examples of few case studies of cybercrimes

Course Contents

1. **Introduction to Cybercrime:** Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective.
2. **Cyber offenses: How Criminals Plan Them:** Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.
3. **Tools and Methods Used in Cybercrime :** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks **(Expected to cover the introduction to all these terms).**
4. **Cybercrime: Illustrations, Examples and Mini-Cases** :Introduction, Real-Life Examples, Mini-Cases, Illustrations of Financial Frauds in Cyber Domain, Digital Signature-Related Crime Scenarios, Digital Forensics Case Illustrations, Online Scams.

Text Books :

1. Nina Godbole, Sunit Belapure , "Cyber Security- Understanding Cyber Crimes", Computer Forensics and Legal Perspectives, Wiely India Pvt. Ltd, ISBN- 978-81-265-2179-1
2. William Stallings, "Computer Security: Principles and Practices", Pearson 6thEd, ISBN 978-0-13-335469-0

Reference Books :

1. Berouz Forouzan, "Cryptography and Network Security", TMH, 2 edition, ISBN -978-00-707-0208-0. 5.
2. Mark Merkow, "Information Security-Principles and Practices", Pearson Ed., ISBN- 978-81-317-1288-7
3. CK Shyamala et el., "Cryptography and Security", Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	1	1	2	1	-	3	-	1	-	2
CO2	1	1	1	1	1	1	-	3	-	1	-	2
CO3	1	1	1	1	1	1	-	3	-	1	-	2
CO4	1	1	1	1	1	1	-	3	-	1	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(B): Professional Ethics and Etiquettes

Home

Prerequisites: Business Communication Skill

Course Objectives:

- To learn importance of ethics and the rules of good behavior for today's most common social and business situations.
- To acquire basic knowledge of ethics to make informed ethical decisions when confronted with problems in the working environment.
- To develop an understanding towards business etiquettes and the proper etiquette practices for different business scenarios.
- To learn the etiquette requirements for meetings, entertaining, telephone, email and Internet business interaction scenario.

Course Outcomes:

On completion of the course, learners will be able to

CO1: Summarize the principles of proper courtesy as they are practiced in the workplace.
CO2: Apply proper courtesy in different professional situations.
CO3: Practice and apply appropriate etiquettes in the working environment and day to day life.
CO4: Build proper practices personal and business communications of Ethics and Etiquettes.

Course Contents

1. **Introduction to Ethics**: Basics, Difference Between Morals, Ethics, and Laws, Engineering Ethics: Purpose of Engineering Ethics-Professional and Professionalism, Professional Roles to be played by an Engineer, Uses of Ethical Theories, Professional Ethics, Development of Ethics.
2. **Professional Ethics:** IT Professional Ethics, Ethics in the Business World, Corporate Social Responsibility, Improving Corporate Ethics, Creating an Ethical Work Environment, Including Ethical Considerations in Decision Making, Ethics in Information Technology, Common Ethical issues for IT Users, Supporting the Ethical Practices of IT users.
3. **Business Etiquette**: ABC's of Etiquette, Developing a Culture of Excellence, The Role of Good Manners in Business, Enduring Words Making Introductions and Greeting People: Greeting Components, The Protocol of Shaking Hands, Introductions, Introductory Scenarios, Addressing Individuals Meeting and Board Room Protocol: Guidelines for Planning a Meeting, Guidelines for Attending a Meeting.
4. **Professional Etiquette**: Etiquette at Dining, Involuntary Awkward Actions, How to Network, Networking Etiquette, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, interview Etiquette, Dressing Etiquettes : for interview, offices and social functions.

References Books:

1. Ghillyer, "Business Ethics Now", 3rd Edition, McGraw-Hill.
2. George Reynolds, "Ethics in information Technology", Cengage Learning, ISBN- 10:1285197151.
3. Charles E Harris, Micheat J. Rabins, "Engineering Ethics", Cengage Learning, ISBN- 13:978-1133934684,4th Edition.

@The CO-PO Mapping Matrix

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	3	1	2	-	2
CO2	-	-	-	-	-	1	1	3	1	2	-	2
CO3	-	-	-	-	-	1	1	3	1	2	-	2
CO4	-	-	-	-	-	1	1	3	1	2	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(C): Learn New Skills- Full Stack Developer

Home

Prerequisites: Programming Skills

Course Objectives:

- To understand the fundamental concepts in designing web based applications and applying frontend and backend technologies
- To understand the fundamental concepts in applying database techniques in application
- To progress the student towards term "industry ready engineer"

Course Outcomes:

On completion of the course, learners will be able to

CO1: Design and develop web application using frontend and backend technologies.
CO2: Design and develop dynamic and scalable web applications
CO3: Develop server side scripts
CO4: Design and develop projects applying various database techniques

Course Contents

Full stack Developer

1. HTML5
2. CSS3
3. Bootstrap
4. Vanilla JS (ES6+)
5. Flask or Django
6. Wagtail CMS
7. Node.js
8. MySQL
9. jQuery

Team Projects: Design and develop an e-commerce a dynamic, scalable and responsive web application. (Sample Project similar problem statements and be formulated).

Reference Books:

1. Laura Lemay, Rafe Colburn and Jennifer Kyrnin, "Mastering HTML, CSS & Javascript Web Publishing", SAMS, BPB Publications
2. DT Editorial Services " HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)" 2Ed , Dreamtech Press.

Note: **This is sample contents for Software Development Using Agility Approach, however the course instructor may design suitable course giving opportunity to the students for learning new skills.**

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	3	3	1	1	1	1	1	1	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1
CO4	3	3	3	3	3	1	1	1	1	1	1	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(D): Engineering Economics

Engineering economics is one of the most practical subject matters in the engineering curriculum, but it is an always challenging, ever-changing discipline. Engineers are planners and builders. They are also problem solvers, manager, decision makers. Engineering economics touches of these activities.

Course Objectives:

Home

- To understand engineering economics and money management
- To understand financial project analysis
- To estimate project cost and apply for business
- To understand making financial decisions when acting as team member or manager in the engineering project

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand economics, the cost money and management in engineering

CO2: Analyze business economics and engineering assets evaluation

CO3: Evaluate project cost and its elements for business

CO4: Develop financial statements and make business decisions

Course Contents

1. **Understanding money and its management**: Engineering Economic Decisions, Time value of money, Money management, Equivalence calculations.
2. **Evaluating business and engineering assets**: Present worth analysis, Annual equivalence Analysis, Rate of Return Analysis, Benefit Cost Analysis.
3. **Development project cash flow**: Accounting of Income Taxes, Project cash flow Analysis, Handling Project Uncertainty.
4. **Special topics in Engineering Economics**: Replacement decisions, understanding financial statements.

Reference Books :

1. Chan S Park, “Fundamentals of Engineering Economics”, Pearson, ISBN-13: 9780134870076
2. James Riggs, “Engineering Economics”, Tata McGraw-Hill, ISBN – 13: 9780070586703

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	1	-	-	-	-	-	2	2	3	1
CO2	1	1	1	-	-	-	-	-	2	2	3	1
CO3	1	1	1	-	-	-	-	-	2	2	3	1
CO4	1	1	1	-	-	-	-	-	2	2	3	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 5
310250(E): Foreign Language (Japanese)-Module 3

Home

Prerequisites: We recommend that candidates should have previously completed AC3-V(210251) and AC4-V (210260)

Course Objectives:

- To open up more doors and job opportunities
- To introduce to Japanese society, culture and entertainment

Course Outcomes:

On completion of the course, learners will be able to

CO1: Apply language to communicate confidently and clearly in the Japanese language
CO2: Understand and use Japanese script to read and write
CO3: Apply knowledge for next advance level reading, writing and listening skills
CO4: Develop interest to pursue further study, work and leisure

Course Contents

1. The Kanji: Brief Historical Outline, Introduction to Kanji, From Pictures to characters
2. Read and Write 58 Kanji Characters, talk about yourself/family/others, things, time, events, and activities-in the present, future, and past tense; shop at stores and order food at restaurants;
3. Lessons: Karate, Park(Playground), The Grandpa's Inaka, The Sun and the Moon, My little sister, Rice Fields, My Teacher, People who Exit and People who Enter.

Reference Books :

1. Japanese Kanji and Kana, "A complete guide to the Japanese writing system", Wolfgang Hadamitzky & Mark Spahn, Tuttle Publishing, Third edition ISBN: 978-1-4629-1018-2(eBook)
2. Banno, Eri, Yoko Ikeda, et al. Genki I, "An Integrated Course in Elementary Japanese", 2nd ed. Japan Times/Tsai Fong Books, 2011. ISBN: 9784789014403.
3. Anna Sato and Eriko Sato, "My First Japanese Kanji Book, Learning kanji the fun and easy way", TUTTLE PUBLISHING, First Edition ISBN: 978-1-4629-1369-5 (eBook)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Semester VI

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310251: Data Science and Big Data Analytics

Home

Teaching Scheme:	**Credit:** 03	**Examination Scheme:**
Theory: 04 Hours/Week$$		**Mid-Sem (TH) :** 30 Marks **End-Sem (TH):** 70 Marks

Prerequisites Courses: Discrete Mathematics (210241), Database Management Systems (310341)

Companion Course: Data Science and Big Data Analytics Laboratory (310256)

Course Objectives:

- To understand the need of Data Science and Big Data
- To understand computational statistics in Data Science
- To study and understand the different technologies used for Big Data processing
- To understand and apply data modeling strategies
- To learn Data Analytics using Python programming
- To be conversant with advances in analytics

Course Outcomes:

After completion of the course, learners should be able to

CO1: Analyze needs and challenges for Data Science Big Data Analytics
CO2: Apply statistics for Big Data Analytics
CO3: Apply the lifecycle of Big Data analytics to real world problems
CO4: Implement Big Data Analytics using Python programming
CO5: Implement data visualization using visualization tools in Python programming
CO6: Design and implement Big Databases using the Hadoop ecosystem

Course Contents

Unit I	**Introduction to Data Science and Big Data**	**07 Hours**
Basics and need of Data Science and Big Data, Applications of Data Science, Data explosion, 5 V's of Big Data, Relationship between Data Science and Information Science, Business intelligence versus Data Science, Data Science Life Cycle, Data: Data Types, Data Collection. Need of Data wrangling, Methods: Data Cleaning, Data Integration, Data Reduction, Data Transformation, Data Discretization.		
#Exemplar/Case Studies	Create academic performance dataset of students and perform data pre-processing using techniques of data cleaning and data transformation.	
***Mapping of Course Outcomes for Unit I**	CO1	
Unit II	**Statistical Inference**	**07 Hours**
Need of statistics in Data Science and Big Data Analytics**, Measures of Central Tendency**: Mean, Median, Mode, Mid-range. **Measures of Dispersion**: Range, Variance, Mean Deviation, Standard Deviation. Bayes theorem, Basics and need of hypothesis and hypothesis testing, Pearson Correlation, Sample Hypothesis testing, Chi-Square Tests, t-test.		
#Exemplar/Case Studies	For an employee dataset, create measure of central tendency and its measure of dispersion for statistical analysis of given data.	
***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Big Data Analytics Life Cycle**	**07 Hours**
Introduction to Big Data, sources of Big Data, **Data Analytic Lifecycle**: Introduction, Phase 1: Discovery, Phase 2: Data Preparation, Phase 3: Model Planning, Phase 4: Model Building, Phase 5: Communication results, Phase 6: Operation alize.		

Home

#Exemplar/Case Studies	Case study: Global Innovation Social Network and Analysis (GINA).	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Predictive Big Data Analytics with Python**	**07 Hours**
Introduction, Essential Python Libraries, Basic examples. **Data Preprocessing**: Removing Duplicates, Transformation of Data using function or mapping, replacing values, Handling Missing Data. Analytics Types: Predictive, Descriptive and Prescriptive. **Association Rules**: Apriori Algorithm, FP growth. **Regression**: Linear Regression, Logistic Regression. **Classification**: Naïve Bayes, Decision Trees. **Introduction to Scikit-learn**, Installations, Dataset, mat plotlib, filling missing values, Regression and Classification using Scikit-learn.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply data preprocessing methods	
***Mapping of Course Outcomes for Unit IV**	CO4,CO2	
Unit V	**Big Data Analytics and Model Evaluation**	**07 Hours**
Clustering Algorithms: K-Means, Hierarchical Clustering, Time-series analysis. **Introduction to Text Analysis**: Text-preprocessing, Bag of words, TF-IDF and topics. Need and Introduction to social network analysis, Introduction to business analysis. **Model Evaluation and Selection**: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Parameter Tuning and Optimization, Result Interpretation, Clustering and Time-series analysis using Scikit-learn, sklearn. metrics, Confusion matrix, AUC-ROC Curves, Elbow plot.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and apply K-means clustering methods	
***Mapping of Course Outcomes for Unit V**	CO4, CO2	
Unit VI	**Data Visualization and Hadoop**	**07 Hours**
Introduction to Data Visualization, Challenges to Big data visualization, Types of data visualization, Data Visualization Techniques, Visualizing Big Data, Tools used in Data Visualization, Hadoop ecosystem, Map Reduce, Pig, Hive, Analytical techniques used in Big data visualization. **Data Visualization using Python:** Line plot, Scatter plot, Histogram, Density plot, Box- plot.		
#Exemplar/Case Studies	Use IRIS dataset from Scikit and plot 2D views of the dataset	
***Mapping of Course Outcomes for Unit VI**	CO5, CO6	

Learning Resources

Text Books:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publication, 2012, ISBN0-07-120413-X
2. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807

Reference Books :

1. EMC Education Services, "Data Science and Big Data Analytics- Discovering, analyzing Visualizing and Presenting Data"
2. DT Editorial Services, "Big Data, Black Book", DT Editorial Services, ISBN: 9789351197577, 2016 Edition
3. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press, (2020), ISBN : ISBN 978-1-108-47244-9
4. Wes McKinney, "Python for Data Analysis ", O' Reilly media, ISBN: 978-1-449-31979-3
5. Trent Hauk, "Scikit-learn Cookbook", Packt Publishing, ISBN: 9781787286382

6. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", OReilly Media, Inc., ISBN: 9781491913703
7. Venkat Ankam,"Big Data Analytics", Packt Publishing, ISBN: 9781785884696
8. Seema Acharya, Subhashini Chellappan, "Big Data And Analytics", Wiley publi ISBN: 9788126579518

Home

e-Books :

- An Introduction to Statistical Learning by Gareth James
  https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
- Python Data Science Handbook by Jake VanderPlas
  https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
- Introducing Data Science by Davy Ciele, Manning Publications
- Introducing Data Science [PDF]
- Handbook for visualizing : a handbook for data driven design by Andy krik
- A Handbook for Data Driven Design
- An introduction to data Science :
  https://docs.google.com/file/d/0B6iefdnF22XQeVZDSkxjZ0Z5VUE/edit?pli=1
- Hadoop Tutorial :
  https://www.tutorialspoint.com/hadoop/hadoop_tutorial.pdf?utm_source=7_&utm_medium=affiliate&utm_content=5f34cd37cdf1050001b09537&utm_campaign=Admitad&utm_term=761c575424fc4a6b48d02f72157eb578
- Learning with Python; How to think like a computer scientist:
  http://openbookproject.net/thinkcs/python/english3e/
- Python for everybody:
  http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
- Scikit Learn Tutorial
  https://scikit-learn.org/stable/

MOOCs Courses links:

- Computer Science and Engineering - NOC:Data Science for Engineers
- Computer Science and Engineering - NOC:Python for Data Science
- Computer Science and Engineering - NOC:Data Mining
- Computer Science and Engineering - NOC:Big Data Computing
- Big Data Computing - Course

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	2	1	-	-	-	-	1	-	-	1
CO2	1	2	1	2	-	1	-	-	1	-	-	1
CO3	2	1	2	1	-	1	-	-	1	-	-	1
CO4	1	2	2	2	2	-	-	-	1	-	-	1
CO5	1	2	2	1	2	-	-	-	1	-	-	1
CO6	1	2	1	2	2	-	-	-	1	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310252: Web Technology

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory : 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Database Management Systems (310341), Computer Networks and Security (310244)

Companion Course: Web Technology Laboratory (310257)

Course Objectives:

- To learn the fundamentals of web essentials and markup languages
- To use the Client side technologies in web development
- To use the Server side technologies in web development
- To understand the web services and frameworks

Course Outcomes:

On completion of the course, learners should be able to

CO1: Implement and analyze behavior of web pages using HTML and CSS
CO2: Apply the client side technologies for web development
CO3: Analyze the concepts of Servlet and JSP
CO4: Analyze the Web services and frameworks
CO5: Apply the server side technologies for web development
CO6: Create the effective web applications for business functionalities using latest web development platforms

Course Contents

Unit I	Web Essentials and Mark-up language- HTML	07 Hours

The Internet, basic internet protocols, the World Wide Web, HTTP Request message, HTTP response message, web clients, web servers.**HTML**: Introduction, history and versions.**HTML elements**: headings, paragraphs, line break, colors and fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. **CSS**: Introduction to Style Sheet, CSS features, CSS core syntax, Style sheets and HTML, Style rule cascading and inheritance, text properties. Bootstrap.

#Exemplar/Case Studies	Create a style sheet suitable for blogging application using HTML and using style sheet
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Client Side Technologies: JavaScript and DOM	07 Hours

JavaScript: Introduction to JavaScript, JavaScript in perspective, basic syntax, variables and data types, statements, operators, literals, functions, objects, arrays, built in objects, JavaScript debuggers. **DOM**: Introduction to Document Object Model, DOM history and levels, intrinsic event handling, modifying element style, the document tree, DOM event handling, jQuery, Overview of Angular JS.

#Exemplar/Case Studies	Enhancement in created blogging application using JavaScript (Add Entry feature)
***Mapping of Course Outcomes for Unit II**	CO2

<table>
<tr><td>Unit III</td><td>Java Servlets and XML</td><td>07 Hours</td></tr>
<tr><td colspan="3">Servlet: Servlet architecture overview, A “Hello World” servlet, Servlets generating dynamic content, Servlet life cycle, parameter data, sessions, cookies, URL rewriting, other Servlet capabilities, data storage, Servlets concurrency, databases (MySQL) and Java Servlets. XML: XML documents and vocabularies, XML declaration, XML Namespaces, DOM based XML processing, transforming XML documents, DTD: Schema, elements, attributes. AJAX: Introduction, Working of AJAX.</td></tr>
<tr><td>#Exemplar/Case Studies</td><td colspan="2">Develop server-side code for blogging application</td></tr>
<tr><td>*Mapping of Course Outcomes for Unit III</td><td colspan="2">CO3</td></tr>
<tr><td>Unit IV</td><td>JSP and Web Services</td><td>07 Hours</td></tr>
<tr><td colspan="3">JSP: Introduction to Java Server Pages, JSP and Servlets, running JSP applications, Basic JSP, JavaBeans classes and JSP, Support for the Model-View-Controller paradigm, JSP related technologies. Web Services: Web Service concepts, Writing a Java Web Service, Writing a Java web service client, Describing Web Services: WSDL, Communicating Object data: SOAP. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.</td></tr>
<tr><td>#Exemplar/Case Studies</td><td colspan="2">Transform the blogging application from a loose collection of various resources (servlets, HTML documents, etc.) to an integrated web application that follows the MVC paradigm</td></tr>
<tr><td>*Mapping of Course Outcomes for Unit IV</td><td colspan="2">CO3, CO4</td></tr>
<tr><td>Unit V</td><td>Server Side Scripting Languages</td><td>07 Hours</td></tr>
<tr><td colspan="3">PHP: Introduction to PHP, uses of PHP, general syntactic characteristics, Primitives, operations and expressions, output, control statements, arrays, functions, pattern matching, form handling, files, cookies, session tracking, using MySQL with PHP, WAP and WML. Introduction to ASP.NET: Overview of the .NET Framework, Overview of C#, Introduction to ASP.NET, ASP.NET Controls, Web Services. Overview of Node JS.</td></tr>
<tr><td>#Exemplar/Case Studies</td><td colspan="2">Use of PHP in developing blogging application.</td></tr>
<tr><td>*Mapping of Course Outcomes for Unit V</td><td colspan="2">CO5, CO6</td></tr>
<tr><td>Unit VI</td><td>Ruby and Rails</td><td>07 Hours</td></tr>
<tr><td colspan="3">Introduction to Ruby: Origins & uses of Ruby, scalar types and their operations, simple input and output, control statements, fundamentals of arrays, hashes, methods, classes, code blocks and iterators, pattern matching. Introduction to Rails: Overview of Rails, Document Requests, Processing Forms, Rails Applications and Databases, Layouts, Rails with Ajax. Introduction to EJB.</td></tr>
<tr><td>#Exemplar/Case Studies</td><td colspan="2">Study of dynamic web product development using ruby and rails</td></tr>
<tr><td>*Mapping of Course Outcomes for Unit VI</td><td colspan="2">CO6</td></tr>
<tr><td colspan="3">Learning Resources</td></tr>
<tr><td colspan="3">Text Books:
1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035</td></tr>
</table>

2. Robert W. Sebesta,“ Programming the World Wide Web”, 4th Edition, Pearson education, 2008

Reference Books :

1. Marty Hall, Larry Brown, “Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
2. H.M. Deitel, P.J. Deitel and A.B. Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006, ISBN 978-0131752429.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.
4. Xue Bai et al, “The web Warrior Guide to Web Programming”, Thomson, 2003.

e-Books :

- https://www.w3.org/html/
- HTML, The Complete Reference http://www.htmlref.com/
- http://w3schools.org/
- http://php.net/
- https://jquery.com/
- https://developer.mozilla.org/en-US/docs/AJAX
- http://www.tutorialspoint.com/css/

MOOCs Courses link:

- http://www.nptelvideos.in/2012/11/internet-technologies.html
- https://freevideolectures.com/course/2308/internet-technology/25video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
- https://www.digimat.in/nptel/courses/video/106105191/L01.html
- http://www.nptelvideos.com/php/php_video_tutorials.php

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO12
CO1	1	1	2	1	1	-	-	-	-	-	-	-
CO2	-	2	1	3	1	-	-	-	1	-	-	-
CO3	2	-	2	1	-	1	-	-	-	-	1	-
CO4	1	3	1	2	2	1	-	1	-	-	-	1
CO5	1	1	2	-	3	-	1	1	-	1	-	-
CO6	2	1	-	2	1	1	-	1	-	-	-	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310253: Artificial Intelligence

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Programming and Problem solving (110005),
Data Structures and Algorithms (210252)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks
- To understand Problem Solving using various peculiar search strategies for AI
- To understand multi-agent environment in competitive environment
- To acquaint with the fundamentals of knowledge and reasoning
- To devise plan of action to achieve goals as a critical part of AI
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

After completion of the course, students should be able to

CO1: Identify and apply suitable Intelligent agents for various AI applications

CO2: Build smart system using different informed search / uninformed search or heuristic approaches

CO3: Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem

CO4: Apply the suitable algorithms to solve AI problems

CO5: Implement ideas underlying modern logical inference systems

CO6: Represent complex problems with expressive yet carefully constrained language of representation

Course Contents

Unit I	Introduction	07 Hours

Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents.

#Exemplar/Case Studies	Kroger: How This U.S. Retail Giant Is Using AI And Robots To Prepare For The 4th Industrial Revolution
***Mapping of Course Outcomes for Unit I**	CO1, CO4

Unit II	Problem-solving	07 Hours

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.

#Exemplar/Case Studies	4th Industrial Revolution Using AI, Big Data And Robotics
***Mapping of Course Outcomes for Unit II**	CO2, CO4

Unit III	Adversarial Search and Games	07 Hours
Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs.		
#Exemplar/Case Studies	Machine Learning At Google: The Amazing Use Case Of Becoming A Fully Sustainable Business	
***Mapping of Course Outcomes for Unit III**	CO3, CO4	
Unit IV	**Knowledge**	**07 Hours**
Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.		
#Exemplar/Case Studies	BBC To Launch AI - Enabled Interactive Radio Show For Amazon Echo And Google Home Chat bots	
***Mapping of Course Outcomes for Unit IV**	CO3, CO4	
Unit V	**Reasoning**	**07 Hours**
Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information		
#Exemplar/Case Studies	The Amazing Ways How Wikipedia Uses Artificial Intelligence	
***Mapping of Course Outcomes for Unit V**	CO4, CO5	
Unit VI	**Planning**	**07 Hours**
Automated Planning, Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches, Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.		
#Exemplar/Case Studies	The Amazing Ways Samsung Is Using Big Data, Artificial Intelligence And Robots To Drive Performance	
***Mapping of Course Outcomes for Unit VI**	CO4, CO6	

Learning Resources

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
4. Dr. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley publication, ISBN: 9788126519934
5. Dr. Nilakshi Jain, "Artificial Intelligence, As per AICTE: Making a System Intelligent", Wiley publication, ISBN: 9788126579945

e-Books :

- https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf
- https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf
- http://aima.cs.berkeley.edu/

MOOCs Courses link:

- https://nptel.ac.in/courses/106/102/106102220/
- https://nptel.ac.in/courses/106/105/106105077/
- https://nptel.ac.in/courses/106/105/106105078/
- https://nptel.ac.in/courses/106/105/106105079/

@ The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	-	-	1	3	-	2	-	-
CO2	1	3	3	2	3	1	-	3	1	2	-	-
CO3	3	2	2	2	1	1	1	-	-	2	-	-
CO4	1	2	2	1	-	-	1	3	1	2	-	-
CO5	1	2	2	1	-	-	1	3	1	2	-	-
CO6	1	2	2	1	-	-	1	3	1	2	-	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(A): Information Security

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: --Computer Networks and Security (310244)

Companion Course: --Laboratory Practice II (310258)

Course Objectives:

- To understand the fundamental approaches, principles and apply these concepts in Information Security
- To acquire the knowledge of mathematics for cryptography, understand the concepts of basic cryptography
- To learn standard algorithms and protocols employed to provide confidentiality, integrity and authenticity
- To acquire the knowledge of security protocol deployed in web security
- To study Information Security tools

Course Outcomes:

On completion of the course, learners should be able to

CO1: Model the cyber security threats and apply formal procedures to defend the attacks

CO2: Apply appropriate cryptographic techniques by learning symmetric and asymmetric key cryptography

CO3: Design and analyze web security solutions by deploying various cryptographic techniques along with data integrity algorithms

CO4: Identify and Evaluate Information Security threats and vulnerabilities in Information systems and apply security measures to real time scenarios

CO5: Demonstrate the use of standards and cyber laws to enhance Information Security in the development process and infrastructure protection

Course Contents

Unit I	Introduction to Information Security	05 Hours

Foundations of Security, Computer Security Concepts, The OSI Security Architecture, Security attacks, Security services, Security mechanism, A Model for Network Security.

#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: Clam AV antivirus engine, Anti Phishing, Anti Spyware, Wireshark
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Symmetric Key Cryptography	07 Hours

Classical Encryption Techniques: Stream Ciphers, Substitution Techniques: Caesar Cipher, Mono alphabetic Ciphers, Play fair Cipher, Hill Cipher, Poly alphabetic Ciphers, Transposition Techniques, Block Ciphers and Data Encryption standards, 3DES, Advanced Encryption standard

#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: crypt tool
***Mapping of Course Outcomes for Unit II**	CO2

Unit III	Asymmetric Key Cryptography	07 Hours

Number theory: Prime number, Fermat and Euler theorems , Testing for primality, Chinese reminder theorem, discrete logarithm, Public Key Cryptography and RSA, Key Management, Diffie-Hellman key exchange, El Gamal algorithm, Elliptic Curve Cryptography		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: crypt tool	
***Mapping of Course Outcomes for Unit III**	CO2	
Unit IV	**Data Integrity Algorithms And Web Security**	**09 Hours**
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3, MD4, MD5. **Message Authentication Codes**: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs. **Digital Signatures**: Digital Signatures, Schemes, Digital Signature standard, PKI X.509 Certificate. Web Security issues, HTTPS, SSH, Email security: PGP, S/MIME, IP Security : IPSec		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: Open SSL, Hash Calculator Tool : MD5, SHA1, SHA256, SHA 512	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Network and System Security**	**07 Hours**
The OSI Security architecture, Access Control, Flooding attacks, DOS, Distributed DOS attacks Intrusion detection, Host based and network based Honeypot, Firewall and Intrusion prevention system, Need of firewall, Firewall characteristics and access policy, Types of Firewall, DMZ networks, **Intrusion prevention system:** Host based, Network based, Hybrid. Operating system Security, Application Security, Security maintenance, Multilevel Security, Multilevel Security for role based access control, Concepts of trusted system, Trusted computing.		
#Exemplar/Case Studies	Open Source/ Free/ Trial Tools: DOS Attacks, DDOS attacks, Wireshark, Cain and Abel, iptables/ Windows Firewall, Suricata, fail2ban, Snort.	
***Mapping of Course Outcomes for Unit V**	CO4	
Unit VI	**Cyber Security and Tools**	**07 Hours**
Introduction, Cybercrime and Information Security, Classification of Cybercrimes, The legal perspectives-Indian perspective, Global perspective, Categories of Cybercrime, Social Engineering, Cyber stalking, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and Cybercrime Scenario in India, Indian IT Act.		
#Exemplar/Case Studies	Study of any two network security scanners: Nmap, Metasploit, Open VAS, Aircrack,Nikito,Samurai,Safe3etc.	
***Mapping of Course Outcomes for Unit VI**	CO5	
Learning Resources		
Text Books : **1.** William Stallings, "Cryptography and Network Security Principals and Practice", Seventh edition, Pearson , ISBN : 978-1-292-15858 **2.** William Stallings, Lawrie Brown, "Computer Security Principles and Practice", 3rd_Edition, Pearson , ISBN : 978-0-13-3777392-7 **3.** Nina Godbole, Sumit Belapure, "Cyber Security", Wiley, ISBN: 978-81-265-2179-1		

Reference Books :

1. Atul Kahate, "Cryptography and Network Security", 3e, McGraw Hill Education
2. V.K. Pachghare, "Cryptography and Information Security", PHI Learning
3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
4. JoshephKizza, "Computer Network Security and Cyber Ethics", McFarland & Company, Inc., Publishers , Fourth Edition
5. Michael Whitman and Herbert Matford, "Principles of Information Security", Course Technnology Ink, 7th edition
6. Neena Godbole, "Information Systems Security, 2ed: Security Management, Metrics, Frameworks and Best Practices" , Wiley publication, ISBN: 9788126564057

e-Books :

- Introduction to Cyber Security, "http://www.uou.ac.in/sites/default/files/slm/FCS.pdf ", by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani
- "Information Security, The complete reference", Second Edition, Mark Rhodes-Ousley, McGrawHill

MOOCs Courses link:

- NPTEL course on https://nptel.ac.in/courses/106/106/106106129/(IIT Madras, Prof. V.Kamakoti)
- Introduction to cyber security, "https://swayam.gov.in/nd2_nou19_cs08/preview" by Dr. Jeetendra Pande | Uttarakhand Open University, Haldwani

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	2	-	1	-	-	-	1
CO2	3	3	2	3	-	2	-	-	-	-	-	-
CO3	3	3	2	3	-	2	-	-	-	1	-	-
CO4	3	3	2	2	-	-	1	-	-	-		-
CO5	3	2	1	2	-	2	1	2	-	1	1	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(B): Augmented and Virtual Reality

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Graphics (210244)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand fundamentals of augmented and virtual reality
- To describe various elements and components used in AR/VR Hardware and Software
- To understand the methods used for representing and rendering the virtual world
- To create Augmented Reality application that allows users to interact with the immersive 3D world

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the basics of Augmented and Virtual reality systems and list their applications

CO2: Describe interface to the Virtual World with the help of input and output devices

CO3: Explain representation and rendering system in the context of Virtual Reality

CO4: Analyze manipulation, navigation and interaction of elements in the virtual world

CO5: Summarize the basic concepts and hardware of Augmented Reality system

CO6: Create Mobile Augmented Reality using Augmented Reality techniques and software

Course Contents

Unit I	Introduction	06 Hours

Virtual Reality (VR): Introduction, Key Elements of VR, Experience, History, Applications. **Augmented Reality (AR)**: Introduction, History, Key Aspects, and Applications.

#Exemplar/Case Studies	Timeline of evolution of AR from VR and Case study of a single application using both VR and AR technologies
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Interface to the Virtual World	08 Hours

Input: User Monitoring, Position Tracking, Body Tracking, Physical input Devices, Speech Recognition (Audio Input) and World Monitoring: Persistent Virtual Worlds, Bringing the Real World into the Virtual World.

Output:

Visual Displays: Properties of Visual Displays, Monitor-basedor Fishtank-VR, Projection-based VR, Head-based VR, See-through Head-based Displays, Handheld VR.

Aural Displays: Properties of Aural Displays, Head-based Aural Displays- Headphones, Stationary Aural Displays-Speakers.

Haptic Displays: Properties of Haptic Displays, Tactile Haptic Displays, End-effector Displays, Robotically Operated Shape Displays, Vestibular and Other Senses.

#Exemplar/Case Studies	Study the use of Virtual Reality at NASA

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Representing and Rendering the Virtual World**	**08 Hours**
Representation of the Virtual World: Visual Representation in Virtual Reality, Aural Representation and Haptic Representation in Virtual Reality. **Rendering Systems:** **Visual Rendering Systems**: Visual Rendering Methods, Geometrically Based Rendering Systems, Non-geometric Rendering Systems, Rendering Complex Visual Scenes, Computer Graphics System Requirements. **Aural Rendering Systems**: Visual Rendering Methods, Rendering Complex Sounds, Sound-Generation Hardware, Internal Computer Representation. **Haptic Rendering Systems** : Haptic Rendering Methods, Rendering Complex Haptic Scenes with Force Displays, Haptic Rendering Techniques.		
#Exemplar/Case Studies	GHOST (General Haptics Open Software Toolkit) software development toolkit.	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Interacting with the Virtual World and Virtual Reality Experience**	**07 Hours**
User Interface Metaphors, Manipulating a Virtual World, Properties of Manipulation, Manipulation Operations, Navigating in a Virtual World-Way finding and Travelling, Classes of Travel Methods Interacting with Others-Shared Experience, Collaborative Interaction, Interacting with the VR System, Immersion, Rules of the Virtual World: Physics, Substance of the Virtual World.		
#Exemplar/Case Studies	Side effects of using VR systems/ VR sickness and Study of Iterative design of any VR game.	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Augmented Reality**	**06 Hours**
Concepts: Computer Graphics, Dimensionality, Depth Cues, Registration and Latency, Working of Augmented Reality, Augmented Reality Hardware (Sensors, Processors, Displays), Ingredients of an AR Experience.		
#Exemplar/Case Studies	Augmented Reality (AR) and Virtual Reality (VR) headsets mainly find applications in gaming, movies, and other forms of entertainment. French startup Lynx has manufactured a standalone Mixed Reality (MR) headset for entertainment, medical, industrial, and defense applications. Analyze the technical specifications of Lynx – Mixed Reality Headset	
***Mapping of Course Outcomes for Unit V**	CO1, CO5	
Unit VI	**Augmented Reality Software and Mobile Augmented Reality**	**07 Hours**
Augmented Reality Systems, Software Components, Software Tools for Content Creation, Interaction in Augmented Reality, **Augmented Reality Techniques**: Marker based and Marker less tracking, Mobile Augmented Reality.		

#Exemplar/Case Studies	Case study of Google Maps AR navigation and its use
***Mapping of Course Outcomes for Unit VI**	CO6

Learning Resources

Text Books:

1. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics), Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086

Reference Books:

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
4. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

e-Books :

- http://lavalle.pl/vr/book.html
- https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf

MOOC Courses link:

- https://nptel.ac.in/courses/106/106/106106138/
- https://www.coursera.org/learn/introduction-virtual-reality
- https://www.coursera.org/learn/ar

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	2	-	-	-	-	-	-	-	-	-
CO3	1	2	2	1	2	-	-	-	-	-	-	1
CO4	1	2	2	-	2	-	-	-	-	-	-	1
CO5	1	1	2	2	1	-	-	-	-	-	-	2
CO6	1	2	2	2	3	-	-	-	-	-	-	2

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(C): Cloud Computing

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Computer Networks and Security(310244), Distributed Systems (310245C)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To study fundamental concepts of cloud computing
- To learn various data storage methods on cloud
- To understand the implementation of Virtualization in Cloud Computing
- To learn the application and security on cloud computing
- To study risk management in cloud computing
- To understand the advanced technologies in cloud computing

Course Outcomes:

On completion of the course, learners should be able to

CO1: Understand the different Cloud Computing environment
CO2: Use appropriate data storage technique on Cloud, based on Cloud application
CO3: Analyze virtualization technology and install virtualization software
CO4: Develop and deploy applications on Cloud
CO5: Apply security in cloud applications
CO6: Use advance techniques in Cloud Computing

Course Contents

Unit I	Introduction to Cloud Computing	07 Hours

Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. **Cloud Service Models**: SaaS, PaaS, IaaS, Storage. **Cloud Architecture**: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.

#Exemplar/Case Studies	Cloud Computing Model of IBM
***Mapping of Course Outcomes for Unit I**	CO1

Unit II	Data Storage and Cloud Computing	07 Hours

Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. **Cloud Storage**: Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. **Cloud Storage from LANs to WANs**: Cloud Characteristics, Distributed Data Storage.

#Exemplar/Case Studies	Online Book Marketing Service, Online Photo Editing Service

***Mapping of Course Outcomes for Unit II**	CO2	
Unit III	**Virtualization in Cloud Computing**	**07 Hours**
Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. **Grid, Cloud and Virtualization**: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. **Virtualization and Cloud Computing**: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.		
#Exemplar/Case Studies	Xen: Para virtualization, VMware: Full Virtualization, Microsoft Hyper-V	
***Mapping of Course Outcomes for Unit III**	CO3	
Unit IV	**Cloud Platforms and Cloud Applications**	**07 Hours**
Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).**Microsoft Cloud Services:** Azure core concepts, SQL Azure, Windows Azure Platform Appliance. **Cloud Computing Applications:** Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.		
#Exemplar/Case Studies	Multiplayer Online Gaming	
***Mapping of Course Outcomes for Unit IV**	CO4	
Unit V	**Security in Cloud Computing**	**07 Hours**
Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. **Data Security in Cloud**: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. **Cloud Security Services**: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.		
#Exemplar/Case Studies	Cloud Security Tool: Acunetix.	
***Mapping of Course Outcomes for Unit V**	CO5	
Unit VI	**Advanced Techniques in Cloud Computing**	**07 Hours**
Future Tends in cloud Computing, Mobile Cloud, **Automatic Cloud Computing**: Comet Cloud. **Multimedia Cloud**: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. **IOT and Cloud Convergence**: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.		
#Exemplar/Case Studies	Case studies on Dev Ops: DocuSign, Forter, Gengo.	
***Mapping of Course Outcomes for Unit VI**	CO6	

Learning Resources

Text Books :

1. A. Srinivasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0

Reference Books :

1. James Bond ,"The Enterprise Cloud", O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
4. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications", Cambridge University Press, ISBN: 9780511778476
5. Tim Mather, Subra K, Shahid L.,"Cloud Security and Privacy", Oreilly, ISBN-13 978-81-8404-815-5
6. Dr. Kumar Saurabh, "Cloud Computing, 4ed: Architecting Next-Gen Transformation Paradigms", Wiley publication, ISBN: 9788126570966
7. Rishabh Sharma, "Cloud Computing: Fundamentals, Industry Approach and Trends", Wiley publication, ISBN:

e-Books :

- https://sjceodisha.in/wp-content/uploads/2019/09/CLOUD-COMPUTING-Principles-and-Paradigms.pdf
- https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf
- https://arpitapatel.files.wordpress.com/2014/10/cloud-computing-bible1.pdf
- https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-291r2.pdf

MOOCs Courses link:

- Cloud Computinghttps://onlinecourses.nptel.ac.in/noc21_cs14/preview?
- Cloud Computing and Distributed System: https://onlinecourses.nptel.ac.in/noc21_cs15/preview?
- https://www.digimat.in/nptel/courses/video/106105167/L01.html
- https://www.digimat.in/nptel/courses/video/106105167/L03.html
- https://www.digimat.in/nptel/courses/video/106105167/L20.html

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	-	-	-	-	-	-	-	-	1
CO2	1	2	1	-	-	-	-	-	-	-	-	-
CO3	1	2	1	-	2	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	1
CO5	1	2	2	2	-	-	-	-	-	-	-	-
CO6	1	2	2	1	1	-	-	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
Elective II
310254(D): Software Modeling and Architecture

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
Theory: 04 Hours/Week$$		Mid-Semester (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Object Oriented Programming (210243), Software Engineering (210253)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand and apply Object Oriented concept for designing Object Oriented based model or application
- To transform Requirement document to appropriate design
- To acquaint with the interaction between quality attributes and software architecture
- To understand different architectural designs, transform them into proper model and document them
- To understand software architecture with case studies and explore with examples, use of design pattern application

Course Outcomes:

On completion of the course, learners should be able to

CO1: Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application

CO2: Design and analyze an application using UML modeling as fundamental tool

CO3: Evaluate software architectures

CO4: Use appropriate architectural styles and software design patterns

CO5: Apply appropriate modern tool for designing and modeling

Course Contents

Unit I	Concepts of Software Modeling	07 Hours

Software Modeling: Introduction to Software Modeling, Advantages of modeling, Principles of modeling. **Evolution of Software Modeling and Design Methods**: Object oriented analysis and design methods, Concurrent, Distributed Design Methods and Real-Time Design Methods, Model Driven Architecture (MDA), 4+1 Architecture, Introduction to UML, UML building Blocks, COMET Use Case–Based Software Life Cycle. **Requirement Study**: Requirement Analysis, SRS design, Requirements Modeling. **Use Case**: Actor and Use case identification, Use case relationship (Include, Extend, Use case Generalization, Actor Generalization), Use case template.

#Exemplar/Case Studies	Requirement modeling and use case modeling for Real life applications (e.g., Online shopping system)
***Mapping of Course Outcomes for Unit I**	CO1, CO2

Unit II	Static Modeling	07 Hours

Study of classes (analysis level and design level classes). **Methods for identification of classes**: RUP (Rational Unified Process), CRC (Class, Responsibilities and Collaboration), Use of Noun Verb analysis (for identifying entity classes, controller classes and boundary classes). **Class Diagram**: Relationship between classes, Generalization/Specialization Hierarchy, Composition and Aggregation Hierarchies, Associations Classes, Constraints.

Object diagram, Package diagram, Component diagram, Composite Structure diagram, Deployment Diagram.

#Exemplar/Case Studies	UML Static Diagrams for Real life applications (e.g., Online shopping system).	
***Mapping of Course Outcomes for Unit II**	CO1 ,CO2	
Unit III	**Dynamic Modeling**	**07 Hours**
Activity diagram: Different Types of nodes, Control flow, Activity Partition, Exception handler, Interruptible activity region, Input and output parameters, Pins. **Interaction diagram**: Sequence diagram, Interaction Overview diagram, State machine diagram, Advanced State Machine diagram, Communication diagram, Timing diagram.		
#Exemplar/Case Studies	UML dynamic Diagrams of for Real life applications.	
***Mapping of Course Outcomes for Unit III**	CO1 ,CO2	
Unit IV	**Software Architecture and Quality Attributes**	**07 Hours**
Introduction to Software Architecture, Importance of Software Architecture, Architectural Structure and Views. **Architectural Pattern**: common module, Common component-and-connector, Common allocation. **Quality Attributes**: Architecture and Requirements, Quality Attributes and Considerations		
#Exemplar/Case Studies	Case study of any real-life application	
***Mapping of Course Outcomes for Unit IV**	CO3	
Unit V	**Architectural Design and Documentation**	**07 Hours**
Architecture in the Life Cycle: Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture. **Documenting Software Architecture**: Notations, Choosing and Combining views, Building the documentation Package, Documenting Behavior, Documenting Architecture in an Agile Development Project.		
#Exemplar/Case Studies	Air Traffic Control.	
***Mapping of Course Outcomes for Unit V**	CO4 , CO5	
Unit VI	**Design Patterns**	**07 Hours**
Design Patterns: Introduction, Different approaches to select Design Patterns. **Creational patterns**: Singleton, Factory, Structural pattern: Adapter, Proxy. **Behavioral Patterns**: Iterator, Observer Pattern with applications.		
#Exemplar/Case Studies	Flight Simulation	
***Mapping of Course Outcomes for Unit VI**	CO4, CO5	
Learning Resources		

Text Books :

1. Jim Arlow, Ila Neustadt, "UML 2 and the unified process –practical object-oriented analysis and design", Addison Wesley, Second edition, ISBN 978-0201770605.
2. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
3. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2.

Reference Books :

1. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures", Cambridge University Press, 2011, ISBN 978-0-521-76414-8
2. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562
3. Ian Sommerville, "Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

e-Books :

- https://ebookpdf.com/roger-s-pressman-software-engineering
- https://dhomaseghanshyam.files.wordpress.com/2016/02/gomaa-softwaremodellinganddesign.pdf
- https://balu051989.files.wordpress.com/2011/06/the-unified-modeling-language-user-guide-by-grady-booch-james-rumbaugh-ivar-jacobson.pdf
- http://index-of.co.uk/Engineering/Software%20Engineering%20(9th%20Edition).pdf)

MOOCs Courses link

- https://nptel.ac.in/courses/106/105/106105224/
- https://onlinecourses.nptel.ac.in/noc20_cs59/preview
- https://onlinecourses.nptel.ac.in/noc20_cs84/preview

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	-	3	-	-	-	-	-	-	1
CO2	1	1	3	-	3	-	-	-	-	-	-	1
CO3	1	1	2	1	2	-	-	-	-	-	-	1
CO4	1	1	3	2	3	-	-	-	-	-	-	1
CO5	1	1	3	-	3	-	-	-	-	-	-	2

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310255: Internship**

Home

Teaching Scheme: **	Credit: 04	Examination Scheme: Term work: 100 Marks

Course Objectives:

Internship provides an excellent opportunity to learner to see how the conceptual aspects learned in classes are integrated into the practical world. Industry/on project experience provides much more professional experience as value addition to classroom teaching.

- To encourage and provide opportunities for students to get professional/personal experience through internships.
- To learn and understand real life/industrial situations.
- To get familiar with various tools and technologies used in industries and their applications.
- To nurture professional and societal ethics.
- To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

Course Outcomes:

On completion of the course, learners should be able to

CO1: To demonstrate professional competence through industry internship.
CO2: To apply knowledge gained through internships to complete academic activities in a professional manner.
CO3: To choose appropriate technology and tools to solve given problem.
CO4: To demonstrate abilities of a responsible professional and use ethical practices in day to day life.
CO5: Creating network and social circle, and developing relationships with industry people.
CO6: To analyze various career opportunities and decide carrier goals.

** Guidelines:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:

Internship is to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

Internship work Identification:

Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry[1].

Students must register at Internshala [2]. Students must get Internship proposals sanctioned from college authority well in advance. Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination and before academic schedule of semester VI.

Student can take internship work in the form of the following but not limited to:

- Working for consultancy/ research project,
- Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute /
- Learning at Departmental Lab/Tinkering Lab/ Institutional workshop,
- Development of new product/ Business Plan/ registration of start-up,
- Industry / Government Organization Internship,
- Internship through Internshala,
- In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship,
- Research internship under professors, IISC, IIT's, Research organizations,
- NGOs or Social Internships, rural internship,
- Participate in open source development.

Internship Diary/ Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.

Internship Work Evaluation:

Every student is required to prepare a maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks

Evaluation through Seminar Presentation/Viva-Voce at the Institute-

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Depth of knowledge and skills
- Communication & Presentation Skills
- Team Work
- Creativity
- Planning & Organizational skills
- Adaptability
- Analytical Skills
- Attitude & Behavior at work

- Societal Understanding
- Ethics
- Regularity and punctuality
- Attendance record
- Diary/Work book
- Student's Feedback from External Internship Supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

Internship Diary/workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries
- Adequacy & quality of information recorded
- Data recorded
- Thought process and recording techniques used
- Organization of the information

The report shall be presented covering following recommended fields but limited to,

- Title/Cover Page
- Internship completion certificate
- Internship Place Details- Company background-organization and activities/Scope and object of the study / Supervisor details
- Index/Table of Contents
- Introduction
- Title/Problem statement/objectives
- Motivation/Scope and rationale of the study
- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines and other sources)

Feedback from internship supervisor(External and Internal)

Post internship, faculty coordinator should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership…..

Reference:

[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
[2] https://internship.aicte-india.org/

@ The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	1	1	1	2	1	1
CO2	1	2	2	2	3	2	1	1	1	2	2	1
CO3	-	-	-	-	-	1	-	-	2	2	1	1
CO4	2	-	-	-	-	2	2	3	-	1	-	2
CO5	-	-	-	-	-	1	2	1	1	1	2	1
CO6	-	-	-	-	-	1	-	-	2	1	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310256:Data Science and Big Data Analytics Laboratory

Home

Teaching Scheme	Credit	Examination Scheme and Marks
Practical: 04 Hours/Week	Credit:02	Term work: 50 Marks Practical: 25 Marks

Companion Course: Data Science and Big Data Analytics (310251)

Course Objectives:

- To understand principles of Data Science for the analysis of real time problems
- To develop in depth understanding and implementation of the key technologies in Data Science and Big Data Analytics
- To analyze and demonstrate knowledge of statistical data analysis techniques for decision-making
- To gain practical, hands-on experience with statistics programming languages and Big Data tools

Course Outcomes:

On completion of the course, learners will be able to

CO1: Apply principles of Data Science for the analysis of real time problems
CO2: Implement data representation using statistical methods
CO3: Implement and evaluate data analytics algorithms
CO4: Perform text preprocessing
CO5: Implement data visualization techniques
CO6: Use cutting edge tools and technologies to analyze Big Data

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A and B. Each student must perform 13 assignments (10 from group A, 3 from group B), 2 mini project from Group C

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - JAVA/Python/R/Scala

Virtual Laboratory:

- "Welcome to Virtual Labs - A MHRD Govt of india Initiative"
- http://cse20-iiith.vlabs.ac.in/List%20of%20Experiments.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Assignments from all Groups (A,B,C) are compulsory.

Sr. No.	Group A : Data Science
1.	**Data Wrangling, I** Perform the following operations using Python on any open source dataset (e.g., data.csv) 1. Import all the required Python Libraries. 2. Locate an open source data from the web (e.g. https://www.kaggle.com). Provide a clear description of the data and its source (i.e., URL of the web site). 3. Load the Dataset into pandas data frame. 4. Data Preprocessing: check for missing values in the data using pandas insult(), describe() function to get some initial statistics. Provide variable descriptions. Types of variables etc. Check the dimensions of the data frame. 5. Data Formatting and Data Normalization: Summarize the types of variables by checking the data types (i.e., character, numeric, integer, factor, and logical) of the variables in the data set. If variables are not in the correct data type, apply proper type conversions. 6. Turn categorical variables into quantitative variables in Python. In addition to the codes and outputs, explain every operation that you do in the above steps and explain everything that you do to import/read/scrape the data set.
2.	**Data Wrangling II** Create an "Academic performance" dataset of students and perform the following operations using Python. 1. Scan all variables for missing values and inconsistencies. If there are missing values and/or inconsistencies, use any of the suitable techniques to deal with them. 2. Scan all numeric variables for outliers. If there are outliers, use any of the suitable techniques to deal with them. 3. Apply data transformations on at least one of the variables. The purpose of this transformation should be one of the following reasons: to change the scale for better understanding of the variable, to convert a non-linear relation into a linear one, or to decrease the skewness and convert the distribution into a normal distribution. Reason and document your approach properly.

3.	**Descriptive Statistics - Measures of Central Tendency and variability** Perform the following operations on any open source dataset (e.g., data.csv) 1. Provide summary statistics (mean, median, minimum, maximum, standard deviation) for a dataset (age, income etc.) with numeric variables grouped by one of the qualitative (categorical) variable. For example, if your categorical variable is age groups and quantitative variable is income, then provide summary statistics of income grouped by the age groups. Create a list that contains a numeric value for each response to the categorical variable. 2. Write a Python program to display some basic statistical details like percentile, mean, standard deviation etc. of the species of ‘Iris-setosa’, ‘Iris-versicolor’ and ‘Iris-versicolor’ of iris.csv dataset. Provide the codes with outputs and explain everything that you do in this step.
4.	**Data Analytics I** Create a Linear Regression Model using Python/R to predict home prices using Boston Housing Dataset (https://www.kaggle.com/c/boston-housing). The Boston Housing dataset contains information about various houses in Boston through different parameters. There are 506 samples and 14 feature variables in this dataset. The objective is to predict the value of prices of the house using the given features.
5.	**Data Analytics II** 1. Implement logistic regression using Python/R to perform classification on Social_Network_Ads.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.
6.	**Data Analytics III** 1. Implement Simple Naïve Bayes classification algorithm using Python/R on iris.csv dataset. 2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error rate, Precision, Recall on the given dataset.
7.	**Text Analytics** 1. Extract Sample document and apply following document preprocessing methods: Tokenization, POS Tagging, stop words removal, Stemming and Lemmatization. 2. Create representation of document by calculating Term Frequency and Inverse Document Frequency.
8.	**Data Visualization I** 1. Use the inbuilt dataset 'titanic'. The dataset contains 891 rows and contains information about the passengers who boarded the unfortunate Titanic ship. Use the Seaborn library to see if we can find any patterns in the data. 2. Write a code to check how the price of the ticket (column name: 'fare') for each passenger is distributed by plotting a histogram.
9.	**Data Visualization II** 1. Use the inbuilt dataset 'titanic' as used in the above problem. Plot a box plot for distribution of age with respect to each gender along with the information about whether they survived or not. (Column names : 'sex' and 'age') 2. Write observations on the inference from the above statistics.

10.	**Data Visualization III** Download the Iris flower dataset or any other dataset into a DataFrame. (e.g., https://archive.ics.uci.edu/ml/datasets/Iris). Scan the dataset and give the inference as: 1. List down the features and their types (e.g., numeric, nominal) available in the dataset. 2. Create a histogram for each feature in the dataset to illustrate the feature distributions. 3. Create a box plot for each feature in the dataset. 4. Compare distributions and identify outliers.
	Group B- Big Data Analytics – JAVA/SCALA (Any three)
1.	Write a code in JAVA for a simple Word Count application that counts the number of occurrences of each word in a given input set using the Hadoop Map-Reduce framework on local-standalone set-up.
2.	Design a distributed application using Map-Reduce which processes a log file of a system.
3.	Locate dataset (e.g., sample_weather.txt) for working on weather data which reads the text input files and finds average for temperature, dew point and wind speed.
4.	Write a simple program in SCALA using Apache Spark framework
	Group C- Mini Projects/ Case Study – PYTHON/R (Any TWO Mini Project)
1.	Write a case study on Global Innovation Network and Analysis (GINA). Components of analytic plan are 1. Discovery business problem framed, 2. Data, 3. Model planning analytic technique and 4. Results and Key findings.
2.	Use the following dataset and classify tweets into positive and negative tweets. https://www.kaggle.com/ruchi798/data-science-tweets
3.	Develop a movie recommendation model using the scikit-learn library in python. Refer dataset https://github.com/rashida048/Some-NLP-Projects/blob/master/movie_dataset.csv
4.	Use the following covid_vaccine_statewise.csv dataset and perform following analytics on the given dataset https://www.kaggle.com/sudalairajkumar/covid19-in-india?select=covid_vaccine_statewise.csv a. Describe the dataset b. Number of persons state wise vaccinated for first dose in India c. Number of persons state wise vaccinated for second dose in India d. Number of Males vaccinated d. Number of females vaccinated
5.	Write a case study to process data driven for Digital Marketing **OR** Health care systems with Hadoop Ecosystem components as shown. (Mandatory) ● HDFS: Hadoop Distributed File System ● YARN: Yet Another Resource Negotiator ● MapReduce: Programming based Data Processing ● Spark: In-Memory data processing ● PIG, HIVE: Query based processing of data services ● HBase: NoSQL Database (Provides real-time reads and writes) ● Mahout, Spark MLLib: (Provides analytical tools) Machine Learning algorithm libraries ● Solar, Lucene: Searching and Indexing
	Learning Resources

Reference Books :

1. Chirag Shah, "A Hands-On Introduction To Data Science", Cambridge University Press,(2020), ISBN : ISBN 978-1-108-47244-9.
2. Wes McKinney, "Python for Data Analysis", O' Reilly media, ISBN : 978-1-449-31979-3.
3. "Scikit-learn Cookbook", Trent hauk,Packt Publishing, ISBN: 9781787286382
4. R Kent Dybvig, "The Scheme Programming Language", MIT Press, ISBN 978-0-262-51298-5.
5. Jenny Kim, Benjamin Bengfort, "Data Analytics with Hadoop", OReilly Media, Inc.
6. Jake VanderPlas,"Python Data Science Handbook" https://tanthiamhuat.files.wordpress.com/2018/04/pythondatasciencehandbook.pdf
7. Gareth James, "An Introduction to Statistical Learning" https://www.ime.unicamp.br/~dias/Intoduction%20to%20Statistical%20Learning.pdf
8. Cay S Horstmann, "Scala for the Impatient", Pearson, ISBN: 978-81-317-9605-4,
9. Alvin Alexander, "Scala Cookbook", O'Reilly, SPD,ISBN: 978-93-5110-263-2

Web Links:

- https://www.simplilearn.com/data-science-vs-big-data-vs-data-analytics-article
- https://hadoop.apache.org/docs/current/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html
- https://www.edureka.co/blog/hadoop-ecosystem
- https://www.edureka.co/blog/mapreduce-tutorial/#mapreduce_word_count_example
- https://github.com/vasanth-mahendran/weather-data-hadoop
- https://spark.apache.org/docs/latest/quick-start.html#more-on-dataset-operations
- https://www.scala-lang.org/

MOOCs Courses link:

- https://nptel.ac.in/courses/106/106/106106212/
- https://onlinecourses.nptel.ac.in/noc21_cs33/preview
- https://nptel.ac.in/courses/106/104/106104189/
- https://onlinecourses.nptel.ac.in/noc20_cs92/preview

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	1	-	-	-	1	-	1	3
CO2	2	2	3	1	2	-	-	-	1	-	-	3
CO3	2	2	3	2	2	2	-	-	2	-	1	3
CO4	2	2	2	2	2	-	-	-	-	-	-	3
CO5	2	2	3	3	3	1	-	-	2	-	2	3
CO6	2	2	1	1	3	2	1	-	2	-	2	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310257:Web Technology Laboratory

Home

Teaching Scheme Practical: 02 Hours/Week	Credit: 01	Examination Scheme and Marks Term Work: 25 Marks Oral: 25 Marks

Companion Course : Web Technology (310252)

Course Objectives:

- To learn the web based development environment
- To use client side and server side web technologies
- To design and develop web applications using front end technologies and backend databases

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand the importance of website planning and website design issues
CO2: Apply the client side and server side technologies for web application development
CO3: Analyze the web technology languages, frameworks and services
CO4: Create three tier web based applications

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, and punctuality.

Guidelines for Oral Examination

Oral examination should be jointly conducted by the internal examiner and external examiner. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementations in term work. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Mini project should be implemented by the students in a group of 2-3 students.

Suggested List of Laboratory Experiments/Assignments

(All assignments are compulsory)

Sr. No.	Assignment Title

1. Case study:
Before coding of the website, planning is important, students should visit different websites (Min. 5) for the different client projects and note down the evaluation results for these websites, either good website or bad website in following format:

Sr. No.	Website URL	Purpose of Website	Things liked in the website	Things disliked in the website	Overall evaluation of the website (Good/Bad)

From the evaluation, students should learn and conclude different website design issues, which should be considered while developing a website.

2. Implement a web page index.htm for any client website (e.g., a restaurant website project) using following:
   a. HTML syntax: heading tags, basic tags and attributes, frames, tables, images, lists, links for text and images, forms etc.
   b. Use of Internal CSS, Inline CSS, External CSS

3. Design the XML document to store the information of the employees of any business organization and demonstrate the use of:
   a) DTD
   b) XML Schema
And display the content in (e.g., tabular format) by using CSS/XSL.

4. Implement an application in Java Script using following:
   a) Design UI of application using HTML, CSS etc.
   b) Include Java script validation
   c) Use of prompt and alert window using Java Script

e.g., Design and implement a simple calculator using Java Script for operations like addition, multiplication, subtraction, division, square of number etc.
   a) Design calculator interface like text field for input and output, buttons for numbers and operators etc.
   b) Validate input values
   c) Prompt/alerts for invalid values etc.

5. Implement the sample program demonstrating the use of Servlet.

e.g., Create a database table ebookshop (book_id, book_title, book_author, book_price, quantity) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using servlet.

6. Implement the program demonstrating the use of JSP.

e.g., Create a database table students_info (stud_id, stud_name, class, division, city) using database like Oracle/MySQL etc. and display (use SQL select query) the table content using JSP.

7. Build a dynamic web application using PHP and MySQL.
   a. Create database tables in MySQL and create connection with PHP.
   b. Create the add, update, delete and retrieve functions in the PHP web app interacting with MySQL database

8.	Design a login page with entries for name, mobile number email id and login button. Use struts and perform following validations a. Validation for correct names b. Validation for mobile numbers c. Validation for email id d. Validation if no entered any value e. Re-display for wrongly entered values with message f. Congratulations and welcome page upon successful entries
9.	Design an application using Angular JS. e.g., Design registration (first name, last name, username, password) and login page using Angular JS.
10.	Design and implement a business interface with necessary business logic for any web application using EJB. e.g., Design and implement the web application logic for deposit and withdraw amount transactions using EJB.
11.	**Mini Project**: Design and implement a dynamic web application for any business functionality by using web development technologies that you have learnt in the above given assignments.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	3	1	-	1	1	-	-	1	-	-
CO2	2	2	-	2	1	-	-	-	1	-	-	-
CO3	2	-	3	-	-	1	-	-	-	1	1	-
CO4	1	2	2	1	2	1	1	-	-	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310258:Laboratory Practice II

Home

Teaching Scheme Practical: 04 Hours/Week	Credit: 02	Examination Scheme and Marks Term Work: 50 Marks Practical: 25 Marks

Companion Course: Artificial Intelligence (310253), Elective II (310254)

Course Objectives:

- To learn and apply various search strategies for AI
- To Formalize and implement constraints in search problems
- To understand the concepts of Information Security / Augmented and Virtual Reality/Cloud Computing/Software Modeling and Architectures

Course Outcomes:

On completion of the course, learner will be able to

- **Artificial Intelligence**
  - **CO1:** Design a system using different informed search / uninformed search or heuristic approaches
  - **CO2:** Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning
  - **CO3:** Design and develop an interactive AI application
- **Information Security**
  - **CO4:** Use tools and techniques in the area of Information Security
  - **CO5:** Use the cryptographic techniques for problem solving
  - **CO6:** Design and develop security solution

OR

- **Augmented and Virtual Reality**
  - **CO4:** Use tools and techniques in the area of Augmented and Virtual Reality
  - **CO5:** Use the representing and rendering system for problem solving
  - **CO6:** Design and develop ARVR applications

OR

- **Cloud Computing**
  - **CO4:** Use tools and techniques in the area of Cloud Computing
  - **CO5:** Use cloud computing services for problem solving
  - **CO6:** Design and develop applications on cloud

OR

- **Software Modeling and Architectures**
  - **CO4:** Use tools and techniques in the area Software Modeling and Architectures
  - **CO5:** Use the knowledge of Software Modeling and Architectures for problem solving
  - **CO6:** Design and develop applications using UML as fundamental tool

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So, adhering to these principles will consummate our team efforts to the promising start of student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Windows OS and Linux
Programming tools recommended: -
Information Security : - C/C++/Java
Augmented and Virtual Reality :- Unity, C#, Blender, VRTK, ARTK, Vuforia
VR Devices: HTC Vive, Google Daydream and Samsung gear VR.
Software Modeling and Architectures:-Front end:HTML5, Bootstarp, JQuery, JS etc.
Backend: MySQL /MongoDB/NodeJS

Virtual Laboratory:

Software Modeling and Architectures : http://vlabs.iitkgp.ernet.in/se
Information Security : http://cse29-iiith.vlabs.ac.in

Part I : Artificial Intelligence

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A All assignments are compulsory
1.	Implement depth first search algorithm and Breadth First Search algorithm, Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph or tree data structure.
2.	Implement A star Algorithm for any game search problem.
3.	Implement Greedy search algorithm for any of the following application: I. Selection Sort II. Minimum Spanning Tree III. Single-Source Shortest Path Problem IV. Job Scheduling Problem V. Prim's Minimal Spanning Tree Algorithm VI. Kruskal's Minimal Spanning Tree Algorithm VII. Dijkstra's Minimal Spanning Tree Algorithm
	Group B
4.	Implement a solution for a Constraint Satisfaction Problem using Branch and Bound and Backtracking for n-queens problem or a graph coloring problem.
5.	Develop an elementary catboat for any suitable customer interaction application.

	Group C
6.	Implement any one of the following Expert System I. Information management II. Hospitals and medical facilities III. Help desks management IV. Employee performance evaluation V. Stock market trading VI. Airline scheduling and cargo schedules

Part II : Elective II

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Assignment Name
	Information Security (Any five)
1.	Write a Java/C/C++/Python program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.
2.	Write a Java/C/C++/Python program to perform encryption and decryption using the method of Transposition technique.
3.	Write a Java/C/C++/Python program to implement DES algorithm.
4.	Write a Java/C/C++/Python program to implement AES Algorithm.
5.	Write a Java/C/C++/Python program to implement RSA algorithm.
6.	Implement the different Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).
7.	Calculate the message digest of a text using the MD5 algorithm in JAVA.
	Cloud Computing (All assignments are compulsory)
1.	Case study on Microsoft azure to learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed data centers. OR Case study on Amazon EC2 and learn about Amazon EC2 web services.
2.	Installation and configure Google App Engine. OR Installation and Configuration of virtualization using KVM.
3.	Creating an Application in SalesForce.com using Apex programming Language.
4.	Design and develop custom Application (Mini Project) using Sales force Cloud.
5.	**Mini-Project** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open-source technologies to implement **with HDFS**. Implement the basic operations may be like to divide the file in segments/blocks and upload/ download file on/from cloud in encrypted form.
	Augmented and Virtual Reality (Assignments 1,2, 3,7 are mandatory, any 2 from 4, 5 & 6)
1.	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2.	Demonstration of the working of HTC Vive, Google Daydream or Samsung gear VR.
3.	Develop a scene in Unity that includes:

	i.A cube, plane and sphere, apply transformations on the 3 game objects. ii.Add a video and audio source.
4.	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the color, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the color and material/texture of the game objects dynamically on button click.
5.	Develop and deploy a simple marker based AR app in which you have to write a C# program to play video on tracking a particular marker.
6.	Develop and deploy an AR app, implement the following using Vuforia Engine developer portal: i. Plane detection ii. Marker based Tracking(Create a database of objects to be tracked in Vuforia) iii. Object Tracking
7.	**Mini-Projects/ Case Study** Create a multiplayer VR game (battlefield game). The game should keep track of score, no. of chances/lives, levels(created using different scenes), involve interaction, animation and immersive environment. **OR** Create a treasure hunt AR application which should have the following features: i. A help button for instruction box to appear. ii. A series of markers which would give hints on being scanned. iii. Involve interaction, sound, and good UI.
	Software Modeling and Architectures **(Problem statement 1, 2 , 5 are mandatory and any one from 3 and 4)**
1.	Consider a library, where a member can perform two operations: issue book and return it. A book is issued to a member only after verifying his credentials. Develop a use case diagram for the given library system by identifying the actors and use cases and associate the use cases with the actors by drawing a use case diagram. Use UML tool.
2.	Consider online shopping system. Perform the following tasks and draw the class diagram using UML tool. Represent the individual classes, and objects Add methods Represent relationships and other classifiers like interfaces
3.	Consider the online shopping system in the assignment 2. Draw the sequence diagram using UML tool to show message exchanges
4.	Consider your neighboring travel agent from whom you can purchase flight tickets. To book a ticket you need to provide details about your journey i.e., on which date and at what time you would like to travel. You also need to provide your address. The agency has recently been modernized. So, you can pay either by cash or by card. You can also cancel a booked ticket later if you decide to change your plan. In that case you need to book a new ticket again. Your agent also allows you to book a hotel along with flight ticket. While cancelling a flight ticket you can also cancel hotel booking. Appropriate refund as per policy is made in case of cancellation. Perform the following tasks and draw the use case diagram using UML tool. a. Identify the use cases from a given non-trivial problem statement. b. Identify the primary and secondary actors for a system. **c.** Use to generalization of use cases and «include» stereotypes to prevent redundancy in the coding phase

Mini-Projects	
5.	Select a moderately complex system and narrate concise requirement Specification for the same. Design the system indicating system elements organizations using applicable architectural styles and design patterns with the help of a detailed Class diagram depicting logical architecture. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.

Learning Resources

Text Books:

Artificial Intelligence

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5

Information Security

1. Atul Kahate, "Cryptography and Network Security", 3e, McGraw Hill Education
2. Prakash C. Gupta, "Cryptography and Network Security", PHI
3. V.K. Pachghare, "Cryptography and Information Security", PHI Learning

Cloud Computing

1. A. Srinivasan, J. Suresh," Cloud Computing: A Practical Approach for Learning and Implementation", Pearson, ISBN: 978-81-317-7651-3
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education, ISBN-13:978-1-25-902995-0

Augmented and Virtual Reality

1. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
2. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086

Software Modeling and Architectures

1. Jim Arlow, Ila Neustadt, "UML 2 and the unified process –practical object-oriented analysis and design", Addison Wesley, Second edition, ISBN 978-0201770605
2. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
3. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures", Cambridge University Press, 2011, ISBN 978-0-521-76414-8
4. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India-

ISBN: 978-0-470-51250-0

Information Security

1. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", 3rd_Edition, Pearson
2. William Stallings, "Cryptography and Network Security Principals and Practice", Fifth edition, Pearson
3. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley, ISBN: 978-81-265-2179-1

Augmented and Virtual Reality

1. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. Schmalstieg / Hollerer, "Augmented Reality: Principles & Practice", Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
4. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0

Cloud Computing

1. James Bond ,"The Enterprise Cloud", O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more", Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.

Software Modeling and Architectures

1. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8.
2. Lan Sommerville, "Software Engineering", 9th edition, ISBN-13: 978-0-13-703515-1 ISBN-10: 0-13-703515-2.

@The CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	3	-	-	2	2	2	1	2
CO2	1	-	2	2	3	2	-	2	2	2	1	2
CO3	1	-	2	2	3	2	-	2	2	2	2	2
CO4	1	-	2	-	3	-	-	2	2	2	2	2
CO5	1	-	2	-	3	-	-	2	2	2	2	2
CO6	1	-	2	-	3	-	-	2	2	2	2	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
310259: Audit Course 6

Home

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 6 Options

Audit Course Code	Audit Course Title
310259(A)	Digital and Social Media Marketing
310259(B)	Sustainable Energy Systems
310259(C)	Leadership and Personality Development
310259(D)	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese (Module 4)** are provided. For other languages institute may design suitably.
310259(E)	Learn New Skills - Software Development Using Agility Approach

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(A): Digital and Social Media Marketing

Home

Prerequisites: Internet Technologies

Course Objectives:

- To understand the importance of digital marketing
- To understand the social media and marketing

To understand the effective marketing strategies and ways

Course Outcomes:

On completion of the course, learners will be able to

CO1: Understand the fundamentals and importance of digital marketing

CO2: Use the power of social media for business marketing

CO3: Analyze the effectiveness of digital marketing and social media over traditional process

Course Contents

1. A Framework for Digital Marketing
2. Domain Names, Email, and Hosting
3. Yes, You need a Website
4. The Three Components of a Modern Website: Mobile, Fast, and Accessible
5. Lock It Down: Digital Privacy, Data Security, and the Law
6. Social Media
7. Email Marketing
8. Online Advertising

Reference Books :

1. Avery Swartz, "See You on the Internet: building your small business with Digital Marketing", ISBN 978-1-989603-08-6.
2. Social Media Marketing Workbook (2021): How to Use Social Media for Business (2021 Social Media Marketing 1).

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CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	1	-	1	-	1	-	-	-	-
CO2	-	1	2	-	1	-	-	-	-	-	1	-
CO3	2	-	2	2	1	-	1	-	-	-	-	-

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(B): Sustainable Energy Systems

Home

Prerequisites: General awareness of environment and natural resources of energy

Course Objectives:

- To understand the importance of sustainable energy systems development
- To create awareness about renewable energy sources and technologies
- To learn about adequate inputs on a variety of issues in harnessing renewable energy
- To recognize current and possible future role of renewable energy sources

Course Outcomes:

On completion of the course, learners will be able to

CO1: Comprehend the importance of Sustainable Energy Systems

CO2: Correlate the human population growth and its trend to the natural resource degradation and develop the awareness about his/her role towards Sustainable Energy Systems protection

CO3: Identify different types of natural resource pollution and control measures

CO4: Correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents

1. **Wind Energy:** Power in the Wind, Types of Wind Power Plants (WPPs), Components of WPPs, Working of WPPs, Siting of WPPs, Grid integration issues of WPPs.
2. **Solar Pv and Thermal Systems:** Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds, Thermal Energy storage system with PCM, Solar Photovoltaic systems: Basic Principle of SPV conversion, Types of PV Systems, Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency and Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.
3. **Other Energy Sources:** Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC), Hydrogen Production and Storage. Fuel cell: Principle of working, various types, construction and applications. Energy Storage System, Hybrid Energy Systems.

Reference Books :

1. Joshua Earnest, Tore Wizeliu, “Wind Power Plants and Project Development”, PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan,“Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt .Ltd, New Delhi, 2013.
3. A.K.Mukerjee and Nivedita Thakur, “Photovoltaic Systems: Analysis and Design”, PHI Learning Private Limited, New Delhi, 2011

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CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12
CO1	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	2

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(C): Leadership and Personality Development

Home

Prerequisites: General awareness of communication and relationship.

Course Objectives:

- To understand the importance of communication
- To create awareness about teamwork and people skills
- To know thyself
- To recognize current and possible future of new-age thinking

Course Outcomes:

On completion of the course, learners will be able to

CO1: Express effectively through communication and improve listening skills

CO3: Develop **e**ffective team leadership abilities.

CO4: Explore self-motivation and practicing creative/new age thinking.

CO5: Operate effectively in heterogeneous teams through the knowledge of team work, people skills and leadership qualities.

Course Contents

1. **Communication :**
   Listening Skills, Communication - 7 C's, Vision and Charisma, Planning and Organizing - Complex Tasks and Ideas --> Actionable Tasks, Presentation Skills.
2. **Teamwork and People Skills :**
   Talent Picking skills, Strong networking and Employee engagement, Coach and Mentor the team, Influencing, Delegate and Empower, Generous, open communicator, Patience and Clarity of Mind, Inspire and Motivate, Ensure Team Cohesion, Empathy, Trust and Reliability.
3. **New-age Thinking :**
   Strategic Thinking, Critical and Lateral Thinking, Problem Solving Skills, Flexibility, Change Management – VUCA.
4. **Self-Awareness :**
   What is Self? – Real, Ideal and Social Self, Concepts related to Self - Self Concept, Self-Presentation, Self-Regulation and Impression Management, Definition and Causes of Prejudice, Relationship between Prejudice, Discrimination and Exclusion, Application – Attitudinal Change and Reducing Prejudices, Self Esteem and Self Awareness, SWOT – JOHARI, Self Esteem Quiz, Introduce Your Partner, Self Introduction - How to sell yourself?-appearance, voice modulation, verbal(simple language), Motivation and Optimism, Positive Emotions and Success.

Reference Books :

1. Paul Sloane, "The Leader's Guide to Lateral Thinking Skills Unlocking the Creativity and Innovation in You and Your Team", 2006
2. Ronald Bennett, Elaine Millam,"Leadership for engineers : the magic of mindset"
3. Urmila Rai and S.M. Rai, "Business Communication", Himalay Publication House
4. Baron R, Byrne D, Branscombe N, BharadwajG (2009), "Social Psychology, Indian adaptation" , Pearson , New Delhi
5. Baumgartner S.R, Crothers M.K. (2009) "Positive Psychology", Pearson Education.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	2	-	1	1	3	-	2
CO2	-	-	-	-	-	-	-	1	-	2	1	2
CO3	-	-	-	-	-	1	-	-	2	1	-	1
CO4	-	-	-	-	-	-	-	1	-	-	2	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(D): Foreign Language (Japanese) Module 4

Home

Prerequisites: We recommend that candidates should have previously completed AC3-V(210251) , AC4-V (210260) and AC-5(310250)

Course Objectives:

- To open up more doors and job opportunities
- To introduce to Japanese society, culture and entertainment

Course Outcomes:

On completion of the course, learner will be able to

CO1: Have the ability to communicate confidently and clearly in the Japanese language
CO2: Understand the nature of Japanese script
CO3: Get introduced to reading, writing and listening skills
CO4: Develop interest to pursue further study, work and leisure

Course Contents

1. Introduction to types of adjectives (i and na)
2. Formation of adjectives (according to tense / negative / affirmative)
3. Introduction to more particles
4. Making sentences using various particles / verbs / adjectives
5. Topic based vocabulary (Places / Train travel related / Technical Katakana words)
6. More verb forms (te form, ta form, nai form, root verb etc.)
7. Question words
8. Further 25 Kanjis
9. Scenario based conversation practice / skits / role plays (At the market, At the hospital etc.)

Reference Books :

1. Minna No Nihongo, “JapaneseforEveryone”,ElementaryMainTextbook1-1(IndianEdition),GoyalPublishers and Distributors Pvt.Ltd.
2. http://www.tcs.com(http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)
3. Kazuko Karasawa, Mikiko Shibuya, “Nihongo Challenge N4 N5 Kannji Tomoko Kigami”, ISBN-10 4872177576,Ask Publishing Co.,Ltd.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Savitribai Phule Pune University
Third Year of Engineering (2019 Course)
Audit Course 6
310259(E): Learn New Skill- 'Software Development Using Agility Approach'

Home

Prerequisites: Software Engineering (210253)

Course Objectives:

- To understand the fundamentals of Dev Ops
- To understand the Agility and ways of Agility
- To understand the software development using Agility approach

Course Outcomes:

On completion of the course, learner will be able to

CO1: Illustrate the agility and principles

CO2: Understand the software development using agile methodology

CO3: Apply Dev Ops for the software product development

CO4: Develop software products for early delivery through continual feedback and learning

Course Contents

1. **THE THREE WAYS :**Agile, continuous delivery and the three ways, The First Way: The Principles of Flow, The Second Way: The Principle of Feedback, The Third Way: The Principles of Continual Learning.
2. **WHERE TO START :**Selecting which value stream to start with, Understanding the work in our value stream…, How to design our organization and architecture, How to get great outcomes by integrating operations into the daily work for development.
3. **THE FIRST WAY: THE TECHNICAL PRACTICES OF FLOW :** Create the foundations of our deployment pipeline, Enable fast and reliable automated testing, Enable and practice continuous integration, Automate and enable low-risk releases, Architect for low-risk releases.
4. **THE SECOND WAY: THE TECHNICAL PRACTICES OF FEEDBACK :**Create telemetry to enable seeing and solving problems, Analyze telemetry to better anticipate problems, Enable feedback so development and operation can safely deploy code, Integrate hypothesis-driven development and A/B testing into our daily work, Create review and coordination processes to increase quality of our current work.
5. **THE THRID WAY: THE TECHNICAL PRACTICES OF CONTINUAL LEARNING :** Enable and inject learning into daily work, Convert local discoveries into global improvements, Reserve time to create organizational learning, Information security as everyone's job, every day, Protecting the deployment pipeline.

Reference Books :

1. Gene Kim, Jez Humble, Petrick Debois, "The Dev Ops Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations"
2. Len Bass, Ingo Weber, Liming Zhu, "Dev Ops: A Software Architect's Perspective " Publisher(s): Addison-Wesley Professional, ISBN: 9780134049885

Note: This is sample contents for Software Development Using Agility Approach, however the course instructor may design suitable course giving opportunity to the students for learning new skills.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	1	1	2	1	3	1	-	1	-	1	-	-
CO2	-	3	2	2	1	-	-	-	1	1	-	1
CO3	2	3	1	1	-	1	1	-	-	-	-	1
CO4	2	1	1	3	1	-	1	1	-	1	1	1

Acknowledgement

It is with great pleasure and honor that I share the curriculum for Third Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all-inclusive curriculum for Third Year of Computer Engineering.

Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to **Dr. Pramod D. Patil (Dr. D. Y. Patil Institute of Technology, Pimpri), member BoS, Computer Engineering**, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

Special thanks are due to Dr. Santosh Kumar Chobe, Dr. Jyoti Rao, Dr. Swati Nikam, Dr. C. R. Jadhav, Dr. S. S. Das, Dr. Rachna Somkunwar, Prof. Rajesh D. Bharati, Prof. Rupesh Mahajan for helping with the formatting and crisp presentation of this draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

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Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that's what makes the team stronger! You took the meaning of teamwork to a whole new level.

Thank you for all your efforts!

Professor (Mrs.) Dr. Varsha H. Patil, Chairman, and
Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University.

Task Force at Curriculum Design

Home

1. Advisors, the Team of Board of Studies-

Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Pramod Patil, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

2. Team Leader- Dr. Pramod D. Patil, Dr. D. Y. Patil Institute of Technology, Pimpri

3. Teams, Course Design-

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Computer Networks and Security	Dr. P. B. Kumbharkar	Dr. Aparna A. Junnarkar Dr. A.V. Dhumane Dr. Vinod V. Kimbahune	Prof. D. B. Gothwal Dr. M. L. Dhore
Elective I: Internet of Things and Embedded Systems	Dr. A. B. Pawar	Dr.Sandeep Chaware Dr. M.S.Chaudhari Dr. M.P. Wankhade	Mr.Rajnikant(Industry) Mr.Mahesh Aher(Industry)
Elective I: Human Computer Interface	Dr. S. D. Babar	Prof. Mrs. G. J. Chhajed Prof. D.D.Sapkal Prof. Mrs.Jayshree R. Pansare Mr. Mukesh Jain (Industry) Prof. Mrs. Shailaja N. Lohar	Prof. S. A. Thanekar Dr.Deepak Dharrao Dr. Ganesh Bhutkar Mr. Himmat Sankhala (Industry)
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Audit Course 5	Dr. Kishor Wagh	Dr. S. S. Das Dr. D. V. Patil	Dr. Sandeep Patil Dr. Bendre Mr. B. B. Gite
Data Science and Big Data Analytics	Dr. Sheetal Sonawane	Dr. H. K. Khanuja Prof. Devidas S. Thosar Dr. S. K. Shinde Mr. Anand Bhalerao (Industry) Mr. Amod Vaidya (Industry)	Dr. B. D. Phulpagar Dr. K. V. Metre Mr. Atul Bengeri (Industry) Mr. Summer Patil (Industry) Mr. Sanjeev Kumar (Industry)
Web Technology	Prof. Abhijit D. Jadhav	Prof. Jayvant Devare	Mr. Avinash Patil (Industry) Mr. Saikrishna Mamidishetty (Industry)
Artificial Intelligence	Dr. J. R. Prasad	Dr. Gayatri M. Bhandari Dr. V. P. Vikhe Dr. Snehal Mohan Kamalapur	Dr. K Rajeswari Dr.Mrs.Madhuri Potey
Elective II: Information Security	Dr. Swati Nikam	Dr Pathan Mohd Shafi Dr.Mininath Nighot Dr. Ms. K.C. Nalavade	Dr. Lomte Archana C. Dr. Amol Potgantwar Mr. Akshay Kokil (Industry)
Elective II: Augmented and Virtual Reality	Dr. (Mrs.) Nuzhat F. Shaikh	Prof.Sagar Balasaheb Shinde Prof. Shweta Ashish Koparde	Prof.Sanjay Agrawal Prof.Priyanka More Mr. Soumya Ranjan (Industry) Mr. Ravi Kiran (Industry)
Elective II: Cloud Computing	Dr. S. K. Sonkar	Prof. Abhijit D. Jadhav Dr. Pankaj Agarkar Dr. N. M. Ranjan	Dr. A. S. Rumale Prof. Thombre B. H. Mr.Ashok Pomnar (Industry) Mr.Santosh Ugale (Industry)
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Internship	Dr. Gitanjali V. Kale	Mr. Arun Kadekodi - (Industry) Mr.Nilesh Deshmukh - (Industry) Prof. Pradnya Kulkarni	Prof. Dheeraj Agrawal Prof. Pranjali Joshi
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Audit Course 6	Dr. Sangve Sunil M.	Dr. S. S. Das	Prof. Abhijit D. Jadhav

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Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Third Year Electrical Engineering (2019 course)

(w.e.f. 2021-22)

Savitribai Phule Pune University, Pune
Syllabus: Third Year (TE) Electrical Engineering (2019 course)
(w.e.f 2021-22)

SEMESTER-I

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303141	Industrial and Technology Management	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303142	Power Electronics	3	4#	0	0	30	70	0	50	0	150	3	2	0	0	5
303143	Electrical Machines-II	3	2	0	0	30	70	25	25	0	150	3	1	0	0	4
303144	Electrical Installation Design and Condition Based Maintenance	3	4#	0	0	30	70	25	0	25	150	3	2	0	0	5
303145	Elective-I	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303146	Seminar	0	0	0	1	0	0	50	0	0	50	0	0	0	1	1
303147	Audit course-V	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		**15**	**10**	**0**	**1**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**5**	**0**	**1**	**21**

303145: Elective-I	**303147 : Audit Course-V**
303145A : Advanced Microcontroller and Embedded System	303147A : Energy storage systems
303145B : Digital Signal Processing	303147B : Start-up & Disruptive innovation
303145C : Open Elective	

SEMESTER-II

Course code	Course Name	Teaching Scheme				Examination Scheme						Credit				
		Th	Pr	Tu	SEM /PW /IN	ISE	ESE	TW	PR	OR	Total	Th	Pr	Tu	SEM /PW /IN	Total
303148	Power System-II	3	2	1	0	30	70	25	50	0	175	3	1	1	0	5
303149	Computer Aided Design of Electrical Machines	3	4#	0	0	30	70	50	0	25	175	3	2	0	0	5
303150	Control System Engineering	3	2$	1$	0	30	70	25	0	25	150	3	1	0	0	4
303151	Elective-II	3	0	0	0	30	70	0	0	0	100	3	0	0	0	3
303152	Internship	0	0	0	4	0	0	100	0	0	100	0	0	0	4	4
303153	Audit Course VI	2*	0	0	0	0	0	0	0	0	0	GRADE: PP/NP				0
Total		12	8	2	4	120	280	200	50	50	700	12	4	1	4	21

303151: Elective-II	**303153 : Audit Course-VI**
303151A : IoT and its Applications in Electrical Engineering	303153A: Ethical Practices for Engineers
303151B : Electrical Mobility	303153B :Project Management
303 151C: Cybernetic Engineering	
303151D: Energy Management	

#Practical consists of Part A & part B. PART A; Regular experiments & part B; to bridge the gap between theory & actual industrial practices. For subject 303144; there will be auto cad drawing on Electrical installation, Electrical wiring, cabling etc. For 303149, Part A, Regular drawing by hand & part B same drawing by AutoCAD.
$ tutorial credit merged with Practical.
* Conduct over and above these lectures.

303141: Industrial and Technology Management

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Course Objectives: This course aims to

- Possess knowledge of types of business organizations.
- Explore the fundamentals of Industrial economics and Management.
- Understand the basic concepts of Technology management and Quality management.
- Analyze and differentiate between marketing management and financial management.
- Recognize the importance of Motivation, Group dynamics, Teamwork, leadership skill and entrepreneurship.
- Explain the fundamentals of Human Resource management.
- Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.
- Software programming to construct and use simple mathematical model.
- Ability to carry out basic manufacturing and testing procedure.

Course Outcomes: At the end of this course, student will be able to

CO1	Differentiate between different types of business organizations and discuss the fundamentals of economics and management.
CO2	Explain the importance of technology management and quality management.
CO3	Explain the importance of IPR and role of Human Resource Management.
CO4	Understand the importance of Quality and its significance.
CO5	Describe the characteristics of marketing & its types and overview of financial Management.
CO6	Discuss the qualities of a good leader and road map to Entrepreneurship.

Unit 01	**Introduction to Management and Economics**	**07 hrs**

A) Management: Meaning, scope, function, and importance of management. Difference between administration and management.

B) Industrial Economics: Definition of economics, Demand and Supply concept, Demand Analysis. Types of Demand, Determinants of Demand, Law of demand and supply, Elasticity of demand and supply, Law of Diminishing Marginal utility, Demand forecasting: Meaning and methods.

C) Business Organizations: Line organization, Staff organization and Functional Organization, (Project, Matrix, Committee Organization.)

D) Business Ownership and its Types: Types of business ownership, Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership) (Act 2008). One person company, Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU).

Unit 02	**Technology Management**	**05 hrs**

A) Technology Management: Definition of technology Management and its relation with society, development, application and its scope.

B) Classification of Technology Management: Classification of technology management at various levels- its importance on National Economy, Ethics in technology management, Critical factors in technology management.

Unit 03	**Intellectual Property Rights (IPR) & Human Resource Management (HRM)**	**06 hrs**

A) Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy rights and trademark (Descriptive treatment only).

B) Human Resource Management: Introduction, importance, scope, HR planning, Recruitment, selection, training and development, Performance management.

Unit 04	Quality Management	06 hrs
A) Quality Management: Definition of quality, continuous improvement, Types of quality, Quality of design, Seven QC Tools, Poka Yoke (Mistake Proofing), Quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma. Basic software used for inventory management and quality management like Zoho inventory, Oracal, Netsuite, Vyapar, Quick book commerce. **B) Quality Management Standards (Introductory aspects only):-** The ISO9001:2000 Quality Management System Standard-The ISO14001:2004, ISO26000, ISO 10004:2012, ISO 9001:2012 ISO 9001:2016, Environmental Management System Standard.		
Unit 05	**Marketing and Financial Management**	**06 hrs**
A) **Marketing Management**: Meaning of Market, Marketing strategy, motives, market characteristics and its types, Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. New product development, Product life cycle, Marketing and selling, methods of selling, marketing planning. Market survey and market research, Online Marketing (Digital Marketing). B) **Financial Management:** Definition of financial management, cost Concept, Types of costs (Fixed, Variable, average, marginal, and total cost) and methods of costing price, capital. Debit, credit, Profit and loss statement, Balance sheet, Depreciation Analysis, causes and significance, methods of calculation of depreciation, Taxation system, and type of taxes.		
Unit 06	**Motivational Theory and Entrepreneurship**	**06 hrs**
A) Motivation: Introduction to Motivation, theories of work motivation, Content Theories: Maslow's Hierarchy of Needs, Herzberg's Two factor theory, McClelland's Three Needs Theory, McGregor's Theory X and Theory Y. Process Theories: Adam's Equity Theory, Vroom's Expectancy Theory, Taylor's Motivation Theory **B) Leadership:** Importance of Leadership, Types of Leadership: Autocratic, Democratic and Laissez-Faire Leadership, qualities of good Leader. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning. **C) Entrepreneurship**: Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India.		

Test Books:

[T1]	O. P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.
[T2]	E. H. McGraw, S. J. Basic managerial skill for all.
[T3]	Tarek Khalil, Management of Technology Tata McGraw Hill Publication Pvt. Ltd.
[T4]	Prabuddha Ganguli Intellectual Property rights Tata McGraw Hill Publication Company
[T5]	Management Accounting and financial management by M. Y.Khan and P.K. Jain, Tata Mcgraw Hill-Tata-ISBN.

Reference Books:

[R1]	C. B. Mamoria and V. S. P. Rao- Personnel Management , Himalaya Publishing House, 30th Edition 2014.
[R2]	Harold Koonlz and OD'onnel–Management. Tata McGraw Hill Publication1980.
[R3]	Philip Kotler-Marketing Management. Pearson Edition 2008.
[R4]	Robert Heller, Managing Teams, Dorling Kindersley, London.
[R5]	Kelly John M, Total Quality Management, InfoTech Standard, Delhi.
[R6]	Joseph M. Juran, Juran's Quality Handbook TATA McGraw-Hill.
[R7]	Dale H. Bester field and Carol Bester field Total Quality Management Prentice Hall of India Pvt. Ltd.
[R8]	Shiv Sahai Singh [Editor] The Law of Intellectual Property rights.
[R9]	N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.
[R10]	Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Deepak

	Bhivpathki.
[R11]	Financial Management by I. M. Pandey, Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler-Marketing Management.

Unit	**Text Books**	**Reference Books**
Unit 1	T1	R2,R10
Unit 2	T1, T2,T3	R5
Unit 3	-	R3,R5,R6
Unit 4	T5	R3, R11
Unit 5	T1	R1,R2
Unit 6	T4	R8

303142: Power Electronics

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					PR	50 Marks

Prerequisite:

1. Knowledge of semiconductor material, basic electronics, diode, BJT, UJT, FET and its characteristics.
2. Working of Diode based rectifier, concept of RMS and average value
3. Use square notebooks for notes and plotting of waveforms.

Course Objectives: The course aims :-

To enable students to gain knowledge and understanding in the following aspects:

1. Fundamentals of power electronic devices and characteristics.
2. The concepts and operating principles of power electronics circuits.
3. Design procedures and techniques of power electronics systems.

Course Outcomes: At the end of this course, student will be able to

CO1	Develop characteristics of different power electronic switching devices.
CO2	Reproduce working principle of power electronic converters for different types of loads.
CO3	Choose the appropriate converter for different applications.

Unit 01	**Power Semi-Conductor Devices**	**06 hrs**

Construction, Static and dynamic Characteristics, specifications/rating of SCR , Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C & D), Protection (over voltage, over current, and Thermal), Gate Turn Off (GTO) Thyristor (Construction, Working and Application), TRIAC- four mode operation, triggering of TRIAC using DIAC, Application-light dimmer.

Unit 02	**Transistor based Devices and DC-DC converter**	**06 hrs**

Transistor based Devices: MOSFET & IGBT- Construction, working, Static and Dynamic Characteristics

DC-DC converter: Principle of operation of chopper, classification on the basis of operating quadrants (A, B, C, D, E), Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step-up Chopper and Numerical with RLE load. Buck Boost Chopper (Descriptive Treatment), Applications- Chargers for Battery operated vehicles.

Unit 03	**Single Phase AC-DC Converter**	**06 hrs**

Single phase Converter: Fully controlled converter, Half controlled converter (Semi- converter)- Operation of all converters with R & RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations, Single phase dual converter (Descriptive treatment only), Application-Speed control of DC motor.

Unit 04	**Three Phase Converter and AC Voltage Regulator**	**06 hrs**

Three phase converters: Fully controlled converter, Half controlled converter (Semi converter)- Operation of all converters with R, RL load, derivation of Average and RMS output voltage. Numerical based on output voltage and current calculations.

AC voltage regulator: Single phase AC Voltage regulator; operation with R and RL Load, derivation of Average and RMS output voltage. Concept of two stage AC voltage regulator (Descriptive treatment only).

Unit 05	**Single phase DC-AC Converter (Transistor based)**	**06 hrs**

Full bridge VSI, derivation of output voltage and current, Numerical, current source inverter with ideal switches and load commutated CSI, Voltage control techniques, Application- UPS.

Unit 06	Three phase DC-AC Converter (Transistor based)	06 hrs

Three phase VSI for 120^0 and 180^0 modes of operation and their comparison, PWM based VSI, voltage control and harmonic elimination techniques (Single Pulse Modulation, Multilevel Control), Multilevel Converter concept its classification (Neutral Point Clamped Converter, Flying Capacitor Converter, cascaded multilevel converter) and their comparison, Application- Speed control of 3 phase Induction motor.

Test Books:

[T1]	M. H. Rashid - Power Electronics 2nd Edition, Pearson publication.
[T2]	Ned Mohan, T.M. Undel and, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons.
[T3]	B.W. Williams: Power Electronics 2nd edition, John Wiley and sons.
[T4]	Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
[T5]	Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
[T6]	K. Hari Babu, Power Electronics, Scitech Publication.

Reference Books:

[R1]	Vedam Subramanyam - Power Electronics , New Age International , New Delhi
[R2]	Dubey, Donalda, Joshi, Sinha, Thyristorised Power controllers, Wiley Eastern New Delhi.
[R3]	M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill.
[R4]	Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
[R5]	L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
[R6]	J. Michael Jacob – Power Electronics Principal and Applications.
[R7]	M. H. Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
[R8]	V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.

Online Resources:

[O1]	NPTEL Web course and video course on Power Electronics by Dr. B. G. Fernandis, IIT, Mumbai.

Unit	Text Books	Reference Books
Unit 1	T5, T6	R3, R8, O1
Unit 2	T4, T5, T6	R3, R5, R6, R9, O1
Unit 3	T1, T5	R3, O1
Unit 4	T5, T6	R1, R7, O1
Unit 5	T1, T2, T3	R3, O1
Unit 6	T1, T2, T3	R3, O1

List of Experiments

Part A:

Minimum 8 hardware experiments to be conducted

1. Static VI characteristic of SCR / GTO.
2. Static VI characteristic of TRIAC.
3. Study of Gate firing circuits of SCR (R, RC & UJT).
4. Single phase Half controlled converter with R and RL load.
5. Single phase fully controlled converter with R load.
6. Single Phase fully controlled converter with and without Free Wheeling diode with RL load.

7. Three phase AC-DC fully controlled bridge converter R and RL load.
8. Study of DC step down chopper.
9. Single phase A.C. voltage regulator with R and RL load.
10. Output and Transfer Characteristic of MOSFET and IGBT (Both).
11. Three phase voltage source inverter using 120^0 and 180^0mode
12. Study of three phase inverter (VSI).

Part B:

Any 8 experiments to be conducted (either hardware or simulation)

1. Fabrication of buck converter/inverter/ac voltage regulator. (compulsory)
2. Study of 1-ø bridge inverter SPWM.
3. Study of Forced commutation circuits of SCR (Class C and Class D).
4. Study and design of SMPS.
5. Study of PWM controls of a single-phase inverter.
6. Power Quality Analysis (Harmonic and PF measurement) at AC side of Single phase controlled Converter.
7. Power Quality Analysis (Harmonic and PF measurement) at AC side of Three phase controlled Converter.
8. Performance analysis of three phase diode clamped Multilevel inverter.
9. Performance analysis of three phase cascaded H-Bridge Multilevel inverter.
10. Study of three phase Active power filter.
11. Study of Standalone/ Grid connected converters for interfacing of renewable energy sources.
12. Industrial Visit to Power Electronics manufacturing unit/Renewable energy power plant.

Guidelines for Instructor's Manual:

- Title and circuit diagram of power electronic switching device and converter circuit.
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit.
- Procedure to carry out the experiment.

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.
- Analyze and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory conduction

- Each group in the lab should have not more than three students.
- All the students in the group must do the connections and perform the practical under the guidance of the staff member.
- Staff member must check the result of all the groups.

303143: Electrical Machines-II						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**PR**	01	**ESE**	70 Marks
					PR	25 Marks
					TW	25 Marks

Prerequisite:

- Magnetic circuits, Force on current carrying conductor placed in magnetic field, Fleming Right Hand & Left Hand Rule.
- Working principle and construction DC Machines, transformer & 3-ph induction motor.
- Phasor diagram and equivalent circuit of single phase transformer.

Course Objectives: The course aims to:

- Learn construction & working principle of three phase synchronous machines and 1-ph induction motors.
- Calculate voltage regulation of Alternator by different methods.
- Study the applications of different machines in industrial, commercial & social sectors.
- Determine the performance indices of AC series & single phase motors by experimentation.

Course Outcomes: At the end of this course, student will be able to

CO1	Learn construction, working principle of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO2	Understand characteristics of three phase Synchronous Machines, Induction Motors, A.C. Series Motor and Special Purpose Motors.
CO3	Select the above machines in Power System, industrial, household & Military Engineering applications.
CO4	Testing of machines to evaluate the performance through experimentation.

Unit 01	**Three phase Synchronous machines.**	**06 hrs**

Three phase Synchronous machines:
Construction, rotating-field type and rotating-armature type, salient-pole and non-salient-pole type and their comparison. Excitation Methods.

Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation and winding factors (No derivation), rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation.

Three phase Synchronous generator (salient pole type):
Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of salient-pole generator and calculation of voltage regulation.

Unit 02	**Voltage regulation of Three phase Synchronous generator**	**06 hrs**

Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio.

Parallel operation of 3-phase alternators:
Necessity, conditions, Load sharing between two alternators in parallel (Descriptive treatment only). Process of synchronizing alternator with infinite bus-bar by lamp method (one dark & two equally

bright lamp method) and by the use of synchroscope, Synchronizing current, power and torque (no numerical).		
Unit 03	**Three phase synchronous motor**	**06 hrs**
Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant load and variable excitation (‘V’ curves and ‘inverted V’ curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Comparison of 3 phase synchronous motor with 3-phase induction motor.		
Unit 04	**3-ph induction motor, Induction generator and special purpose motors**	**06 hrs**
Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super Conducting Generator. **Special Purpose Motors :** Construction, principle of working, characteristics, ratings and applications of Brush less D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.).		
Unit 05	**A.C. series motor**	**06 hrs**
Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies. **Compensated series motor:** Compensating winding, conductively and inductively compensated motor. Approximate phasor diagram. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors. **Universal motors:** Ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.		
Unit 06	**Single phase induction motor**	**06 hrs**
Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run motor and permanent capacitor motor). Comparison of 1-phase induction motor with 3-phase induction motor.		

Test Books:	
[T1]	Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.
[T2]	S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.
[T3]	A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill
[T4]	P. S. Bimbhra, Electric Machinery, Khanna Publications.
[T5]	B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.
[T6]	B. L Theraja –Electrical Technology, Vol II , S. Chand publication.
[T7]	V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publication
[T8]	Krishna Reddy –Electrical Machines Vol.II and III, SCITECH publications.
[T9]	Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.
[T10]	M V Deshpande, Electrical Machines, Prentice Hall of India

Reference Books:

[R1]	M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS
[R2]	J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications
[R3]	Samarjit Ghosh, Electrical Machines, Pearson Publication.
[R4]	Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinery and Transformer, 3rd Edition, Oxford University Press.
[R5]	E G Janardanan, Special Electrical Machines, Prentice Hall of India.
[R6]	Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipment (Rotating Machines) Wiley publication.

Unit	**Text Books**	**Reference Books**
Unit 1	T1,T2,T6,T7,T9	R3
Unit 2	T4, T6,T7,T9	R2
Unit 3	T1,T4, T6,T7	R2,R4
Unit 4	T4, T6,T7,T9	R5,R6
Unit 5	T4,T6,T3	R1,R2
Unit 6	T2,T3, T6,T7,T9	R2,R3

Industrial Visit:

Compulsory visit to Synchronous Machines / Induction motor manufacturing company.

List of Experiments: To perform any eight experiments from the following list.

Compulsory experiments:

1. Determination of voltage regulation of cylindrical rotor alternator by a) EMF method b) MMF method.
2. Determination of voltage regulation of cylindrical rotor alternator by Potier method.
3. Determination of voltage regulation of salient pole alternator by slip test.
4. V and inverted V curve of synchronous motor at constant load.
5. Speed control of three phase induction motor by V/F method.

B) Optional experiments (any three)

1. Determination of voltage regulation of alternator by direct loading.
2. Load test on three phase synchronous motor.
3. Load test on Single -phase induction motor.
4. Load test on Single-phase series motor.
5. No load and blocked-rotor test on a single phase Capacitor-start induction motor and Determination of its equivalent circuit parameters.
6. Synchronization of three phase alternator by Lamp and Synchroscope methods.
7. Simulation of three phase induction motor on MATLAB to obtain its performance.
8. Speed control of three phase induction motor by rotor resistance control method.
9. Speed control of BLDC Motor.

Guidelines for Instructor's Manual:

Prepare 3/4 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges etc.

Theory: Brief theory explaining the experiment.

Circuit / connection diagram or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.

Procedure: Write down step by step procedure to perform the experiment.

Observation table:

Sample calculation: For obs. number ---

Result table:

Nature of graph:
Conclusion:
Questions / Answers: Write minimum 4 /5, questions / answers based on each experiment.
Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
(Use black or blue ink pen for writing.)

Guidelines for Laboratory conduction

1. Check the whether the MCB / main switch is off.
2. Students should go through the name plates of machines.
3. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
4. Perform the experiment only in presence of teacher or Lab Assistant.
5. Do the calculations and get it checked from the teacher.
6. After completion of experiment, switch off the MCB / main switch.
7. Write the experiment in the journal and get it checked within week.

303144: Electrical Installation, Design and Condition Based Maintenance

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**PR**	02	**ESE**	70 Marks
					OR	25 Marks
					TW	25 Marks

Prerequisite:

Basic Electrical Engg, Power System 1, Electrical Machines I and Electrical Machines II.

Course Objectives: The course aims: -

1. To classify different types of distribution supply system and determine economics of distribution system.
2. To compare and classify various substations, bus-bars and Earthing systems.
3. To demonstrate the importance and necessity of maintenance.
4. To analyze and test different condition monitoring methods.
5. To carry out estimation and costing of internal wiring for residential and commercial installations.
6. To apply electrical safety procedures.

Course Outcomes: At the end of this course, student will be able to

CO1	Classify different types of distribution supply system and determine economics of distribution system. compare and classify various substations, bus-bars and Earthing systems.
CO2	Demonstrate the importance and necessity of maintenance.
CO3	Analyse and test different condition monitoring methods.
CO4	Carry out estimation and costing of internal wiring for residential and commercial installations.
CO5	Apply electrical safety procedures.

Unit 01	**Economics of Distribution Systems:**	**06 hrs**

Classification of supply systems (State Only)
(i) DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical). Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical). Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02	**Substation and Earthing**	**06 hrs**

Substation: Classification of substations, Various equipment used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.
Earthing: Necessity of Earthing, Types of Earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation Earthing grid as per IEEE standard 80-2013.

Unit 03	**Maintenance and Condition Monitoring**	**08 hrs**

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors,

Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipment. Advance tools and techniques of condition monitoring, Thermography. Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, on load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis. Hot Line Maintenance - Meaning and advantages, special types of non-conducting Materials used for tools for hot line maintenance.		
Unit 04	**Basics of Estimation and Costing**	**04 hrs**
Purpose of estimating and costing, qualities of good estimator, essential elements of estimating and costing, tender, guidelines for inviting tenders, quotation, price catalogue, labor rates, schedule of rates and estimating data (only theory),		
Unit 05	**Installation and estimation of distribution system**	**06 hrs**
Introduction cable sizing, Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numerical) installations and estimate for underground LT service lines.		
Unit 06	**Testing and Electrical Safety**	**06 hrs**
Understanding CAT Ratings & Using CAT rated Instrument, Electrical Installation Testing Procedures- Insulation resistance test between installation and earth, Insulation resistance test between conductors (use of GUARD Terminal in IR test & Application) (methods used for IR Testing) Testing of polarity, Testing of earth continuity paths (Applications of PAT Tester "Portable Appliance Tester" in commercial like hotels, hospital & Industry also) and Earth resistance test (methods for earth testing 2-pole, 3-pole new methods clamp on type where we can performs test in Live) Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area. *(Introduction to OSHA)*		

Test Books:	
[T1]	B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.
[T2]	S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.
[T3]	S. L. Uppal - Electrical Power - Khanna Publishers Delhi.
[T4]	Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).
[T5]	S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.
[T6]	B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.
[T7]	Hand book on Electrical Safety.
Reference Books:	
[R1]	P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.
[R2]	S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.
[R3]	Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.
[R4]	Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi
[R5]	B.D. Arora-Electrical Wiring, Estimation and Costing, - New Heights, New Delhi.
[R6]	M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.
[R7]	S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication .
[R8]	Power Equipment Maintenance and Testing (Power Engineering Book 32) by Paul Gill

Unit	Text Books	Reference Books
Unit 1	T1, T3	R1, R7
Unit 2	T1, T2, T3	R1, R4, R6
Unit 3	T2, T4, T5, T6	R6, R7, R8
Unit 4	--	R2, R3, R4, R5
Unit 5	T1, T3	R2, R3, R4, R5
Unit 6	T7	R8

List of Experiments

Part-A: (Any Eight of the following)

1) Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2) Study of thermograph images and analysis based on these images.
3) Practice of Earthing and Measurement of Earth resistance of Campus premises by using 4 Pole, 3 Pole, new technology practicing in industry clamp on method.
4) Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe Earthing. (Drawing sheets 1 using AutoCAD or other CAD software)
5) Assignment on design of Earthing grid for 132/220 kV substation.
6) Design and estimation of light and power circuit of labs/industry.
7) Measurement of insulation resistance of motors and cables.
8) Precautions from Electric shock and method of shock treatment.
9) Using of Installation Multifunction Testers for RCD testing, Phase Sequence Indication, Insulation resistance measurement, Continuity testing.
10) Use REVIT / any BOQ (Bill of Quantity) estimation software for estimation and costing
11) Design and estimation of light and power circuit of residential wiring.

Part-B:(Any 4 out of these)

1) Estimation and costing for 11 kV feeders and substation. (voltage drop calculation, SLD, substation layout)
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (**Any one**). i) Three phase induction motor ii) Transformer iii) Power Cable
3. Trouble shooting of household equipment – Construction, working and troubleshooting of any two household Electrical equipment's (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults) (Here we perform Practical by using PAT Testers)
4) Design, Estimation and costing of Earthing pit and Earthing connection for computer lab, Electrical Machines Lab.
5) Wiring installation and maintenance of pump motor.
6) Activity: Interview of Electrical maintenance personnel/Technician/Electrician.
7) Activity: Safety awareness for housing societies/schools/Junior colleges.
8) Activity: Preparation of Tender notice and studying the Tender notices published in newspapers.
9) Any innovative activity related to EIDCBM syllabus.

Industrial Visit (if any): Visit to substation/ installation sites.

303145A: Elective-I: Advanced Microcontroller and Embedded System

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	TH	03	ISE	30 Marks
					ESE	70 Marks

Prerequisite:

1. Knowledge of Number system and Basic logic components.
2. Programming basics of C language.
3. Advantage of Microcontroller over Microprocessor.

Course Objectives: The course aims to:

1. Help Students understand Architecture of PIC 18F458 microcontroller.
2. Create and enhance ability to write and Interpret Assembly and C language for PIC 18F458.
3. Make students understand procedure to interface peripherals with PIC 18F458 for various Applications.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain architecture of PIC 18F458 microcontroller, its instructions and the addressing modes.
CO2	Use Ports and timers for peripheral interfacing and delay generation.
CO3	Interface special and generate events using CCP module.
CO4	Effectively use interrupt structure in internal and External interrupt mode.
CO5	Effectively use ADC for parameter measurement and also understand LCD interfacing.
CO6	Use Serial Communication and various serial communication protocols.

Unit 01	**PIC Architecture and Embedded C**	**07 hrs**

Comparison of CISC and RISC Architectures, Data and Program memory organization, Program Counters, Stack pointer, Bank Select Register, Status register, Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations.

Unit 02	**Port and Timer 0 Programming**	**05 hrs**

I/O Ports and related SFRs, I/O port programming in C. PIC 18 Timer 0 Programing in C. Delay programming (with and without Timer0). LED Interfacing and its programming.

Unit 03	**CCP Module and its applications**	**06 hrs**

CCP module in PIC 18 microcontroller, Timers required for CCP Applications, Applications of CCP mode Generation of Square waveform using Compare mode of CCP module. Period measurement of unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module.

Unit 04	**Interrupt structure and its Programming**	**05 hrs**

Interrupt Programming, Programming of Timer0 interrupts, Programming of External interrupts INT0.

Unit 05	**ADC structure and LCD interfacing**	**07 hrs**

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and Power. Using PIC microcontroller. Interfacing of LCD (16x2) in 4 bit mode.

Unit	**Serial Communication and its protocols**	**06 hrs**

06		
Serial Communication structure and its programming (Data transmit and Receive), Introduction to Communication protocols as SPI and MODE BUS		

Test Books:

[T1]	PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.
[T2]	Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.
[T3]	Programming And Customizing the PIC Microcontroller by Myke Predko, TATA McGraw-Hill.
[T4]	PIC microcontroller: An introduction to software and Hardware interfacing by Han-Way-Huang Thomson Delmar Learning.
[T5]	Microcontroller Theory and Applications with PIC18F, M. Rafiquzzaman, John Wiley and Sons

Reference Books:

[R1]	PIC18F458 datasheet
[R2]	MPLAB IDE user guides
[R3]	MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall

Unit	Text Books	Reference Books
Unit 1	T1,T2,T3,T4	R1
Unit 2	T1, T2,T3,T4,T5	R1,R2
Unit 3	T1,T4,T5	R1
Unit 4	T1,T2,T3,T4	R1
Unit 5	T1,T2,T3,T4	R1
Unit 6	T1,T2,T3,T4	R1,R3

303145B: Elective-I: Digital Signal Processing

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Knowledge of basic signals and systems

Course Objectives: The course aims:

1. To introduce discrete signals and systems.
2. To ability to analyse DT signals with Z transform, DTFT and DFT.
3. To introduce Digital filters and analyze the response.
4. To explore DSP Applications in electrical engineering.

Course Outcomes: At the end of this course, student will be able to

CO1	Analyse discrete time signals and systems.
CO2	Construct frequency response of LTI system using Fourier Transform.
CO3	Design and realize IIR and FIR filters.
CO4	Apply concepts of DSP in applications of electrical engineering.

Unit 01	Discrete time signal and system	06 hrs

Analog, Discrete-time and Digital signals, Basic sequences and sequence operations, Discrete time systems, Properties of D. T. Systems and Classification, Linear Time Invariant Systems, impulse response, linear convolution and its properties, properties of LTI systems: stability, causality, Periodic Sampling, Sampling Theorem, Frequency Domain representation of sampling, reconstruction of a band limited Signal, A to D Conversion Process: Sampling, quantization and encoding.

Unit 02	Z and Inverse Z transform	06 hrs

Revision of Z-transform, Numerical of Z transform, Inverse Z transform using partial fraction and power series method, Linear constant coefficient difference equations, solution of difference equation, stability and causality using ROC of Z-transform.

Unit 03	Discrete Time Fourier Transform	06 hrs

Representation of Sequences by Fourier Transform, Symmetry properties of D. T., F. T. theorems: Linearity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, Frequency response analysis of first and second order system, steady state and transient response.

Unit 04	Discrete Fourier Transform	06 hrs

Sampling in frequency domain, The Discrete Fourier Transform, Relation with z transform Properties of DFT: Linearity, circular shift, duality, symmetry, Circular Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT.

Unit 05	Design of IIR filter	06 hrs

Ideal frequency selective filters, Concept of filtering, specifications of filter, IIR filter design from continuous time filters: Characteristics of Butterworth and Chebyshev, impulse invariant and bilinear transformation techniques, Design examples (Butterworth low pass filter) , Basic structures for IIR Systems: direct form, cascade form

Unit 06	Design of FIR Filter and DSP Applications	06 hrs

A) Specifications of properties of commonly used windows, Design Examples using rectangular and hanning windows. Basic Structures for FIR Systems: direct form. Comparison of IIR and FIR Filters.
B) Applications: Measurement of magnitude and phase of voltage, current, power, frequency and power factor correction, harmonic Analysis and measurement, applications to machine control, DSP based protective relaying.

Test Books:

[T1]	Proakis J., Manolakis D., "Digital signal processing", 3rd Edition, Prentice Hall, ISBN 81-203-0720-8.
[T2]	P. Ramesh Babu, "Digital Signal Processing", 4th Edition SciTech Publication.

[T3]	Dr. S. D. Apte, "Digital Signal Processing",2nd Edition Wiley India Pvt. Ltd ISBN: 97881-265-2142-5
[T4]	W. Rebizant, J. Szafran, A. Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0
Reference Books:	
[R1]	Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2]	A.V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete Time Signal Processing", 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3]	Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists",1st Edition Elsevier, ISBN: 9780750674447

Unit	Text Books	Reference Books
Unit 1	T1,T2	R1, R2, R3
Unit 2	T1,T2	R2, R3
Unit 3	T1,T2	R2, R3
Unit 4	T1,T2	R2, R3
Unit 5	T1,T2,T3	R1,R2,R3
Unit 6	T2, T4	R3

303146: Seminar

Teaching Scheme			Credits		Examination Scheme	
SEM	01	Hr/Week	**SEM**	01	**TW**	50 Marks

Course Objectives:

1. Gaining of actual knowledge (terminology, classification, methods and advanced trends)
2. Learning fundamental principles, generalization or theories.
3. Discussion and critical thinking about topics of current intellectual importance.
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

Course Outcomes: At the end of this course, student will be able to

CO1	Relate with the current technologies and innovations in Electrical engineering.
CO2	Improve presentation and documentation skill
CO3	Apply theoretical knowledge to actual industrial applications and research activity.
CO4	Communicate effectively.

Seminar should be based on a detailed study of any topic related to the advance areas/applications of Electrical Engineering. Topic should be related to Electrical Engineering. However, it must not include contents of syllabus of Electrical Engineering. It is expected that the student should collect the information from journals, internet and reference books in consultation with his/her teacher/mentor, have rounds of discussion with him/her. The report submitted should reveal the student assimilation of the collected information. Mere compilation of information from the internet and any other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly typed on white paper. The typing shall be with normal spacing, Times New Roman (12 pt) font and on one side of the paper. (A-4 size).
2. Illustrations downloaded from internet are not acceptable.
3. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
4. Front cover: This shall have the following details with Block Capitals
    a. Title of the topic.
    b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
    c. Name of the guide with designation below the candidate's details.
    d. The name of the institute and year of submission on separate lines at the bottom.
5. Certificate from institute as per specimen, Acknowledgement and Contents.
6. The format of the text of the seminar report should be as follows
    I. The introduction should be followed by literature survey.
    II. The report of analytical or experimental work done, if any.
    III. The discussion and conclusions shall form the last part of the text.
    IV. They should be followed by nomenclature and symbols used.
    V. The Reference Books are to be given at the end.
7. The total number of typed pages, excluding cover shall from 20 to 25 only.
8. All the pages should be numbered.
9. Two spiral bound copies of the seminar report shall be submitted to the college.
10. Candidate shall present the seminar before the examiners.
11. The total duration of presentation and after-discussion should be about 30 minutes.

The assessment for the subject shall be based on:

1. Content. 2. Presentation 3. Report

Rubrics for assessment

	Does not meet criterion	Meets criterion somewhat	Meets criterion fully
Content			
Background/Intro is sufficient to understand how this project fits into larger field	0	1	2
Description of methodology is sufficient for audience to understand the procedure	0	1	2
Explanations are understandable/clear	0	1	2
Conclusions stated are supported to topic	0	1	2
References/Sources are cited correctly	0	1	2
Audience questions are answered honestly (i.e. no bluffing or guessing)	0	1	2
Presentation Quality			
Speaking is understandable/clear	0	1	2
Speaker can answer questions professionally	0	1	2
Speaker makes eye contact with audience	0	1	2
Speaker uses professional body language	0	1	2
Visuals/PPT are clear and readable	0	1	2
Visuals/PPT have appropriate amount of text, diagrams	0	1	2
Visuals/PPT are free of errors/typos	0	1	2
Report Writing			
Abstract is meaningful	0	1	2
Graphs/diagrams are labeled completely	0	1	2
References/Sources are cited correctly	0	1	2
At least one reference is from a journal	0	1	2
Grammar is correct	0	1	2
Spelling is correct	0	1	2
Report format is clear	0	1	2
Total	______/40 (convert to 50)		

303147A: Audit Course V: Energy Storage System						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Batteries, Inductor and Capacitor.

Course Objectives:

To elaborate various energy storage systems
To be familiar with various aspects such as hybridization, selection of storage system.

Course Outcomes: At the end of this course, student will be able to

CO1	Explain and differentiate various types of energy storage for suitable applications
CO2	Understand battery recycling techniques

Unit 01	**Energy Storage Fundamentals**	**12 hrs**

(A) Battery: Energy Density, Power Density, Cycle life, C-rate, State of Charge (SoC), State of Health (SoH), Depth of Discharge (DoD), Characteristic.
(B) Types of Batteries: Nickel Metal Hydrate, Nickel Cadmium, Lithium ion, Lithium Polymer, Flow Batteries (Vanadium, Zinc, Manganese)
(C) Super capacitor, Superconducting Magnetic Energy Storage, Compressed Air Energy Storage, Flywheel storage
(D) Hybridization of energy storage

Energy storage sizing, Selection of storage as per application

Unit 02	**Recent Trends in Storage**	**12 hrs**

Solid state batteries, Aluminum air and Aluminum ion batteries, Lithium ion Capacitor, Advances in Thermal energy storage systems. Batteries recycling techniques and policies, Case studies.

Reference Books:

[R1]	Handbook of Energy Storage: Demand, Technologies, Integration Michael Sterner, Ingo Stadler.
[R2]	Energy Storage: Fundamentals, Materials and Applications, Robert Huggins.

Industrial Visit: Manufacturing industry of battery or Capacitor.

303147B: Start-up and Disruptive Innovations

Teaching Scheme			Credits		Examination Scheme	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Course Objectives:

To learn fundamentals related to Start-up and initiatives taken by government along with policies.
To understand Disruptive technologies.

Course Outcomes: At the end of this course, student will be able to

CO1	Describe role of incubation for Startup and recent national policy.
CO2	Identify various types of Startups.
CO3	Explain impacts of disruptive innovation and Differentiate between disruptive innovation and disruptive technology

Unit 01	**Start-up**	**12 hrs**

Startup Fundamentals

Startup: Stages of startup life cycle, business model, business plan, Business incubation, Startup financing life cycle, Funding options for startup, Market, Market Segments.

Entrepreneurship: Types of Entrepreneurship: Social, Rural, Women, Agri-preneurship. Factors affecting Entrepreneurship Growth

Government Initiatives and Policies

Initiatives taken by the government, Startup India Scheme, National Innovation and Startup Policy 2019, Approvals and other regulatory processes, Challenges faced by startups in India, Students Startup, Faculty Startup.

Types of Startups and Case Studies

Types of Startups: E-commerce Startups, EdTech Startups, FinTech Startups, Food and Beverages Startups, Health Care Startups, Block chain Startups etc.

Case study : Airbnb, Paytm, Byju, Zomato, Red bus, Ola, Razorpay

Unit 02	**Disruptive Technologies**	**12 hrs**

Disruptive Innovation Fundamental

What is invention? What is innovation? Defining Disruptive Innovation, Sustaining Innovation, Disruptive Innovation Theory, Disruptive innovation model, Disruptive strategy, Impact of Disruptive Innovation, Requirements of Disruptive Innovation, Types of Disruptive Innovations.

Inventor vs. Entrepreneur vs. Manager: Schumpeter's Trumpeters

Schumpeter's "creative destruction"

Maslow's Hierarchy of Needs Revisited, Disrupting Brands, Disrupting Religion.

Disruptive Technologies

Agricultural Revolution, Scientific Revolution, Industrial Revolution, Digital Revolution

Disruptive Innovation Vs Disruptive Technology

IoT, AI, Cloud Computing, Digital Twin, CRISPR, Block chain, 3D printing, Advanced Energy Storage, Hyperloop, Autonomous Vehicles, Nano technology, Industrial Automation (Industry 4.0)

Reference Books:

[R1]	The $100 Startup : Reinvent the Way you Make a Living, Do What You Love and Create a New Future, Chris Guillebeau
[R2]	Creating a Successful Business Plan, Entrepreneur Magazine
[R3]	Thomas Kuhn and The Theory of Scientific Revolutions revisited, CRC Press
[R4]	P. Armstrong. Disruptive Technologies: Understand, Evaluate, Respond Kogan Page Publishers. (2017)
[R5]	Innovator's Solution: Creating and Sustaining Successful Growth – Clayton Christensen, 16 December 2013
[R6]	Digital Disruption: Unleashing the Next Wave of Innovation – James McQuivey, 26

	February 2013
Online Resources:	
[O1]	https://ipindia.gov.in/
[O2]	https://www.wipo.int/about-ip/en/
[O3]	https://www.weforum.org/agenda/2016/06/what-is-disruptive-innovation/

303148: Power System-II

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**	01	**PR**	50 Marks
					TW	25 Marks

Note: TW marks: 15 for Tutorial and 10 for continuous assessment of lab work

Prerequisite:

Power Generation Technology, Power System-I, Electrical machine I and II

Course Objectives:

1) Develop analytical ability for Power system.
2) Introduce concept of EHVAC and HVDC System.
3) Demonstrate different computational methods for solving problems of load flow.
4) Analyze the power system under symmetrical and Unsymmetrical fault conditions.

Course Outcomes: At the end of this course, student will be able to

CO1	Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
CO2	Calculate per unit values and develop Y bus for solution power flow equations in power transmission networks
CO3	Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

Unit 01 — Performance of Transmission Lines — 06 hrs

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow.

Unit 02 — EHVAC Transmission — 05 hrs

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.

Unit 03 — Per Unit System and Load Flow Analysis — 07 hrs

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.
Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using bus incidence matrix method, Numerical based on Y bus Matrix, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (polar method) Decoupled and Fast decoupled load flow (descriptive treatment only).

Unit 04 — Symmetrical Fault Analysis — 06 hrs

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical

Based on symmetrical fault analysis.		
Unit 05	**Unsymmetrical Fault Analysis**	**07 hrs**
Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedance of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.		
Unit 06	**HVDC Transmission**	**05 hrs**
Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.		
Test Books:		
[T1]	I.J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.	
[T2]	B R Gupta , "Power System Analysis and Design", S. Chand.	
[T3]	Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition.	
[T4]	J. B. Gupta. "A course in power systems" S.K. Kataria Publications.	
[T5]	P.S.R. Murthy, "Power System Analysis", B.S. Publications	
Reference Books:		
[R1]	H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.	
[R2]	G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.	
[R3]	M. E. El- Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.	
[R4]	Rakash Das Begamudre, "Extra High voltage A.C. Transmission Engineering", New age publication.	
[R5]	M. A. Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.	
[R6]	Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.	
[R7]	K. R. Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.	
[R8]	Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.	
[R9]	V. K. Chandana, Power Systems, Cyber tech Publications.	
[R10]	P. Kundur, Power System Stability And Control, McGraw Hill	
Online Resources:		
[O1]	NPTEL Course on power system engineering:Debpriya Das https://nptel.ac.in/courses/108/105/108105104/	
[O2]	NPTEL Course on power system analysis By Dr. A.K. Sinha https://nptel.ac.in/courses/108/105/108105067/	
[O3]	NPTEL Course on power system analysis By Dr. Debpriya Das https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee72/	

Unit	Text Books	Reference Books
Unit 1	T1, T4	R1, R2, R3, R10
Unit 2	T2	R3, R4
Unit 3	T1, T3, T4	R1, R2, R3, R6, R8, R10
Unit 4	T3, T4	R1, R2, R3, R6, R8, R9, R10
Unit 5	T3	R1, R2, R3, R6, R8
Unit 6	T2, T3, T4	R3, R7, R9, R10

Industrial Visit:

Compulsory visit to EHV-AC substation/ HVDC substation

List of Tutorial: (Minimum 10 Tutorial should be conducted) (Maintain Record in file or separate notebook)

(Such types of numerical also in INSEM and ENDSEM examination)

1) ABCD parameters of long transmission line--(3 numerical)
2) power flow using generalized constant--(3 numerical)
3) power flow and losses in EHVAC transmission line for specified ratings. --(3 numerical)
4) Determination of Y-bus for three, four and five bus system--(3 numerical)
5) Load flow analysis using NR method for three bus system (1 numerical)
6) Calculation of symmetrical fault current and determine value of current limiting reactor suitable for given circuit breaker rating (2 numerical)
7) Determination of line/phase current, voltage and power calculation using symmetrical component. (4 numerical)
8) Calculation of unsymmetrical fault current (4 numerical)
9) Write a report on different HVDC project in India / world wide
10) Solve challenging questions related to syllabus (5 numerical)
11) Receiving end Power Circle diagram (1 Numerical)

List of Experiments

List of Experiments (Compulsory experiments):

1. Measurement of ABCD parameters of a medium transmission line with magnitude and angle.
2. Measurement of ABCD parameters of a long transmission line with magnitude and angle.
3. Performance study of the effect of VAR compensation using capacitor bank on the transmission line.
4. Formulation and calculation of Y- bus matrix of a given system using software.
5. Static measurement of sub-transient reactance of a salient-pole alternator.
6. Measurement of sequence reactance of a synchronous machine (Negative and zero).

Any three experiments are to be performed out of following:

1. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
2. Solution of a load flow problem using Newton-Raphson method using software.
3. Simulation of Symmetrical fault of single machine connected to infinite bus.
4. Simulation of Unsymmetrical fault of single machine connected to infinite bus.
5. Simulation of HVDC system.

Guidelines for Instructor's Manual:

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.

- Graph and Conclusions.
- Few questions related to the experiment.

Guidelines for Student's Lab Journal

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

There should be continuous assessment for the TW.

- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

303149: Computer Aided Design of Electrical Machines

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	04	Hr/Week/batch	**TU**	00	**ESE**	70 Marks
Tutorial	00	Hr/Week/batch	**PR**	02	**OR**	25 Marks
					TW	50Marks

Prerequisite:

1. Knowledge of fundamentals of electrical engineering.
2. Knowledge of various materials used in electrical machines.
3. Knowledge of types, construction and working of transformer.
4. Knowledge of types, construction and working of three phase induction motor.

Course Objectives: The course aims to:-

1. Design of transformer based on specifications.
2. Determine performance based on the parameters of transformer.
3. Design of Induction motor based on specifications.
4. Determine performance based on the parameters of Induction motor.
5. Apply computer aided design techniques to transformer and induction motor design.

Course Outcomes: At the end of this course, student will be able to

CO1	Summarize temperature rise, methods of cooling of transformer and consider IS 2026 in transformer design.
CO2	Design the overall dimensions of the transformer.
CO3	Analyze the performance parameters of transformer.
CO4	Design overall dimensions of three phase Induction motor
CO5	Analyze the performance parameters of three phase Induction motor.
CO6	Implement and develop computer aided design of transformer and induction motor.

Unit 01 | Transformer Design: Part 1 | 06 hrs

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Methods of cooling of transformer. Types and constructional features of core and windings used in transformer. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of three phase transformers as per IS 2026 (Part I). Introduction to computer aided design

Unit 02 | Transformer Design: Part 2 | 06 hrs

Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of core, estimation of overall dimensions of frame and windings of transformer. Design of tank with cooling tubes.

Unit 03 | Performance parameters of Transformer | 06 hrs

Estimation of resistance and leakage reactance of transformer. Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04 | Three phase Induction Motor Design:Part1 | 06 hrs

Specifications and constructional features. Types of ac windings. Specific electrical and magnetic loadings, ranges of specific loadings. Output equation with usual notations. Calculations for main dimensions, turns per phase and number of stator slots.

Unit 05 | Three phase Induction Motor Design:Part2 | 06 hrs

Suitable combinations of stator and rotor slots. Selection of length of air gap, factors affecting length of air gap. Design of rotor slots, size of bars and end rings for cage rotor. Conductor size, turns and area of rotor slots for wound rotor.

Unit 06 | Performance parameters of Three Phase Induction motor | 06 hrs

Leakage flux and leakage reactance: Slot, tooth top, zig - zag, overhang. Leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency. Computer aided design of induction motor, generalized flow chart for design of induction motor.

Test Books:

[T1]	M. G. Say–Theory and Performance and Design of A.C. Machines,3rd Edition, ELBS London.
[T2]	A.K. Sawhney–A Course in Electrical Machine Design, -Dhanpat Rai and sons New Delhi
[T3]	K. G. Upadhyay- Design of Electrical Machines, New age publication
[T4]	R. K. Agarwal–Principles of Electrical Machine Design, S. K. Katariya and sons.
[T5]	Indrajit Dasgupta –Design of Transformers–TMH

Reference Books:

[R1]	K. L. Narang, A Text Book of Electrical Engineering Drawings, Reprint Edition, Satya Prakashan, New Delhi.
[R2]	A Shanmuga sundaram,G. Gangadharan, R. Palani,-Electrical Machine Design Data Book,3rd Edition, 3rd Reprint 1988- Wiely Eastern Ltd.,- New Delhi
[R3]	Vishnu Murti, "Computer Aided Design for Electrical Machines", B. S. Publications.
[R4]	Bharat Heavy Electricals Limited, Transformers - TMH.

Unit	**Text Books**	**Reference Books**
Unit 1	T1,T2,T4,T5	R1,R2,R4
Unit 2	T1,T2,T4,T5	R1,R4
Unit 3	T2,T5	R3,R4
Unit 4	T1,T2,T3,T4	R1,R2,R3
Unit 5	T2	R3
Unit 6	T2	R3

Industrial Visit:

Industrial visit to a transformer and Induction motor manufacturing/repairing unit.

List of Experiments

1. Details and assembly of transformer with design report. (Sheet in CAD)
2. Details and layout of single layer three phase winding with design report. (Sheet in CAD)
3. Details and layout of double layer three phase winding with design report. (Sheet in CAD)
4. Details and layout of three phase mush winding with design report. (Sheet in CAD)
5. Assembly of three phase induction motor. (Sheet in CAD)
6. Use of Finite Element Analysis(FEA) software for analysis of electrical machines, the report should include:

a. Schematic diagram (Diagram/FEA model/Layout)

b. Current/Flux/Force/Heat distribution.

c. Analysis by variation of design parameters.

7. Report based on transformer manufacturing/repairing unit.
8. Report based on induction motor manufacturing/repairing unit.

Guidelines for Instructor's Manual:

Theinstructor'smanualshouldcontainfollowingrelatedtoeverydrawingsheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.

6. Few short questions related to design.
7. A3 size sheet to be used for CAD drawing.

Guidelines for Student's Lab Journal

TheStudent'sLabJournalshouldcontainfollowingrelatedtoeverydrawingsheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.
7. A3 size sheet to be used for CAD drawing.

Guidelines for Laboratory conduction

1. There should be continuous assessment for the Lab/TW
2. Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to design as per the problem statement.
3. Timely submission of design report and sheet.

303150: Control System Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
Practical	02	Hr/Week/batch	**TU**	01	**ESE**	70 Marks
Tutorial	01	Hr/Week/batch	**PR**		**OR**	25 Marks
					TW	25 Marks

Prerequisite:

Laplace Transform, Ordinary differential equations.

Course Objectives: The course aims to:-

- To understand basic concepts of the classical control theory.
- To model physical systems mathematically.
- To analyze behavior of system in time and frequency domain.
- To design controller to meet desired specifications.

Course Outcomes: At the end of this course, student will be able to

CO1	Construct mathematical model of Electrical and Mechanical system using differential equations and transfer function and develop analogy between Electrical and Mechanical systems.
CO2	Determine time response of systems for a given input and perform analysis of first and second order systems using time domain specifications.
CO3	Investigate closed loop stability of system in s-plane using Routh Hurwitz stability criteria and root locus.
CO4	Analyze the systems in frequency domain and investigate stability using Nyquist plot and Bode plot
CO5	Design PID controller for a given plant to meet desired time domain specifications.

Unit 01	**Basics of Control System**	**07 hrs**

Basic concepts of control system, classification of control systems, types of control system: feedback, tracking, regulator system, feed forward system, transfer function, concept of pole and zero, modeling of Electrical and Mechanical systems (Only series linear and rotary motion) using differential equations and transfer function , analogy between electrical and mechanical systems, block diagram algebra, signal flow graph, Mason's gain formula.

Unit 02	**Time domain analysis**	**06 hrs**

Concept of transient and steady state response, standard test signals: step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input, time domain specifications of second order systems, derivation of time domain specifications for second-order under-damped system for unit step input, steady state error and static error coefficients.

Unit 03	**Stability analysis and Root Locus**	**05 hrs**

Concept of stability: BIBO, nature of system response for various locations of poles in S-plane. Routh's-Hurwitz criterion. Root Locus: Angle and magnitude condition, Basic properties of root locus. Construction of root locus, Stability analysis using root locus.

Unit 04	**Frequency domain analysis-I**	**06 hrs**

Introduction, Frequency domain specifications, correlation between time and frequency domain specifications, polar Plot, Nyquist plot, stability analysis using Nyquist plot.

Unit	**Frequency domain analysis-II**	**06 hrs**

05		
Introduction to Bode plot, Asymptotic approximation: sketching of Bode plot, stability analysis using Bode plot.		
Unit 06	**PID controllers and Control system components**	**06 hrs**
Basic concept of P, PI, PID controller, design specifications in time domain and frequency domain. design of PID controller by Root Locus, tuning of PID controllers using Ziegler-Nichol Methods Control System Components: Working principle and transfer function of Lag network, lead network, potentiometer, DC servo motors.		

Test Books:

[T1]	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 6th edition, 2017.
[T2]	Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.
[T3]	Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011
[T4]	R. Anandanatrajan and P. Ramesh Babu, "Control Systems Engineering", Scitech Publication,3rd edition, 2011
[T5]	C. D. Johnson, "Process Control Instrumentation Technology, 8th edition, PHI Learning Pvt. Ltd., 2013

Reference Books:

[R1]	B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.
[R2]	Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.
[R3]	D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.
[R4]	B. Wayne Bequette, "Process Control: Modeling, Design and Simulation", PHI, 2003.

Unit	Text Books	Reference Books
Unit 1	T1,T2,T3	R1,R2
Unit 2	T1,T2,T3	R1,R3
Unit 3	T1,T2,T3	R2,R3
Unit 4	T1,T2,T3	R1,R3
Unit 5	T1,T2,T3	R1,R3
Unit 6	T1,T2,T5	R4

List of Tutorial:

Tutorial (Minimum ten tutorials should be conducted)

1. Reduce the given block diagram and determine overall transfer function.
2. Determine transfer function of the system represented by signal flow graph using Mason's gain formula.
3. Determine time domain specifications of given second order systems.
4. Determine static error constants and steady state error for the given systems.
5. Investigate closed loop stability of a given systems using Routh Hurwitz stability criterion.
6. Sketch the root locus of a given systems and comment on stability.
7. Sketch the polar plot of given systems.
8. Sketch the Nyquist plot of a given system, determine stability margins and comment on stability.
9. Sketch the Bode plot of a given systems, determine stability margins and comment on stability.
10. Determine the tuning parameters of PID controller using open loop step response and closed loop ultimate cycle methods of Ziegler and Nichol.
11. Design the PID controller for desired specifications using root locus approach.

List of Experiment

A) Minimum five experiments should be conducted.

1. Experimental determination of DC servo motor parameters for mathematical modeling and transfer function
2. Experimental study of time response characteristics of R-L-C second order system. Validate the results using software simulation.
3. Experimental determination of frequency response of Lead compensator.
4. Experimental determination of frequency response of Lag compensator.
5. PID control of level/ Temperature/speed control system.
6. Experimental determination of transfer function of any one physical systems (AC Servomotor/ Two Tank System/ Temperature control/ Level control)
7. Experimental analysis of D.C. Motor Position control System.

B) Minimum three experiments should be conducted (perform using software)

1. Stability analysis using a) Bode plot, b) Root locus and c) Nyquist plot.
2. Effect of P, PI and PID controllers on time response of second order system.
3. Analysis of closed loop DC position control system using PID controller.
4. Effect of addition of pole-zero on root locus of second order system.
5. Effect of addition of dominant and non-dominant poles on step response of second order system.
6. PID controller for speed/position control of DC servomotor.

Guidelines for Instructor's Manual:

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram
- Basic MATLAB instructions for control system/ Simulink basics
- Observation table/ Expected simulation results
- Sample calculations for one/two reading
- Result table

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram/Simulink diagram/MATLAB program
- Observation table/ simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Software program and result (if applicable)
- Few short questions related to the experiment.

Guidelines for Laboratory conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results. Understanding fundamentals and objective of experiment, timely submission of journal

303151A: Elective II: IoT and Its Applications in Electrical Engineering

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	TH	03	ISE	30 Marks
					ESE	70 Marks

Prerequisite:

Basics of Electrical generation, transmission, distribution and utilization, Fundamentals of logic circuits, C, C+.

Course Objectives: The course aims to

1. Understand the architecture of Internet of Things
2. Evaluate the electrical systems for making them IoT enable
3. Assess the automated processes and retrofit it for enhancement is user accessibility.

Course Outcomes: At the end of this course, student will be able to

CO1	Build circuits for signal acquisition and conditioning
CO2	Experiment with sensors and actuators and choose the right sensor for application
CO3	Determine the performance of IoT based automated process
CO4	Design and develop IoT based applications

Unit 01	**Introduction to IoT**	**06 hrs**

Fundamental components of IoT, Evolution of Connected Devices, Basic Architecture of IoT, ISO and IEC Standards, IoT categories, IoT gateways, challenges, Security concerns and hurdles, Overview of applications - home automation, agriculture, Industrial, health care, Smart Grid.

Unit 02	**IoT Development platforms**	**06 hrs**

Basics of Microcontroller and Microprocessor, Introduction to Edge devices e.g. Arduino, Node MCU, Raspberry Pi. Comparative analysis of the Platforms.

Unit 03	**Programming the hardware**	**06 hrs**

Introduction to Integrated Development Environment, Overview of different IDE's, Example of programs using Arduino IDE, Basics of Python, Example of programs using Python.

Unit 04	**Sensing and Actuation**	**06 hrs**

Sensors, Types of sensors – Digital and Analog, characteristics, choosing right sensor for Application, Interfacing Sensor with Node MCU, Reading data from Sensors like LM35, DHT 11, Ultrasonic Sensor, IR Sensor, sound sensor, touch sensor, LDR, Potentiometer, Current and voltage Sensor, Connecting actuators - relay, stepper motor.

Unit 05	**Communication Technologies and Cloud**	**06 hrs**

Introduction to communication Technologies like Wi-Fi, Bluetooth, RFID, Z-Wave, Zigbee, 6LoWPAN, LORA, Wireless HART, MQTT, Introduction to cloud platforms.

Unit 06	**Development of IoT based Application**	**06 hrs**

Reading sensor data and sending it to cloud platform, Visualization and analysis of the data on cloud, actuation and control, case study – Home automation

Test Books:

[T1]	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
[T2]	Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
[T3]	Parikshit N. Mahalle & Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (e-book).
Reference Books:	
[R1]	Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web", ISBN : 978-1-84821-140-7, Willy Publications
[R2]	Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications.
[R3]	Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things". Publisher: Lightning Source Inc; 1st edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700.
[R4]	Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.
[R5]	Michael Margolis, Arduino Cookbook, 2nd Edition, O'Reilly Media, Inc, 2011.
[R6]	Alex Bradbury & Ben Everard, Learning Python with Raspberry Pi, 1st Edition, John Wiley & Sons, Feb 2014.
[R7]	Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi, 1st Edition, Apress, 2014.

303151B: Elective-II: Electric Mobility

Teaching Scheme			Credits		Examination Scheme	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Basic concept of Batteries, Electrical Motors, Power Electronics

Course Objectives: This course aims to

1. To make students understand the need & importance of Electric & Hybrid Electric vehicles.
2. To differentiate and analyze the various energy storage devices.
3. To impart the knowledge about architecture and performance of Electric and Hybrid Vehicles
4. To classify the different drives and controls used in electric vehicles.

Course Outcomes: At the end of this course, student will be able to

CO1	Analyze the concepts of Hybrid and Electric vehicles.
CO2	Describe the different types of energy storage systems
CO3	Comprehend the knowledge of the battery charging and management systems.
CO4	Classify the different mode of operation for hybrid vehicle.
CO5	Apply the different Charging standards used for electric vehicles.
CO6	Differentiate between Vehicle to home & Vehicle to grid concepts.

Unit 01 | Introduction to Hybrid and Electric vehicles | 06 hrs

Need and importance of Electric Vehicle and Hybrid Electric Vehicles, Environmental importance of Hybrid and Electric vehicles. Hybrid Electric vehicles: Concept and architecture of HEV drive train (Series, parallel and series-parallel). Micro Hybrid, Mild Hybrid, Full Hybrid, Plug-in Hybrid, Electric vehicles: Components, configuration, performance, tractive effort, Advantages and challenges in EV.

Unit 02 | Energy Storage Systems | 06 hrs

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery specifications, Battery based energy storage and its analysis, Classification of lithium-ion batteries, Aluminum Air and Aluminum ion battery. Fuel Cell based energy storage, Super Capacitor based energy storage, Hybridization of Ultra capacitor and Battery. Selection methodology for the energy storage.

Unit 03 | Battery Charging and Management Systems | 06 hrs

introduction: Different Charging algorithms and Charging method, Cell Balancing methods.
Battery Management System: Functions of BMS, Block diagram of BMS. SoC Estimation methods, Thermal Management of Battery.

Unit 04 | Hybrid Power Train and mode of operation | 06 hrs

Control Strategies and Design of the Major Components: Series and Parallel Hybrid Electric Drive Train. Energy Consumption in Braking, Braking Power and Energy on Front and Rear Wheels, Brake System of EVs and HEVs, Regenerative braking

Unit 05 | Drives and Charging Infrastructure | 06 hrs

Selection of drives for Electric vehicle: PMSM drive and BLDC drive, Sizing of motor, Charging Levels: 01,02 and 03, Charging Standards: CCS, CHAdeMO, SAE J1772, IEC 60309, Bharat DC 001, Bharat AC 001, Electric Vehicle Supply Equipment (EVSE).

Unit 06 | Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid | 06 hrs

Vehicle to Home: Introduction, applications, V2H with demand response, Case Study of V2H.
Vehicle to Grid: Introduction of V2G, V2G infrastructure in the smart grid, Role of aggregator for V2G, Case study of V2G, Vehicle to Vehicle: Introduction of V2V, Concept & structure.

Test Books:

[T1] "Electrical Vehicle", James Larminie and John Lowry, John Wiley & Sons, 2012.

[T2]	"Electric and Hybrid-Electric Vehicles", Ronald K. Jurgen, SAE International Publisher.
[T3]	"Energy Systems for Electric and Hybrid Vehicles", K T Chau, The institution of Engineering and Technology Publication
[T4]	"Batteries for Electric Vehicles", D.A.J Rand, R Woods & R M Dell ,Research studies press Ltd, New York, John Willey & Sons
[T5]	Electric & Hybrid Vehicles-Design Fundamentals, CRC press
Reference Books:	
[R1]	"Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", Mehrdad Ehsani, Yimin Gao and Ali Emadi. CRC Press, 2009.
[R2]	"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", Junwei Lu & Jahangir Hossain et al (eds), IET Digital Library.
[R3]	"Automobile Electrical and Electronic systems", Tom Denton, SAE International publications.
[R4]	"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
[R5]	The Electric Vehicle Conversion handbook –Mark Warner, HP Books, 2011.
Online Resources:	
[O1]	https://www.theiet.org/resources/books/transport/vehicle2grid.cfm?
[O2]	https://www.sae.org/publications/books/content/pt-143.set/
[O3]	http://nptel.ac.in/courses/108103009/

303151C:Elective-II: Cybernetics Engineering						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Laplace transform, basics of matrices, computer programming and fundamentals.

Course Objectives: This course aims to

1. Introduce the concept of engineering cybernetics.
2. Give basic knowledge of key topics in cybernetics, such as system theory, control engineering, embedded computer systems, mathematical modeling, simulation, and optimization.

Course Outcomes: At the end of this course, student will be able to

CO1	Define cybernetics in terms of control and how is it used in controlling technical, biological, and other processes.
CO2	Understand various matrix operations.
CO3	Describe different types of control system configurations and their applications.
CO4	Carry out mathematical modeling and simulation of simple processes.
CO5	Appreciate the essential requirements for computers and computer equipment that are intended to operate in dedicated applications and industrial environments.
CO6	Know intelligent optimization techniques.

Unit 01	**Introduction to Cybernetics**	**06 hrs**

History of Cybernetics, various definitions of cybernetics, Control or regulation in machines, Control or regulation in human affairs.

Unit 02	**Linear system theory**	**06 hrs**

Vector Spaces, Bases, Coordinate Transformation, Invariant Subspaces, Inner product, Norms, Rank, Types of Matrices, Eigenvalues, Eigenvectors, Diagonalization, Matrix Factorization.

Unit 03	**Control Engineering**	**06 hrs**

Introduction to control systems, basic terminologies, Linearization. Laplace transform and transfer functions, types of control systems, introduction of nonlinear control system, adaptive control system, optimal control system, multivariable control system and their examples and applications.

Unit 04	**Mathematical Modeling and Simulation**	**06 hrs**

Mathematical modeling of physical processes, Differential equations of physical systems, such as electrical, mechanical, fluid, linear approximation, solution of ordinary differential equations using ODE solvers.

Unit 05	**Embedded computer systems**	**06 hrs**

Design of embedded computer systems. Computer architectures and system components for embedded and industrial applications. Microcontrollers and specialized microprocessors. Parallel and serial bus systems. Data communication in industrial environments. Analog/digital interfaces.

Unit 06	**Modern Optimization Methods**	**06 hrs**

Definition, applications, types of methods for optimization, Introduction to modern optimization techniques, Genetic algorithm, Simulated Annealing method, Particle Swarm Optimization, Ant Colony method.

Test Books:

[T1]	https://asc-cybernetics.org/foundations/history.htm [Online available on 30.05.2021]
[T2]	Dan C. Marinescu, "Complex Systems and Clouds A Self-Organization and Self-Management Perspective", Elsevier, United States, 2017
[T3]	C-T Chen, "Linear System Theory and Design", Oxford University Press, 1999
[T4]	Richard C. Dorf, Robert H. Bishop, "Modern Control System", Pearson Education Limited, 2011
[T5]	Hassan K. Khalil, "Nonlinear Control", Pearson Education Limited, 2011

[T6]	Karl Johan Astrom, Bjorn Wittenmark, “Adaptive Control”, Dover Publications Inc., New York 2008
[T7]	Y. S. Apte, “Linear Multivariable Control Systems”, McGraw-Hill, 1981
[T8]	Nirmala Sharma, “Computer Architecture”, Laxmi Publication, 2009
[T9]	Soliman Abdel- Hady Soliman, Abdel-Aal Hassan Mantawy, “Modern Optimization Techniques with Applications in Electric Power Systems” Springer

303151D:Elective-II Energy Management						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	03	Hr/Week	**TH**	03	**ISE**	30 Marks
					ESE	70 Marks

Prerequisite:

Various electrical equipment and specifications, Construction and operation of different equipment/process like HVAC, Pumps, Compressors etc.

Course Objectives: The course aims to:-

1. Understand importance of energy Conservation and energy security and impact of energy use on environment.
2. Follow format of energy management, energy policy.
3. Understand demand side management tools and impact of tariff on demand management.
4. Importance of Data Analytics in Energy audit and audit process.
5. Calculate energy consumption and saving options with economic feasibility.
6. Use of appropriate energy conservation measure in field applications or industry.

Course Outcomes: At the end of this course, student will be able to

CO1	Describe BEE Energy policies, Energy ACT.
CO2	List and apply demand side management measures for managing utility systems.
CO3	Explore and use simple data analytic tools.
CO4	Use various energy measurement and audit instruments.
CO5	Evaluate economic feasibility of energy conservation projects.
CO6	Identify appropriate energy conservations methods for electric and thermal utilities.

Unit 01 | **Energy Scenario** | **06 hrs**

Classification of Energy resources, Commercial and noncommercial sources, primary and secondary sources, commercial energy production, final energy consumption. Energy needs of growing economy, short terms and long terms policies, energy sector reforms, energy security, importance of energy conservation, energy and environmental impacts, introduction to CDM, UNFCCC, Paris treety, emission check standard, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Latest amendments in Electricity Act. Indian and Global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC).

Unit 02 | **Energy Management** | **06 hrs**

Definition and Objective of Energy Management, Principles of Energy management, Energy Management Strategy, Energy Manager Skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy, Organization setup and energy management. Responsibilities and duties of energy manager under the latest Act. Energy Efficiency Programs. Energy monitoring systems.

Unit 03 | **Demand Management** | **06 hrs**

Supply side management (SSM), Generation system up gradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM. Use of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control. Apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.) Introduction to ISO 50001- Energy Management.

Unit 04 | **Energy Audit** | **06 hrs**

Definition, need of energy audits, types of audit, procedures to follow, data and information analysis, Introduction to Data Analytics, data quality processing, clustering techniques, pattern mining, regression and classification. Relevance of Data Analytics in Audit, energy audit instrumentation,

energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options. Bench- marking energy performance of an industry. Energy Audit reporting format – Executive Summary , Detailing of report.		
Unit 05	**Financial Analysis**	**06 hrs**
Financial appraisals; criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost of energy, cost of generation Energy Audits case studies – Sugar Industry, Steel Industry, Paper and Pulp industry.		
Unit 06	**Energy Conservation**	**06 hrs**
a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and steam systems) d) Ventilation(Fan, Blower and Compressors) and Air Conditioning systems e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T and D Sector) and Performance Assessments.		

Test Books:

[T1]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 1, General Aspects (available on line)
[T2]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities (available on line)
[T3]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities (available on line)
[T4]	Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 4 (available on line)

Reference Books:

[R1]	Success stories of Energy Conservation by BEE (www. Bee-india.org)
[R2]	Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.
[R3]	Energy Management by W.R. Murphy and Mackay, B.S. Publication.
[R4]	Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication
[R5]	Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.
[R6]	A General Introduction to Data Analytics by Andre Carvalho and Tomáš Horváth Wiley Inc First Edition 2019.

Online Resources:

[O1]	www.energymanaertraining.com
[O2]	www.em-ea.org
[O3]	www.bee-india.org
[O4]	https://www.iso.org/iso-50001-energy-management.html

Unit	Text Books	Reference Books
Unit 1	T1	O1, O2
Unit 2	T1	O1, O2
Unit 3	T1	R4, O4
Unit 4	T1	R4, R5 and O1 and O2, R6
Unit 5	T1 and T4	R1, R2, R3, R5 O1 and O2
Unit 6	T2, T3 and T4	R1, R5 and O1 and O2

303152: Internship						
Teaching Scheme			**Credits**		**Examination Scheme**	
IN	04	Hr/Week	**IN**	04	**TW**	100 Marks

Preamble

Internship is a short-term industrial working experience for the students. The internship aims at providing entry-level exposure to a particular industry. It is expected that students should spend time working on relevant projects or part of the project and acquire learning about the field, along with developing industry connections, and employability skills.

Course Objectives:

1. Encourage and provide opportunities to the students to acquire professional learning experiences.
2. Empower students to relate and then apply the theoretical knowledge in real-life industrial situations.
3. Provide exposure for handing and using various tools, measuring instruments, meters, and technologies used in industries.
4. Enable students to develop professional and employability skills and expand their professional network.
5. Empower students to apply the internship learnings to the academic courses and project completions.
6. Impart professional and societal ethics in students through the internship.
7. Make students aware of social, economic, and administrative aspects influencing the working environment of the industry.

Course Outcomes: At the end of this course, student will be able to

CO1	Understand the working culture and environment of the Industry and get familiar with various departments and practices in the industry.
CO2	Operate various meters, measuring instruments, tools used in industry efficiently and develop technical competence.
CO3	Apply internship learning in other course completions and final year project management, i.e. topic finalization, project planning, hardware development, result interpretations, report writing, etc.
CO4	Create a professional network and learn about ethical, safety measures, and legal practices.
CO5	Appreciate the responsibility of a professional towards society and the environment.
CO6	Identify career goals and personal aspirations.

Guidelines: The guidelines related to the internship are given below.

Duration: Guidelines related to duration are as follows.

1. The internship should be started after semester 5 and should be completed before the commencement of semester 6.
2. It should be for at least 4 to 6 weeks.
3. It should be assessed and evaluated in semester 6.

2. Internship Identification:

A student may choose to undergo an Internship at Industries, Government organizations, NGOs, Micro-Small-Medium enterprises, startups, Innovation and Incubation Centers, Institutes of National interests, organizations working for rural development, organizations promoting IPR and Entrepreneurship, etc. Approaching various industries for Internships and finalizing the same should be initiated in the 5^{th} semester in consultation with Institute's Training and Placement Cell, Industry-Institute Cell, or Internship Cell. This will help students to start their internship work on time. Also, it will allow students to work in a vacation period after their 5^{th}-semester examination and before the start of the 6^{th} semester. Student can take internship work in the form of Online/Onsite work from any of the following but not limited to:

1. Working for consultancy or the funded research project of the institute/Department.
2. Contributing at Incubation, Innovation, Entrepreneurship Cell, Institutional Innovation Council, Start-up Cell of Institute where students will get learning opportunities on projects.
3. Learning at Departmental Lab leading to lab development and modernization, Tinkering Lab, Institutional workshop for prototyping and model development, etc.
4. Working at Industry or Government Organization on project or part of the project.
5. Internship through Internshala, AICTE, Government initiatives, etc.
6. In-house product or working model development, intercollegiate, inter-department research under research lab or research group, etc.
7. Working at micro-small-medium enterprises on solving their specific problems.
8. Research internship under professors at IISc, IIT's, NIT's, Research organizations, etc.
9. Working with NGOs or Social Internships, Rural Internship, etc.

Further, other internship opportunities should be discussed and finalized in consultation with Department/Institute constituted committees for Internship.

3. Internship Record Book:
Students must maintain an Internship record book. The main purpose of maintaining a record book is to nurture the habit of documenting and keeping records by students. The students should maintain the record of daily activities completed which may include, field visits, important discussions, observations, project work completed, suggestions received, etc. The record book should be signed every day by the supervisor or in-charge where the student is undergoing an internship. The internship record book and well-drafted Internship Report should be submitted by the students to the department faculty coordinator within a week after the completion of the internship.

4. Internship Evaluation:
The evaluation of activities recorded in the Internship Record Book will be done by Program Head, Cell In-charge, Project Head, faculty mentor, or Industry Supervisor based on the overall compilation of internship activities, sub-activities, the level of achievement expected, and the duration for certain activities. Assessment and Evaluation are to be done in consultation with the internship supervisors (Internal from the institute and External from industry).

5. Evaluation and Assessment of Internship:
Internship Record Book – 25 Marks + Internship Report - 25 Marks + Post Internship Internal Evaluation-50 Marks = Total 100 Marks

5.1 Internship Record Book: The attendance record of the student along with the evaluation sheet, duly signed and stamped by the industry should be submitted by the industry Supervisor or Mentor to the Institute/Department after the completion of the internship. The internship record book may be evaluated based on the following criteria:

- Proper and timely documented entries
- Adequacy and quality of information
- Data, observations, discussions recorded
- Thought process and recording techniques used
- Organization of the information

5.2 Internship Report: After completion of the Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learned in the internship period. The report shall be presented covering the following recommended fields but not limited to:

- Title/Cover Page
- Internship certificate with details like company name, location, duration, supervisor, etc.
- Institute Certificate
- Declaration
- Abstract
- Index/Table of Contents
- List of Figures/Tables
- **Chapter 1:** Introduction: Brief about company, industry or organization, objectives, motivation, organization of the report
- **Chapter 2:** Problem Identification/Problem statement/objectives and scope/expected outcomes
- **Chapter 3:** Methodological details
- **Chapter 4:** Results / Analysis /inferences and conclusion
- **Chapter 5:** Suggestions/Recommendations for improvement to industry, if any
- Attendance Record
- Acknowledgement
- List of reference (Library books, magazines, and other sources)

5.3 Post Internship Internal Evaluation: The student will give a presentation based on his Internship report before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

1. Internship Identification and Selection
2. Problem Studied with objectives and expected outcomes
3. Consideration of Environment/ Social /Ethics/ Safety measures/Legal aspects.
4. Methodology/System/Procedure Q&A
5. Block-diagram, flow-chart, algorithm, system description Q&A
6. Final results, discussions, suggestions, comments, etc. Q&A
7. Presentation and Communication

6. Feedback from internship supervisor (External and Internal)

Post internship, the faculty Internship coordinator should collect feedback about the student on the following suggested parameters from Industry Supervisor.

- Technical knowledge,
- Discipline and Punctuality,
- Work Commitment,
- Willingness to do the work,
- Communication skills, etc.

303153A: Audit Course IV: Ethical Practices for Engineers						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	02	Hr/Week	**TH**	00	**GRADE**	PP/NP

Prerequisite:

Basic understanding of business management

Course Objectives: This course aims to

Create awareness to serve the public by strictly adhering to codes of conduct and placing paramount the health, safety and welfare of public.

Course Outcomes: At the end of this course, student will be able to

CO1	Understand for their professional responsibilities as Engineers.
CO2	Recognize and think through ethically significant problem situations that are common in Engineering.
CO3	Evaluate the existing ethical standards for Engineering Practice.

Unit 01	**Introduction: Justice and Moral**	**12 hrs**

Introduction to Ethical Reasoning and Engineer Ethic, Professional Practice in Engineering, Ethics as Design - Doing Justice to Moral Problems, Central Professional Responsibilities of Engineers.

Unit 02	**Rights and Responsibility**	**12 Hrs**

Computers, Software, and Digital Information, Rights and Responsibilities Regarding Intellectual Property, Workplace Rights and Responsibilities, Responsibility for the Environment.

Test Books:

[T1]	Ethics in Engineering practice and Research (2nd Edition) by Caroline Whitbeck Cambridge
[T2]	Ethics in Engineering MW Martin and R Schinzinger MC Graw Hill
[T3]	Engineering Ethics and Environment P a Vesilind and AS Gunn Cambridge

Online Resources:

[O1]	NPTEL course on “Ethics in Engineering Practice”, By Prof. Susmita Mukhopadhyay, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc19_hs35/preview

303153B:Audit Course VI: Project Management						
Teaching Scheme			**Credits**		**Examination Scheme**	
Theory	02	Hr/Week	**TH**	00	**GRADE**	**PP/NP**

Prerequisite:

Course Objectives: This course aims to

1. Plan a successful project through project management.
2. Select the right members of a team for a project.

Course Outcomes: At the end of this course, student will be able to

CO1	Elaborate importance of project management and its process.
CO2	Learn about the role of high performance teams and leadership in project management.

Unit 01	**Basics of Project Management:**	**12 hrs**

Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

Unit 02	**Project Identification, Selection, planning:**	**12 hrs**

Project Identification, Selection Introduction, Project Identification Process, Project Initiation, Pr-Feasibility Study, Feasibility Studies, Project Break-even point

Project Planning: Introduction, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

Test Books:

[T1]	Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner.
[T2]	Guide to Project Management: Getting it right and achieving lasting benefits by Paul Roberts.

Online Resources:

[O1]	https://www.coursera.org/learn/project-planning?specialization=project-management
[O2]	Project management for managers By Prof. Mukesh Kumar Barua, IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_mg48/preview

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus

For

Third Year

Bachelor of Engineering

(Choice Based Credit System)

Mechanical Engineering

(2019 Course)

Board of Studies – Mechanical and Automobile Engineering

(With Effect from Academic Year 2021-22)

Savitribai Phule Pune University

Board of Studies - Automobile and Mechanical Engineering
Undergraduate Program - Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
Semester-V														
302041	Numerical & Statistical Methods	3	-	1	30	70	25	-	-	125	3	-	1	4
302042	Heat & Mass Transfer	3	2	-	30	70	-	50	-	150	3	1	-	4
302043	Design of Machine Elements	3	2	-	30	70	-	-	25	125	3	1	-	4
302044	Mechatronics	3	2	-	30	70	-	-	25	125	3	1	-	4
302045	Elective I	3	-	-	30	70	-	-	-	100	3	-	-	3
302046	Digital Manufacturing Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302047	Skill Development	-	2	-	-	-	25	-	-	25	-	1	-	1
302048	Audit course - V$	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**1**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**5**	**1**	**21**
Semester-VI														
302049	Artificial Intelligence &Machine Learning	3	2	-	30	70	-	-	25	125	3	1	-	4
302050	Computer Aided Engineering	3	2	-	30	70	-	50	-	150	3	1	-	4
302051	Design of Transmission Systems	3	2	-	30	70	-	-	25	125	3	1	-	4
302052	Elective II	3	-	-	30	70	-	-	-	100	3	-	-	3
302053	Measurement Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302054	Fluid Power &Control Laboratory	-	2	-	-	-	50	-	-	50	-	1	-	1
302055	Internship/Mini project *	-	4	-	-	-	100	-	-	100	-	4	-	4
302056	Audit course - VI$	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**14**	**-**	**120**	**280**	**200**	**50**	**50**	**700**	**12**	**9**	**-**	**21**

Elective-I		Elective-II	
302045-A	Advanced Forming & Joining Processes	302052-A	Composite Materials
302045-B	Machining Science & Technology	302052-B	Surface Engineering

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam, **TW**: Term Work, **OR**: Oral

Note: Interested students of TE (Automobile Engineering and Mechanical Engineering) can opt for any one of the audit course from the list of audit courses prescribed by BOS (Automobile and Mechanical Engineering)

Instructions:

- Practical/Tutorial must be conducted in FOUR batches per division only.
- Minimum number of Experiments/Assignments in PR/Tutorial shall be carried out **as mentioned in the syllabi** of respective courses.
- Assessment of tutorial work has to be carried out similar to term-work. The Grade cum marks for Tutorial and Term-work shall be awarded on the basis of **continuous evaluation.**
- $Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

302041: Numerical and Statistical Methods					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Tutorial	**1Hr./Week**	**Tutorial**	**1**	**End-Semester**	**70 Marks**
				Term Work	**25 Marks**

Prerequisites: System of linear equations, Partial differentiation, Statistics, Probability, Problem solving and programming.

Course Objectives:

1. **UNDERSTAND** applications of systems of equations and solve mechanical engineering applications.
2. **APPLY** differential equations to solve the applications in the domain of fluid mechanics, structural, etc.
3. **LEARN** numerical integration techniques for engineering applications.
4. **COMPARE** the system's behavior for the experimental data.
5. **INTERPRET** Statistical measures for quantitative data.
6. **ANALYZE** datasets using probability theory and linear algebra.

Course Outcomes:

On completion of the course the learner will be able to;

CO1: **SOLVE** system of equations using direct and iterative numerical methods.
CO2: **ESTIMATE** solutions for differential equations using numerical techniques.
CO3: **DEVELOP** solution for engineering applications with numerical integration.
CO4: **DESIGN** and **CREATE** a model using a curve fitting and regression analysis.
CO5: **APPLY** statistical Technique for quantitative data analysis.
CO6: **DEMONSTRATE** the data, using the concepts of probability and linear algebra.

Course Contents

Unit 1	**Roots of Equation and Simultaneous Equations**	**07 Hrs.**

Roots of Equation: Bracketing method and Newton-Raphson method
Solution of simultaneous equations: Gauss Elimination Method with Partial pivoting, Gauss-Seidel method, Thomas algorithm for Tri-diagonal Matrix.

Unit 2	**Numerical Solution of Differential Equations**	**08 Hrs.**

Ordinary Differential Equations [ODE]: Taylor series method, Euler Method, Runge-Kutta 4th order. Simultaneous equations using Runge-Kutta 2nd order method.
Partial Differential Equations [PDE]: Finite difference method, Simple Laplace method, PDE's Parabolic explicit solution, Elliptic explicit solution.

Unit3	**Numerical Integration**	**06 Hrs.**

Numerical Integration (1D): Trapezoidal rule, Simpson's 1/3rdRule, Simpson's3/8thRule, Gauss Quadrature2-point and 3-point method.
Double Integration: Trapezoidal rule, Simpson's 1/3rdRule.

Unit 4	Curve Fitting and Regression Analysis	08 Hrs.
Curve Fitting: Least square technique- first order, power equation, exponential equation and quadratic equation. **Regression Analysis:** Linear regression, Nonlinear regression, Multiple regressions, Polynomial regression. Lagrange's interpolation, Numerical interpolation and differentiation using Newton's forward method, inverse interpolation (Lagrange's method only).		
Unit 5	**Statistics**	**08 Hrs.**
Measures of central tendency: mean, median, mode. Measurement of variability and dispersion: Standard deviation, standard error, variance, range. Measure of shape: skewness, kurtosis Statistical diagram: scattered diagram, histogram, pie charts, and measure of association between two variables. Correlation: Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations.		
Unit 6	**Probability and Linear Algebra**	**08 Hrs.**
Probability: Joint, conditional and marginal probability, Bayes' theorem, independence, theorem of total probability, expectation and variance, random variables. Probability distributions: Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Normal and Chi square. **Linear algebra:** Review of matrix operations, vector and vector spaces, linear mapping.		

Books and other resources

Text Books:

1. Steven C. Chapra, 'Applied Numerical Methods with MATLAB for Engineers and Scientist', Tata Mc-Graw Hill Publishing Co. Ltd.
2. B. S. Grewal, 'Numerical Methods in Engineering and Science', Khanna Publication.
3. B. S. Grewal, 'Higher Engineering Mathematics', Khanna Publication.

References Books:

1. Erwin Kreyszig, 'Advanced Engineering Mathematics', Wiley India
2. Joe D. Hoffman, 'Numerical Methods for Engineers and Scientists', CRC Press
3. Sheldon M. Ross, 'Introduction to Probability and Statistics for Engineers and Scientists', 5e, by Elsevier Academic Press
4. Deisentoth, Faisal, Ong, 'Mathematics for machine learning', Cambridge University Press.
5. Kandasamy, 'Numerical methods', S Chand.
6. Jason Brownlee, 'Statistical Methods for Machine Learning', Machine learning Mastery.

Web References:

1. http://nptel.ac.in/courses/111101003/
2. http://nptel.ac.in/courses/111105038/
3. http://nptel.ac.in/courses/111107063/
4. http://nptel.ac.in/courses/111105041/
5. http://nptel.ac.in/courses/111104079/
6. https://www.analyticsvidhya.com/

List of Tutorials
Term Work shall consist of: **Group A – (Any three programs using suitable programming language)** 1. Roots of equation 2. Simultaneous equations 3. Ordinary differential equation 4. Partial differential equation 5. Numerical Integration **Group B (Any three programs for simple dataset using suitable programing)** 6. Curve fitting using least square technique 7. Regression analysis 8. Determine statistical measures 9. Probability distribution **Group C (Mandatory)** 10. One program based mini project using mechanical engineering application dataset **Note: Tutorials shall be mandatorily conducted in the computer laboratory.**

302042: Heat and Mass Transfer					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3 Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Practical	**50 Marks**

Prerequisites: First and Second Law of Thermodynamics, Fluid properties, Continuity equation, Differential and Integral Calculus, Ordinary differential and Partial Differential Equations, Numerical solution for Differential Equations.

Course Objectives:

1. **IDENTIFY** the laws for different modes of heat transfer.
2. **UNDERSTAND** the properties and economics of thermal insulation and **ANALYZE** heat transfer through fins and thermal systems with lumped heat capacitance.
3. **ANALYZE** the natural and forced convective mode of heat transfer in various geometric configurations.
4. **UNDERSTAND AND REALIZE** various laws with their interrelations and analyze Radiation heat transfer in black and grey bodies/surfaces with or without radiation shields.
5. **UNDERSTAND** the fundamentals and laws of mass transfer and its applications.
6. **ANALYZE** various performance parameters for existing heat exchanger and **DEVELOP** methodologies for designing a heat exchanger under prescribed conditions and for a particular application, with references TEMA standards

Course Outcomes: On completion of the course, learner will be able to

CO1. **ANALYZE** & **APPLY** the modes of heat transfer equations for one dimensional thermal system.

CO2. **DESIGN a** thermal system considering fins, thermal insulation and & Transient heat conduction.

CO3. **EVALUATE** the heat transfer rate in natural and forced convection & validate with experimentation results.

CO4. **INTERPRET** heat transfer by radiation between objects with simple geometries, for black and grey surfaces.

CO5. **ABILITY** to analyze the rate of mass transfer using Fick's Law of Diffusion and understands mass diffusion in different coordinate systems.

CO6. **DESIGN & ANALYSIS** of heat transfer equipments and investigation of its performance.

Course Contents

Unit 1	**Fundamentals of Heat Transfer**	**08 Hrs.**

Basic Concepts: Different Modes and Laws of heat transfer, 3-D heat conduction equation in Cartesian coordinates (with derivation), and its simplified equations, simplified equations in cylindrical and spherical coordinates (simplified equations, no derivation) thermal conductivity,

thermal diffusivity, electrical analogy, Thermal contact Resistance. **Boundary and initial conditions:** Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition. **1-D steady state heat conduction without and with heat generation:** Heat conduction without heat generation in plane wall, composite wall, composite cylinder, composite sphere. Heat conduction with heat generation in Plane wall, Cylinder and Sphere with different boundary conditions.		
Unit 2	**Heat Transfer through Extended Surfaces & Transient Heat Conduction**	**08 Hrs.**
Thermal Insulation – Critical thickness of insulation, Types and properties of insulating materials, Safety considerations in thermal insulation, Economic and cost considerations, Payback period, Numerical on payback period. **Heat transfer through extended surfaces:** Types of fins and its applications, Governing Equation for constant cross sectional area fins, Solution for infinitely long fin (with derivation), adequately long fin with insulated end tip and short fins (no derivation), Fin Efficiency & Effectiveness of fins, estimation of error in Temperature measurement by thermometer. **Transient heat conduction:** Validity and criteria of lumped system analysis, Biot Number, Fourier Number, Time Constant and Response of thermocouple, Use of Heisler Charts for plane wall, cylinder and sphere		
Unit 3	**Convection**	**08 Hrs.**
Principles of Convection: Local and average heat transfer coefficient, Hydrodynamic and Thermal boundary layer for a flat plate and pipe flow. **Forced Convection:** Physical significance of non-dimensional numbers, Empirical correlations for flat plate, pipe flow, and flow across cylinders, spheres, tube banks. **Free Convection:** Physical significance of non-dimensional numbers, Free convection from a vertical, horizontal surface, cylinder and sphere. Mixed Convection **Boiling and Condensation:** Types of boiling, Regimes of pool boiling, Film wise condensation, Drop wise condensation (No Numerical treatment), Critical heat flux.		
Unit 4	**Radiation**	**07 Hrs.**
Thermal Radiation; definition of various terms used in radiation mode; Stefan-Boltzmann law, Kirchhoff's law, Planck's law and Wein's displacement law. Intensity of radiation and solid angle; Lambert's law; Radiation heat exchange between two black surfaces, configuration or view factor. Radiation heat exchange between grey surfaces, Electrical analogy for radiation, Radiation shields, Numerical.		
Unit 5	**Mass Transfer**	**07 Hrs.**
Physical origins, applications of mass transfer, Mixture Composition, Phase diagram, Fick's Law of Diffusion with numerical treatment, Restrictive Conditions, Mass diffusion coefficient, Conservation of Species, The Mass Diffusion equation – Cartesian coordinates deviation, cylindrical coordinates and Spherical coordinates (no derivation), Boundary and initial conditions.		

Unit 6:	Heat Exchangers and Equipment Design	07 Hrs.

Heat Exchangers: Classification and applications of heat exchangers, Heat exchanger analysis – LMTD for parallel and counter flow heat exchangers, Effectiveness– NTU method for parallel and counter flow heat exchangers, cross flow heat exchangers, LMTD correction factor, Heat Pipe, Introduction to electronic cooling - Active and passive methods of augmented heat transfer.

Process Equipment Design: Condenser Design, Introduction to TEMA standards, Design considerations for heat exchangers, Materials of construction and corrosion, Temperature effects, Radiation effects, Economic consideration, Condenser and Heat exchanger design and performance calculations, Design of shell and tube type Heat Exchanger

Books & Other Resources

Text Books:

1. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
4. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. Joshi's Process Equipment Design, by V.V. Mahajani , S.B. Umarji ,Trinity Press

Reference Books:

1. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
2. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
3. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.
4. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
5. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
6. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
7. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
8. B.K. Dutta, Heat Transfer-Principles and Applications, PHI.
9. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science.
10. Process heat Transfer, D. Q. Kern, Wiley Publication

NPTEL Links:

E books: Links to be provided

1. https://libgen.is
2. http://libgen.li/item/index.php?md5=314BFA11A24C3C1ACFDED2B5AB88E5E9

Links of NPTEL / related videos

1. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
2. https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785
3. https://www.youtube.com/watch?v=J_zqQcncAu4&index=3&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3
4. https://www.youtube.com/watch?v=SNnd0f3xXlg&list=PLpCr5N2IS7Nmu22MOgDWOr0s

SlIpUNUz3&index=11 5. https://www.youtube.com/watch?v=SNnd0f3xXlg&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3&index=11 6. https://www.youtube.com/watch?v=lnFjt30goiY&index=18&list=PLpCr5N2IS7Nmu22MOgDWOr0sSlIpUNUz3
Guidelines for Laboratory Conduction
The student shall complete the following activity as a Term Work
Complete **eight** experiments and **two** assignments (Sr. no.10 to 13). 1. Determination of Thermal Conductivity of insulating powder. 2. Determination of Thermal Conductivity of metal rod. 3. Determination of local and average heat transfer coefficient in Natural Convection. 4. Determination of local and average heat transfer coefficient in Forced Convection. 5. Determination of temperature distribution, fin efficiency in Natural / Forced Convection. 6. Determination of Emissivity of a Test surface. 7. Determination of Stefan Boltzmann Constant. 8. Determination of heat transfer, overall heat transfer coefficient and effectiveness of Plate Heat Exchanger. 9. Study of Pool boiling phenomenon and determination of Critical Heat Flux (CHF). 10. Assignment to solve transient heat transfer problem using Heisler and Grober Charts. 11. Design of heat exchanger for any simple application. 12. Industrial visit to heat treatment industry/ heat exchanger manufacturing industry. 13. Demonstration of dropwise and filmwise condensation. 14. Virtual laboratory: study of the performance of heat exchanger /study of variation of Thermal Conductivity. **Link for Virtual Lab: - https://www.vlab.co.in/**

302043: Design of Machine Elements					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: The basics of material elastic behavior, stress, strain, its relationship, failure modes, different theories of failure and its applications. The design cycle, basis of design considerations like strength, rigidity, manufacture, assembly and cost, standards and codes. The preferred sizes and series, tolerances and types of fits. Construction of SMD and BMD. Roots of equations, Interpolation rule.

Course Objectives:

1. **UNDERSTAND** the various design considerations, design procedure and select materials for a specific application
2. **CALCULATE** the stresses in machine components due to various types of loads and failure
3. **ANALYZE** machine components subjected to variable loading for finite and infinite life
4. **DESIGN** various machine components such as shafts, couplings, keys, screws, joints, springs

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DESIGN AND ANALYZE** the cotter and knuckle Joints, levers and components subjected to eccentric loading.

CO2. **DESIGN** shafts, keys and couplings under static loading conditions.

CO3. **ANALYZE** different stresses in power screws and **APPLY** those in the procedure to design screw jack.

CO4. **EVALUATE** dimensions of machine components under fluctuating loads.

CO5. **EVALUATE & INTERPRET** the stress developed on the different type of welded and threaded joints.

CO6. **APPLY** the design and development procedure for different types of springs.

Course Contents

Unit 1	**Design of Simple Machine Elements**	**08 Hrs.**

Factor of safety, Selection of Factor of Safety, Service factor, Design of Cotter joint, Knuckle joint, Design of hand / foot lever, lever for safety valve, bell crank lever, Design of components subjected to eccentric loading.

Unit 2	**Design of Shafts, Keys and Couplings**	**08 Hrs.**

Shaft design on the Strength basis, torsional rigidity basis and lateral rigidity basis, Design of shaft as per A.S.M.E. code. Design of square and rectangular keys, Kennedy key and splines. Design of Flange Coupling and Bushed-Pin Flexible Coupling.

Unit 3	Design of Power Screws	07 Hrs.
Terminology of Power Screw, Torque analysis and Design of power screws with square and trapezoidal threads, Collar friction torque, Self-locking screw, Efficiency of square threaded screw, Efficiency of self-locking screw, Design of screw, nuts and C-Clamp. Design of screw jack, Differential and Compound Screw and Re-circulating Ball Screw (Theoretical treatment only).		
Unit 4	**Design against Fluctuating loads**	**07 Hrs.**
Stress concentration and its factors, Reduction of stress concentration factors, fluctuating stresses, fatigue failures, endurance limit, S-N curve, Notch sensitivity, Endurance limit, Endurance strength modifying factors, Reversed stresses – Design for Finite and Infinite life, Cumulative damage in fatigue failure, Soderberg, Gerber, Goodman Lines, Modified Goodman diagrams, Fatigue design under combined stresses:- (Theoretical treatment only.)		
Unit 5	**Threaded and Welded joints**	**08 Hrs.**
Introduction to threaded joints, Bolts of uniform strength, locking devices, eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base. Introduction to welded joints, Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments.		
Unit 6	**Design of Springs**	**07 Hrs.**
Types and applications of springs, Stress and deflection equations for helical compression Springs, Springs in series and parallel, Design of helical springs, concentric helical springs, surge in spring, Design of Multi-leaf springs, Nipping of Leaf springs, Shot Peening.		

Books and other resources

Text Books:

1. Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
2. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.

References Books:

1. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
2. Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons.
3. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
4. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
5. Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series.
6. C. S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learing Pvt. Ltd.
7. D. K. Aggarwal & P. C. Sharma, Machine Design, S.K Kataria and Sons.
8. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learing Pvt. Ltd.
9. Design Data - P.S.G. College of Technology, Coimbatore.
10. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.

Term Work
The student shall complete the following activity as a Term Work; The term work shall consist of three design projects. The design project shall consist of assembly drawing, with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of maximum four students. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components should be submitted in a separate file. Design data book shall be referred for selection of materials and standard components for given loading conditions. All three design projects should be carried out using suitable software. Project 1: - Cotter joint/ knuckle joint/turn buckle for a specified application. Project 2: - Bush Pin Flexible Coupling for specified application. Project 3: - Bottle type/toggle jack for vehicles. OR Project 3: - A Design Project to develop and apply the knowledge of Machine Design and drafting software for any mechanical system on the basis of: (1) Idea generation, (2) Creativity, Reliability and safety, (3) Design parts of the system (4) Ergonomic Considerations (5) Use of International standards.
Web References:

UNIT 1: Design of Simple Machine Elements		
Sr. No	**Topic Title**	**NPTEL video Link**
1	Factor of safety, Selection of Factor of Safety, Service factor	https://www.youtube.com/watch?v=ofmbhbVCUqI&list=PL3D4EECEFAA99D9BE&index=3
2	Design of components subjected to eccentric loading.	https://www.youtube.com/watch?v=__py5xbKHGA
UNIT 2: Design of Shafts, Keys and Couplings		
3	Design of shaft as per A.S.M.E. code	https://www.youtube.com/watch?v=SL21aDqgs8Q
4	Design of a C-Clamp. Design of screw jack,	https://youtu.be/PEKfS2Q1WqM https://www.youtube.com/watch?v=PEKfS2Q1WqM&list=PL3D4EECEFAA99D9BE&index=19
5	Differential and Compound Screw and Re-circulating Ball Screw	https://www.youtube.com/watch?v=TPURJnlekeo
UNIT 4: Design against Fluctuating Loads		
6	Cumulative damage in fatigue failure,	https://www.youtube.com/watch?v=WRoPQGE0WdI
7	Soderberg, Gerber, Goodman Lines, Modified Goodman Diagrams	https://www.youtube.com/watch?v=WRoPQGE0WdI
8	Fatigue design under combined stresses	https://www.youtube.com/watch?v=WRoPQGE0WdI

UNIT 5: Threaded and Welded joints		
9	Eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt	https://www.youtube.com/watch?v=__py5xbKHGA https://www.youtube.com/watch?v=YZYcMtkZiDY
10	Eccentric load on circular base	https://www.youtube.com/watch?v=__py5xbKHGA
11	Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments	https://www.youtube.com/watch?v=__py5xbKHGA https://www.youtube.com/watch?v=YZYcMtkZiDY
UNIT 6: Design of Springs		
12	Surge in spring	https://www.youtube.com/watch?v=tTBnW5gAieM
13	Shot Peening.	https://www.youtube.com/watch?v=46quOD7V-cQ
14	Design of Multi-leaf	https://youtu.be/T4IgtIkBnOo

302044: Mechatronics					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Basics of Electrical components, Binary to Decimal Conversion, Data communication Module, Op amp Circuits, Linear Algebra, Laplace Transformation method, Logic gates.

Course Objectives:

1. **UNDERSTAND** the key elements of mechatronics, principle of sensor and its characteristics.
2. **UNDERSTAND** the concept of signal processing and use of interfacing systems such as ADC, DAC, Digital I/O.
3. **UNDERSTAND** the block diagram representation and concept of transfer function.
4. **UNDERSTAND** the system modeling and analysis in frequency domain.
5. **UNDERSTAND** the system modeling and analysis in time domain, controller modes and its industrial applications..
6. **UTILIZE** the concepts of PLC system and its ladder programming and significance of PLC system in industrial application.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEFINE** key elements of mechatronics, principle of sensor and its characteristics.

CO2. **UTILIZE** concept of signal processing and **MAKE** use of interfacing systems such as ADC, DAC, Digital I/O.

CO3. **DETERMINE** the transfer function by using block diagram reduction technique.

CO4. **EVALUATE** Poles and Zero, frequency domain parameter for mathematical modeling for mechanical system.

CO5. **APPLY** the concept of different controller modes to an industrial application.

CO6. **DEVELOP** the ladder programming for industrial application.

Course Contents

Unit 1	Introduction to Mechatronics, Sensors & Actuators	07 Hrs.

Introduction to Mechatronics and its Applications Measurement Characteristics (Static/Dynamic), **Sensors:** Types of sensors; Motion Sensors – Encoder (Absolute & incremental), Lidar, Eddy Current, Proximity (Optical, Inductive, Capacitive), MEMS Accelerometer;
Temperature sensor –Pyrometer, Infrared Thermometer; Force / Pressure Sensors – Strain gauges, Piezoelectric sensor; Flow sensors – Electromagnetic, Ultrasonic, Hot-wire anemometer; Color sensor – RGB type; Biosensors – Enzyme, ECG, EMG
Actuators: Servo motor; Hydraulic and Pneumatic (must be restricted to classification and working of one type of linear and rotary actuator); linear electrical actuators Selection of Sensor & Actuator

Unit 2	Data Acquisition and Signal Communication	08 Hrs.
Signal Communication: Serial, Parallel; Synchronous, Asynchronous Introduction to DAQ, Types, Components of a Data Acquisition System (Sensor, Signal conditioning, processing, controlling and storage/display/action) Data Acquisition: Signal collection, Signal conditioning – Isolation& Filtering, Amplification, Sampling, Aliasing, Sample and hold circuit, Quantization, Analog-to-digital converters (4 bit Successive Approximation type ADC), Digital-to-Analog converters (4 bit R2R type DAC), Data storage Applications: DAQ in Household ,Digital Pressure Gauge, Digital Flow measurement, DVB Digital Video Broadcast, AM/FM		
Unit 3	**Control systems & transfer function based modelling**	**07 Hrs.**
Introduction to control systems, need, Types- Open and Closed loop, Concept of Transfer Function, Block Diagram & Reduction principles and problems; Applications (Household, Automotive, Industrial shop floor) Transfer Function based modeling of Mechanical, Thermal and Fluid system; Concept of Poles & Zeros; Pole zero plot, Stability Analysis using Routh Hurwitz Criterion (Numerical Approach)		
Unit 4	**Time and Frequency Domain Analysis**	**08 Hrs.**
Time Domain Analysis – Unit step Response analysis via Transient response specifications (Percentage overshoot, Rise time, Delay time, Steady state error etc.) Frequency Domain Analysis – Frequency Domain Parameters - Natural Frequency, Damping Frequency and Damping Factor; Mapping of Pole Zero plot with damping factor, natural frequency and unit step response ; Introduction to Bode Plot, Gain Margin, Phase Margin		
Unit 5	**Controllers**	**07 Hrs.**
Introduction to controllers, Need for Control, Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems in parallel form; (Numerical approach), Feed forward anticipatory control Manual tuning of PID control, Ziegler–Nichols method Applications: Electro–Hydraulic/Pneumatic Control, Automotive Control		
Unit 6	**Programmable Logic Controller (PLC)**	**08 Hrs.**
Introduction to PLC; Architecture of PLC; Selection of PLC; Ladder Logic programming for different types of logic gates; Latching; Timers, Counters; PLC control of Hydraulics / Pneumatics / Mechatronics systems involving timing and counting operations.		

Books and other resources

Text Books:

1. William Bolton, Mechatronics: Electronics Control Systems in Mechanical and Electrical Engineering, 6th Ed, 2019
2. K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008

References Books:

1. Alciatore and Histand, Introduction to Mechatronics and Measurement Systems, 5th Ed, 2019
2. Bishop (Editor),Mechatronics – An Introduction CRC 2006
3. Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi
4. C.D.Johnson, Process Control Instrumentation Technology, Prentice Hall,New Delhi
5. Bolton, Programmable Logic Controller, 4th Ed, Newnes, 2006

Web References:

1. https://www.elprocus.com/what-is-a-biosensor-types-of-biosensors-and-applications/
2. https://www.elprocus.com/color-sensor-working-and-applications/
3. https://www.youtube.com/watch?v=kbjCGGTXqUo&ab_channel=Controlengineering
4. https://youtu.be/clTA0pONnMs?list=PLHMDN3JFtE5wEz95H2XuzRaafK3fUsaki
5. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-12(SS)%20(IA&C)%20((EE)NPTEL).pdf
6. https://nptel.ac.in/content/storage2/courses/112104158/lecture5.pdf

Term Work

The Term work shall consist of completion of Practical, Self-learning Study Assignments and Presentations. Oral examination shall be based on the Term work undertaken during the semester.

Practical (**Any one** experiments out of experiment no **1 to 3** from the following list whereas experiment no. **4 to 10** are mandatory).

1. Experiment on measurement of temperature using suitable sensor.
2. Experiment on measurement of load using suitable sensor.
3. Experiment on measurement of displacement using suitable sensor.
4. Development of a data acquisition / mechatronics system using low cost open source hardware and software.
5. Experiment on interfacing of suitable sensor and actuator with DAQ.
6. Modeling and analysis of mechanical system and its verification using suitable simulation software.
7. PID control of Mechanical System using suitable simulation software and experimental verification (verification only if experimental setup is available).
8. Ladder Logic Simulation of suitable application.
9. Demonstration of PLC controlled electro hydraulic / elector pneumatic circuit.
10. Industrial visit to understand integration and application of Mechatronics.

Assignments:

1. Application of Sensors and Actuators in Health Science and Selection of Suitable Sensor and Actuator.
2. Block Diagram Representation of Feedback Control System and determination of Closed Loop Transfer Function.

302045-A: Advanced Forming & Joining Processes					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisite Courses: Manufacturing Processes, Engineering Materials and Metallurgy, Machine shop

Course Objectives:

1. **UNDERSTAND** advances in sheet metal forming operations
2. **UNDERSTAND** the advanced special metal forming processes.
3. **UNDERSTAND** weld metallurgy and weld characterization techniques.
4. **UNDERSTAND** and describe various advanced solid state welding processes.
5. **CLASSIFY AND DESCRIBE** various advanced welding processes.
6. **KNOW** about sustainable manufacturing and its role in manufacturing industry

Course Outcomes:

On completion of the course, learner will be able to

CO1. **ANALYSE** the effect of friction in metal forming deep drawing and IDENTIFICATION of surface defects and their remedies in deep drawing operations

CO2. **ASSESS** the parameters for special forming operation and SELECT appropriate special forming operation for particular applications

CO3. **ANALYSE** the effect of HAZ on microstructure and mechanical properties of materials

CO4. **CLASSIFY** various solid state welding process and **SELECT** suitable welding processes for particular applications

CO5. **CLASSIFY** various advanced welding process and **SELECT** suitable welding processes for particular applications.

CO6. **INTERPRET** the principles of sustainable manufacturing and its role in manufacturing industry.

Course Contents

Unit 1	Mechanics of Sheet Metal Forming	08 Hrs.

Theory of plasticity – yield criteria-work of plastic deformation- Sheet Metal Forming-Formability studies-conventional processes, Effect of friction in forming operation, Experimental techniques of evaluation of friction in metal forming, deep drawing, analysis (Numerical), surface defects identification and remedies, introduction to Forming simulation, Challenges in Forming.

Unit 2	Special Forming Processes	08 Hrs.

Special Forming Processes: HVF, HERF (Explosive Forming) techniques- super plastic forming techniques-Hydro forming-Stretch forming, Laser beam forming-principles and process parameters-Advantages, limitations and applications of different forming processes. Orbital forging-Isothermal-Hot and cold isostatic pressing-High speed extrusion, Water hammer forming, Incremental Sheet forming, Magnetic Pulse forming, Metal Spinning, Electro Hydraulic Forming, Micro forming.

Unit 3	Weld Metallurgy	07 Hrs.
Weld Metallurgy: Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of dissimilar materials, Weld characterization, Weld decay and weld sensitization, Introduction to ASME, ASWE, IS Welding Standards, (welding skill levels).		
Unit 4	**Solid State Welding Processes**	**07 Hrs.**
Solid State Welding Processes: Cold pressure welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction stir welding, Forge welding, Roll welding and Hot pressure welding processes - features, advantages, limitations and applications, Advances in adhesive bonding, cladding.		
Unit 5	**Advanced Welding Processes**	**08 Hrs.**
Advanced Welding Processes: Electrogas, electroslag welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding - principle, working and applications, Cold Metal Transfer - concepts, processes and applications, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles, Robotic Welding, Plasma Arc Welding, Plasma Transferred Arc Welding.		
Unit 6	**Sustainable Manufacturing**	**07 Hrs.**
Sustainable Manufacturing: Introduction to sustainability and drivers for sustainable development and sustainable manufacturing, fundamentals of sustainable manufacturing, various tools, factors of sustainability, Principles of Life Cycle Assessment (Goal, Scope and Life Cycle Inventory), Approaches, Role in Industry 4.0, Green Manufacturing, Environment protection norms, ISO 14000, recycling techniques, safety norms in forming and welding, socio-economic aspects, case study on waste recycling, material recycling, etc.		

Books and other resources

Text Books:

1. Sindo Kou, "Welding Metallurgy", Wiley Publications Second Edition
2. Dr. V. D. Kodgire and S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication
3. William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley & Sons, Inc.
4. O.P. Khanna, " Welding Technology", Dhanpat Rai & Sons Publications Edition 2015
5. Dr. R. S. Parmar,"Welding Processes and Technology", Khanna Publications Edition 2017
6. J. Paulo Davim, " Sustainable Manufacturing", Wiley Publications Edition 2010

References Books:

1. Z. Marciniak, J.L.Duncan, "Mechanics of Sheet Metal Forming", Butterworth Heinemann-2002.
2. Dr. Sadhu Singh, "Theory of Plasticity and Metal Forming Processes", Khanna Publishers Edition 2008
3. O.P. Khanna, " Engineering Metallurgy", Dhanpat Rai & Sons Publications
4. Ali Hasan - Islam Nawaz, "Advanced Welding Technology", SCITECH Publications India Pvt. Ltd. Edition 2018
5. Dr. K. S. Yadav, "Advanced Welding Technology"', Rajsons Publications Pvt. Ltd.
6. Tool and Manufacturing Engineers' Handbook: Forming V by Charles Wick Publisher

: Society of Manufacturing Engineers; 4th edition (1 Aug. 1996)

7. Dornfeld and David, "Green Manufacturing" - Fundamentals and Applications, DOI 10.1007/978.1.4419.6016.0_2, Springer Science +Business Media, New York 2013.
8. R. Ganesh Narayanan, Jay S Gunasekera,"Sustainable Material Forming and Joining", by CRC Press 2020.

Web References:

1. NPTEL Course on "Forming" by Dr. R. Chandramouli, IIT Madras
2. NPTEL Course on "Welding Engineering" by Dr. D. K. Dwivedi, IIT Roorkee
3. NPTEL Course on "Advances in welding and joining technologies" by Prof. SwarupBag IIT Guwahati.
4. NPTEL Course on "Welding Metallurgy" by Prof. Pradeep K. Jha, IIT Roorkee
5. NPTEL Course on "Sustainability through Green Manufacturing System – An Applied Approach" by Prof. Deepu Philip IIT Kanpur and Dr. Amardeep Singh Oberaoi, NIT Jalandar.

302045-B:Machining Science &Technology					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Mechanics, Gear terminology, Material properties, Degree of freedom.

Course Objectives:

1. **KNOW** about fundamentals of metal cutting process, tool wear and tool life.
2. **IMPART** the knowledge of machining phenomenon like milling, gear and thread manufacturing, grinding, super finishing, etc.
3. **UNDERSTAND** the basic concepts, importance and functions of Jigs, Fixtures.
4. **PREPARE** list of operations, tools, set of manufacturing instructions and selection of quality assurance method.
5. **GENERATE** CNC program for appropriate machining processes like turning and milling.

Course Outcomes:

On completion of the course, learner will be able to

- CO1. **DEFINE** metal cutting principles and mechanics of metal cutting and tool life.
- CO2. **DESCRIBE** features of gear and thread manufacturing processes.
- CO3. **SELECT** appropriate grinding wheel and demonstrate the various surface finishing processes.
- CO4. **SELECT** appropriate jigs/fixtures and to draw the process plan for a given component.
- CO5. **SELECT** & **EVALUATE** various parameters of process planning.
- CO6. **GENERATE** CNC program for Turning / Milling processes and generate tool path using CAM software.

Course Contents

Unit 1	**Mechanics of Metal Cutting**	**08 Hrs.**

Introduction to metal cutting, Elements of machining process, Geometry of single-point cutting tool, Orthogonal and Oblique cutting processes,

Chip formation, Types of chips, Chip thickness ratio, Process parameters and their effect on machining, chip breakers,

Merchant's Circle of forces analysis – forces and energy calculations, power consumed – MRR-Effect of Cutting variables on forces,

Concepts of Machinability- Factors affecting machinability, Machinability Index, Tool Life, Tool life equation of Taylor, Tool wear and its types, Factors affecting on tool life.

Unit 2	**Gear and Thread Manufacturing**	**07 Hrs.**

Introduction, Materials of gears, Methods of gear manufacturing-casting, forging, forming etc, milling of gears (indexing methods and numerical), Helical gear cutting, Gear Shaping and Gear hobbling, Gear inspection.

Thread Manufacturing: Various methods of thread manufacturing**,** thread rolling, die threading & tapping, Thread milling, Thread grinding etc.

Unit 3	Grinding & Surface finishing	08 Hrs.

Types and Operations of grinding machines, Grinding wheel– Shapes, Designation and selection, Abrasives & classification, Bond & bonding, Grit, Grade & Structure of wheels, Types of grinding wheels, mounting of grinding wheels, Glazing and loading of wheels, Dressing and truing of wheels, Balancing of wheels, Diamond wheels.

Super-finishing processes – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)

Unit 4	Jigs and Fixtures	08 Hrs.

Significance and purpose of jigs and fixtures and their functions in the manufacturing processes, Concept of degree of freedom, 3-2-1 principle of location. General guidelines to design jigs and fixtures, advantages of jigs and fixtures.

Jigs- Definition, Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, Latch type jig.

Fixtures: Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, turning fixture, welding fixture, Milling fixture, Assembly and Inspection fixtures.

Unit 5	Process Planning	06 Hrs.

Introduction- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection, process parameters calculation for various production processes, Selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, Economics of process planning, case studies.

Unit 6	CNC Programming	08 Hrs.

CNC Programming-CNC part programming adaptable to suitable controller. Steps in developing CNC part program. CNC part programming for Lathe Machine – Threading & Grooving cycle (Canned cycle). CNC part programming for Milling Machine - Linear & circular interpolation, milling cutter, tool length compensation & cutter radius compensation. Pocketing, contouring & drilling, subroutine and Do loop using canned cycle.

Books and other resources

Text Books:

1. A Text Book of Production Technology, P. C. Sharma, S.Chand Publications
2. A Text Book of Manufacturing Technology, R. K. Rajput, Laxmi Publications (p) LTD
3. A Text book of Manufacturing Technology, Metal Cutting and Machine Tools, P. N. Rao, Vol. 2, 2nd edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi, 2002
4. Elements of Workshop Technology, Vol-II, S. K. HajraChaudhary, Media Promoters &Publications Pvt Ltd.
5. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional

References Books:

1. Theory of Metal Cutting, M. C. Shaw, 1st Edition, Oxford and I.B.H. publishing, 1994
2. Jigs & Fixtures, P.H. Joshi, Third edition, McGraw Hill, 2017
3. Production Technology Manufacturing Systems VOL-I & II, R. K. Jain, Khanna Publishers
4. Production Technology –HMT, Tata McGraw Hill publication
5. An Expert Process Planning System, Chang, T. C., Addison Wesley Longman, 1990

6. Process Planning- Design/Manufacture Interface, Scallan P, Butterworth-Heinemann, 2003
7. CNC Machines, B. S. Pabla, M. Adithan, New Age International, 2018
8. Manufacturing Science, Amitabh Ghosh and AshokKumar Mallik, Affiliated East-West Press, 2010

Web References:

1. https://nptel.ac.in/content/storage2/courses/108105063/pdf/L-
2. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-32.pdf
3. https://nptel.ac.in/content/storage2/courses/112105127/pdf/LM-34.pdf
4. https://nptel.ac.in/courses/112/107/112107143/

302046: Digital Manufacturing Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Construction and operating of conventional machine tools, principles of machining and forming processes, cutting tool and machining parameters, programming languages like C, Python etc., basics of 3D printing.

Course Objectives:

1. **ACQUIRE** skills to handle conventional machines and CNC machine for manufacturing of a component.
2. **PREPARE** manual part program for given component as per ISO standards.
3. **ACCUSTOM** skills of Additive manufacturing technology.
4. **APPRECIATE** the influence of cutting tool parameters on the performance.
5. **APPLY** Digital Manufacturing tools for process simulation of manufacturing processes.
6. **SELECT** appropriate type of jigs and fixtures for a given component

Course Outcomes:

On completion of the course, learner will be able to

CO1.**DEVELOP** a component using conventional machines, CNC machines and Additive Manufacturing Techniques.

CO2.**ANALYZE** cutting tool parameters for machining given job.

CO3.**DEMONSTRATE** simulation of manufacturing process using Digital Manufacturing Tools.

CO4.**SELECT** and **DESIGN** jigs and Fixtures for a given component.

CO5.**DEMONESTRATE** different parameters for CNC retrofitting and reconditioning.

Guidelines for Laboratory Conduction

The learner shall complete the following activity as a Term Work;

1. Demonstration of cutting tool geometry and nomenclature of the tools used in conventional and CNC machines.
2. Machining of a mechanical component using conventional machines such as lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement. Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.
3. Preparing manual CNC part program using G Codes and M Codes as per ISO (DIN 66025) and RS274 standards for CNC lathe/mill machine.
4. Machining of mechanical component using CNC machine (Lathe/Mill/HMC/VMC). Manufacturing drawing with appropriate geometrical and dimensional tolerances, detailed process planning to be included.
5. Demonstration of Additive Manufacturing technology (from modelling to printing) (To be performed Batch-wise)
6. Demonstration of the usage of Digital Manufacturing tools for process simulation of manufacturing processes like casting, forging, sheet metal, plastic processing (free / open source software)

7. Demonstration of various types of jigs and fixtures, and a case study on design and use of Jigs & Fixture for any given component.
8. Preparing Online Calculator/Catalogue for selection of cutting parameters by using programming languages like C, Python etc.
9. Study on CNC retrofitting and reconditioning
10. Visit to an Industry which uses advanced manufacturing processes

Please note following instructions regarding Laboratory Conduction:

1. Sr. No. 1 to 7are mandatory and any 2 from Sr. No. 8 to 10.
2. Practical are to be performed under the guidance of concerned faculty member.
3. Journal should consist of Job Drawing, Process Sheet and Program, appropriate write-up and shall be part of term-work submission.

302047: Skill Development					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**TW**	**25 Marks**

Prerequisites: Students should have knowledge of Construction and working of IC engine / compressor / gear box / centrifugal pump/tail stock. Working principles of any type of mechanism / power plants. Working of electric and hydraulic systems of 4 wheeler vehicle. Working of machine tools, engine and transmission of different automotive and home appliances. Advanced manufacturing processes. Solid mechanics and design of machine elements.

Course Objectives:

1. **INTRODUCE** the skills required in an industry such as design, development, assembly & disassembly.
2. **DEVELOP** the skills required for fault diagnose of engine and transmission of different automotive and various home appliances.
3. **ESTABLISH** the skills required for maintenance of any machine tool.
4. **CREATE** awareness about industrial environment.

Course Outcomes:

On completion of the course, learner will be able to

CO1.**APPLY& DEMONSTRATE** procedure of assembly & disassembly of various machines.
CO2.**DESIGN & DEVELOP** a working/model of machine parts or any new product.
CO3.**EVALUATE** fault with diagnosis on the machines, machine tools and home appliances.
CO4.**IDENTIFY & DEMONSTRATE** the various activities performed in an industry such as maintenance, design of components, material selection.

Course Contents

1. Assembly and Disassembly of any of the following mechanical systems/ subsystems: bicycle (geared), e-Bikes, e-Motor Cycles, Drones, Flying devices, gear box, IC engines, centrifugal pump etc.
2. Assembly- Disassembly/ Fault diagnosis of home appliances such as mixer, grinder, washing machine, fan, ovens, gas geyser, chopping machine, kneading machine, exercise machines, etc.
3. Development and demonstration of working/animation model of any mechanism.
4. Design a circuit of electric and hydraulic system of4 wheelers and its verification.

   OR

   Circuit design /PCB design using software for control of BLDC electric motors used in e-Vehicles.
5. Undertake total preventive maintenance for any machine tool or mechanical system.
6. Visit to an industry for awareness about preventive maintenance.
7. Use of ergonomic principles for the design of hand tools, control in automobile dashboards, human operated mobile devices.

8. Use of alternative materials in the construction of daily activity machine and tool components
9. Interpretation of Drawings; Exercises in identifying the type of production, extracting important functional dimensions, checking the number of parts in an assembly. Checking and listing missing dimensions.
10. Exercises in -preparation of detailed production drawings as per BIS standard of simple machine parts having relevant notes and indications (limits/tolerances, surface finish, the process of production, relevant tools, materials, measuring instruments).

The documentation activity as a part of the Term work shall not be restricted to merely generation of 2D/3D CAD Drawings with dimensions (as applicable), Exploded View, Flowchart of Maintenance Work etc. but can be beyond.

Skill Development Documentation Diary must be maintained by every student.

302048: Audit Course V		
Teaching Scheme	**Credits**	**Examination Scheme**
	Non-Credit	

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from third year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course V

- Entrepreneurship and IP strategy
- Engineering Economics
- Mangment of Inventory Systems

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BOS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the

corresponding online course available on the NPTEL platform as an Audit course. • Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal. • After clearing the examination successfully; student will be awarded with a certificate.
Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary. • During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the mark-sheet.

302049: Artificial Intelligence & Machine Learning					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Oral	**25 Marks**

Prerequisites: Linear Algebra, Probability, Statistics, Logical Reasoning.

Course Objectives:

1. **ACQUAINT** with fundamentals of artificial intelligence and machine learning.
2. **LEARN** feature extraction and selection techniques for processing data set.
3. **UNDERSTAND** basic algorithms used in classification and regression problems.
4. **OUTLINE** steps involved in development of machine learning model.
5. **FAMILIARIZE** with concepts of reinforced and deep learning.
6. **IMPLEMENT AND ANALYZE** machine learning model in mechanical engineering problems.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEMONSTRATE** fundamentals of artificial intelligence and machine learning.
CO2. **APPLY** feature extraction and selection techniques.
CO3. **APPLY** machine learning algorithms for classification and regression problems.
CO4. **DEVISE AND DEVELOP** a machine learning model using various steps.
CO5. **EXPLAIN** concepts of reinforced and deep learning.
CO6. **SIMULATE** machine learning model in mechanical engineering problems.

Course Contents

Unit 1	**Introduction to AI & ML**	**06 Hrs.**

History of AI, Comparison of AI with Data Science, Need of AI in Mechanical Engineering, Introduction to Machine Learning. **Basics:** Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation.
Approaches to AI: Cybernetics and brain simulation, Symbolic, Sub-symbolic, Statistical.
Approaches to ML: Supervised learning, Unsupervised learning, Reinforcement learning.

Unit 2	**Feature Extraction and Selection**	**08 Hrs.**

Feature extraction: Statistical features, Principal Component Analysis.
Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical Engineering.

Unit 3	**Classification & Regression**	**08 Hrs.**

Classification: Decision tree, Random forest, Naive Bayes, Support vector machine.
Regression: Logistic Regression, Support Vector Regression. **Regression trees:** Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Mechanical Engineering.

Unit 4	Development of ML Model	07 Hrs.
Problem identification: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.		
Unit 5	**Reinforced and Deep Learning**	**08 Hrs.**
Characteristics of reinforced learning; Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of Deep Learning, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning in Mechanical Engineering.		
Unit 6	**Applications**	**08 Hrs.**
Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Dynamic System Order Reduction, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms.		

Books and other resources

Text Books:

1. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
3. Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015
4. Stuart Russell and Peter Norvig (1995), "Artificial Intelligence: A Modern Approach," Third edition, Pearson, 2003.

References Books:

1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
4. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)
5. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH

Web References:

1. http://nptel.ac.in/courses/111101003/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/112/103/112103280/
4. https://www.analyticsvidhya.com/

Term Work
List of Experiments: 1. To study supervised/unsupervised/Reinforcement learning approach. 2. To acquire, visualize and analyze the data set (from time-domain/ frequency-domain/ etc.) . 3. To extract features from given data set and establish training data. 4. To select relevant features using suitable technique. OR 5. To use PCA for dimensionality reduction. 6. To classify features/To develop classification model and evaluate its performance (any one classifier). 7. To develop regression model and evaluate its performance (any one algorithm). 8. Markov process for modelling manufacturing processes. OR 9. Reinforced Learning for optimizing engineering designs / Robot Guidance and Navigation. 10. GA for optimization of multi-dimensional function / path planning in robotics. OR 11. NN for parameter and model identification / tuning of Control Algorithms. **Note:** • Students need to apply the computational algorithms using suitable software / programming language. • Experiment 1, 2, 3, 6 & 7 are compulsory. Experiment 2 to 7 to be taken on same data set

302050: Computer Aided Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
Practical	**2 Hrs./Week**	**Practical**	**1**	**End-Semester**	**70 Marks**
				Practical	**50 Marks**

Prerequisite Courses: Solid Mechanics, Numerical and Statistical Methods, Engineering Mathematics, Manufacturing Processes, Fluid Mechanics, Heat and Mass Transfer.

Course Objectives:

1. **UNDERSTAND** the basic concepts of Computer Aided Engineering (CAE) and **CHARACTERISTICS** of various elements required for analysis.
2. **NURTURE** students about the discretization process and criteria for quality mesh.
3. **UNDERSTAND** the approaches of Finite Element Method (FEM) and to find displacement and stresses over the body.
4. **DEVELOP** the knowledge and skills needed to effectively evaluate the results using Finite Element Analysis (FEA).
5. **APPLY** computational technique to solve complex solid mechanics problems and its loading states.
6. **STUDY** the applications of CAE in the various domains of the Mechanical Engineering.

Course Outcomes:

On completion of the course, learner will be able to

CO1: **DEFINE** the use of CAE tools and **DESCRIBE** the significance of shape functions in finite element formulations.

CO2: **APPLY** the various meshing techniques for better evaluation of approximate results.

CO3: **APPLY** material properties and boundary condition to SOLVE 1-D and 2-D element stiffness matrices to obtain nodal or elemental solution.

CO4: **ANALYZE** and **APPLY** various numerical methods for different types of analysis.

CO5: **EVALUATE** and **SOLVE** non-linear and dynamic analysis problems by analyzing the results obtained from analytical and computational method.

CO6: **GENERATE** the results in the form of contour plot by the USE of CAE tools.

Course Contents

Unit 1	**Elemental Properties**	**07 Hrs.**

Introduction to Computer Aided Engineering (CAE), Use of CAE in Product development, Discretization methods – Finite Element Method (FEM), Finite Difference Method (FDM) and Finite Volume Method (FVM), CAE Tools- Pre-processor, Solver and Post-Processor.

Element Shapes – 1D, 2D and 3D elements, Nodal Unknowns and field variables, Coordinate Systems, Shape Functions- linear, quadratic and cubic, Convergence Requirements of Shape Functions, Derivation of Polynomial Shape Functions using coordinate systems for Bar, Beam, Triangular, and rectangular elements.

Unit 2	**Meshing Techniques**	**06 Hrs.**
Discretization of a Structure, 1D, 2D and 3D element Meshing, Element selection criteria, Refining Mesh, Effect of mesh density in critical region, Use of Symmetry. Element Quality Criterion:-Jacobian, Aspect ratio, Warpage, Minimum and Maximum angles, Average element size, Minimum Length, skewness, Tetra Collapse etc., Higher Order Element vs Mesh Refinement, Geometry Associate Mesh, Mesh quality, Bolted and welded joints representation, Mesh independent test.		
Unit 3	**1D Finite Element Analysis**	**08 Hrs.**
Consistent Unit System, Introduction to approaches used in Finite Element Analysis (FEA) such as direct approach and energy approach **Bar and Truss Element** - Element stiffness matrix, Assembling stiffness Equation, Load vector, stress and reaction forces calculations. **Temperature effect on Bar Element-** Calculation due to uniform temperature change, Stress and reaction forces calculations.		
Unit 4	**2D Finite Element Analysis**	**08 Hrs.**
Plane Stress-Strain, axi-symmetric problems in 2D elasticity. **Constant Strain Triangle (CST) -** Element Stiffness matrix, Assembling stiffness equation, Load vector, Stress and reaction forces calculations. **Post Processing Techniques** – Check and validate accuracy of results, Average and Un-average stresses, and special tricks for Post Processing. Interpretation of results and design modifications, CAE reports.		
Unit 5	**Non-Linear and Dynamic Analysis**	**08 Hrs.**
Non-Linear Analysis: Introduction to Nonlinear Problems, Comparison of Linear and Nonlinear analysis, Types of Nonlinearities, Stress-strain measures for Nonlinear analysis, Analysis of Geometric, Material Nonlinearity, Solution Techniques for Nonlinear analysis, Newton Raphson Method, Essential steps in Nonlinear analysis. **Dynamic Analysis:** Introduction to Dynamic Analysis, Comparison of Static and Dynamic analysis, Time domain and frequency domain, Types of loading, Simple Harmonic motion, Free vibration, Boundary conditions of free vibration, Solution.		
Unit 6	**Applications of Computer Aided Engineering**	**08 Hrs.**
Computational Fluid Dynamics (CFD): Introduction, Three dimensions of Fluid Dynamics, Equilibrium Equation for a fluid, Conservation form of Fluid flow equation, Integral form of the Conservation Laws. **Injection moulding of Plastics:** Simplification of Mould Geometry for FEA, Material Model for Mould FEA, Boundary Conditions for Mould FEA, Loading of Mould in FEA, Results Analysis. **Simulation for Manufacturing Processes like Casting and Sheet Metal Applications:** Introduction and workflow of Casting Simulation Software and Sheet Metal Applications. **Durability Analysis:** Durability, Reliability and Fatigue**,** FEA bases fatigue analysis viz: Stress-Life approach (S-N method) and Strain-Life approach (E-N method). **Crash Analysis:** Introduction, Explicit time integration schemes, implicit integration schemes. **Noise Vibration and Harshness (NVH) Analysis:** NVH Concepts, Terminology, FEA for structural Dynamics, FEA for Acoustics.		

Books and other resources
Text Books: 1. Gokhale N. S., Deshpande S. S., Bedekar S. V. and Thite A. N., Practical Finite Element Analysis, Finite to Infinite, Pune, 1^{st} Edition, 2008. 2. S. S. Bhavikatti, Finite Element Analysis, New Age International Publishers, Third Edition, 2015. 3. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002. 4. G Lakshmi Narasaiah, Finite Element Analysis, BS Publications / BSP Books, 2nd edition, 2020. 5. J. N. Reddy, An Introduction to the Finite Element Method, Mcgraw Hill Series in Mechanical, 2005. 6. P. Seshu, Text book of Finite Element Analysis, PHI Learning Private Limited, New Delhi, 10^{th} Printing, 2012.
References Books: 1. K. J. Bathe, Finite Element Procedure, Prentice-Hall of India (P) Ltd., New Delhi, 1996. 2. Cook R. D., Finite Element Modeling for Stress Analysis, John Wiley and Sons Inc, 1995. 3. G.R. Liu S. S. Quek, The Finite Element Method- A Practical Course, Butterworth Heinemann, 2013. 4. Fagan M. J., Finite Element Analysis Theory and Practice, Harlow Pearson/Prentice Hall, 2012. 5. S. Moaveni, Finite element analysis, theory and application with Ansys, Pearson, Third Edition, 2011. 6. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill, 2017. 7. Mukhopadhyay M and Sheikh A. H., Matrix and Finite Element Analyses of Structures, Ane Books Pvt. Ltd., 2009 8. Daryl L. Logan, A First Course in the Finite Element Method, Fourth Edition, Thomson Canada Limited, 2007. 9. O.C. Zienkiewicz, The Finite Element Method: Its Basis and Fundamentals, Sixth Edition, Elsevier Butterworth-Heinemann, 2005.
Web References: • **https://nptel.ac.in/courses/112/104/112104116/-** for Basics of Finite Element Analysis by Prof.Nachiketa Tiwari, IIT Kanpur • **https://nptel.ac.in/courses/112/106/112106130/** for Advanced Finite Element Analysis by Dr. R. Krishnakumar, Department of Mechanical Engineering, IIT Madras • **https://nptel.ac.in/courses/112/103/112103299/** for Finite Element Analysis for Welding Analysis by Prof. Swarup Bag, Department of Mechanical Engineering, IIT Guwahati. • **https://sites.ualberta.ca/~wmoussa/AnsysTutorial/** for ANSYS Tutorials

Term Work
The student shall complete the following activity as a Practical using any commercial FEA software or open-source software's 1. 1D Bar Element – Structural Linear Analysis 2. Truss Analysis using 1D Element 3. Plate/Shell Element – Structural Linear and Non-Linear Analysis 4. Beam Element – Non-Linear Buckling Analysis 5. Thermal Analysis – Static/Transient Analysis 6. Coupled Analysis- (Structural + Thermal) 7. Analysis of Machine Component using 3D Elements 8. Non-Linear Analysis of Assembly using Contact Elements 9. Modal Analysis – Spring -Mass system, simply supported/Cantilever beam, etc. 10. Presentation on advanced applications of FEA, NVH, CFD, Crash, Fatigue, Manufacturing, etc. **Note:** • The lab report shall consist of completion of Practical's and Presentations. • Practical examination shall be based on the practical undertaken during the semester.

302051: Design of Transmission Systems

Teaching Scheme		Credits		Examination Scheme	
Theory	3Hrs./Week	Theory	3	In-Semester	30 Marks
Practical	2 Hrs./Week	Practical	1	End-Semester	70 Marks
				Oral	25 Marks

Prerequisites: Classification of Gears, Gear Terminology, Terminology of Helical gear, Virtual number of teeth. Classification, selection and application of Belt, chain and rope drives.

Course Objectives:

1. **APPLY** fundamentals for the design and/or selection of elements in transmission systems.
2. **UNDERSTAND** the philosophy that real engineering design problems are open-ended and challenging.
3. **DEMONSTRATE** design skills for the problems in real life industrial applications.
4. **DEVELOP** an attitude of team work, critical thinking, communication, planning and scheduling through design projects.
5. **PERCEIVE** about safety, ethical, legal, and other societal constraints in execution of their design projects.
6. **BUILD** a holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcomes:

On completion of the course, learner will be able to

CO1.**APPLY** the principle of Spur & Helical gear design for industrial application and PREPARE a manufacturing drawing with the concepts of GD&T.

CO2.**EXPLAIN** and **DESIGN** Bevel & Worm gear considering design parameters as per design standards.

CO3.**SELECT&DESIGN** Rolling and Sliding Contact Bearings from manufacturer's catalogue for a typical application considering suitable design parameters.

CO4.**DEFINE** and **DESIGN** various types of Clutches, Brakes, used in automobile.

CO5.**APPLY** various concept to **DESIGN** Machine Tool Gear box, for different applications

CO6.**ELABORATE** various modes of operation, degree of hybridization and allied terms associated with hybrid electric vehicles.

Course Contents

Unit 1	Spur and Helical Gears	07 Hrs.

Introduction to gears: Material selection for gears, Modes of gear tooth failure, Gear Lubrication Methods.

Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.

AGMA (American Gear Manufacturing Association) approach of Gear design (Only mathematical relations, no numerical)

<table>
<tr><td colspan="3">Helical Gears: Force analysis of Helical Gear, Beam Strength of Helical Gear, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham’s equation. (No numerical on force analysis of helical)</td></tr>
<tr><td>Unit 2</td><td>Bevel and Worm Gear</td><td>08 Hrs.</td></tr>
<tr><td colspan="3">Bevel Gears: Types of Bevel gears, Terminology, Virtual number of teeth, and force analysis of Straight Bevel Gear. Design of Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham’s equation. (Simple numerical to be taken no design calculations)
Worm Gears: Worm and worm gear terminology and proportions of worm and worm gears, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive.
(Simple numerical to be taken no design calculations)</td></tr>
<tr><td>Unit 3</td><td>Sliding and Rolling Contact Bearing</td><td>07 Hrs.</td></tr>
<tr><td colspan="3">Sliding contact bearing (Theoretical treatment only): Introduction to sliding contact bearing, classification, Reynolds’s equation (2D), Petroff’s equations, Sommerfeld number, Parameters of bearing design.
Rolling Contact Bearings: Types of rolling contact Bearings and its selection, Static and dynamic load carrying capacities, Stribeck’s Equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Selection of rolling contact bearings from manufacturer's catalogue, Design for cyclic loads, Types of failure in rolling contact bearings - causes and remedies. (Simple Numerical treatment)</td></tr>
<tr><td>Unit 4</td><td>Design of Clutches and Brakes</td><td>07 Hrs.</td></tr>
<tr><td colspan="3">Clutches: Introduction, Types of clutches, Material, Positive clutches, friction clutches, single plate, multiple plate, Cone clutch, and centrifugal clutches, Application of friction clutches automotive and industrial machinery sector. (Only Theoretical Treatment)
Brakes: Introduction, Types of brakes, Material, Design of band brake, external and internal shoe breaks internal expanding shoe brakes, design of disc brakes. Application of brakes in automotive and industrial machinery sector. (Only Theoretical Treatment)</td></tr>
<tr><td>Unit 5</td><td>Design of M/C Tool Gear Box</td><td>08 Hrs.</td></tr>
<tr><td colspan="3">Introduction to Machine Tool Gearboxes, classification, basic considerations in design of drives and its Applications, Determination of variable speed range, Graphical representation of speed and structure diagram, Ray diagram, selection of optimum ray diagram, Kinematic /Gearing Diagram, Deviation diagram, Difference between numbers of teeth of successive gears in a change gear box.
(Note: Full design problem to be restricted up to 2 Stages only & No design problem on deviation diagram)</td></tr>
<tr><td>Unit 6</td><td>Transmission system in Hybrid Electric Vehicle</td><td>08 Hrs.</td></tr>
<tr><td colspan="3">Introduction, Types of Hybrid Electric Vehicles: Basic Classification, Basic Modes of Operation, Other Derivatives, Degree of Hybridization. Power Split Devices (PSD): Simple and EM compound PSD, HEV Component Characteristics: The IC Engine, Electric Machines, Battery, HEV Performance Analysis: Series HEV, Parallel HEV, HEV Component Sizing: General Considerations, Sizing for Performance, Optimum Sizing, Power Management: Control Potential, Control.</td></tr>
</table>

Books and other resources

Text Books:

1. Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. ltd.
2. Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
3. Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
4. Juvinal R.C, Fundamentals of Machine Components Design, John Wiley and Sons.

References Books:

1. Design Data - P.S.G. College of Technology, Coimbatore.
2. Vehicle Powertrain Systems by Behrooz Mashadi, David Crolla. A John Wiley & Sons, Ltd
3. Automobiles–Power trains and Automobiles–Dynamics by Crolla, David, A John Wiley &Sons, Ltd
4. Automotive Engineering Powertrain, Chassis System and Vehicle Body by David A Crolla, Elsevier B H New York, London, Oxford.
5. lack P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
6. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
7. P. Kannaiah, Design of Transmission systems‖, SCIETCH Publications Pvt Ltd.
8. C.S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
9. D.K. Aggarwal& P.C. Sharma, Machine Design, S.K Kataria and Sons.
10. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
11. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
12. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.

Web References:

1. https://www.youtube.com/watch?v=b42_IO87X4s
2. https://www.youtube.com/watch?v=vTZ4Gah3wfo
3. https://www.youtube.com/watch?v=ER6LC7ONCD8
4. https://www.youtube.com/watch?v=nMsB6Soz4Hc
5. https://www.youtube.com/watch?v=WOTDbCPukoM
6. https://www.youtube.com/watch?v=fMNQglkUfhs
7. https://freevideolectures.com/course/2363/design-of-machine-elements

Term Work
Student shall complete the following activity as a Term Work; The Submission shall consist of completion of Two Design projects and study Assignments. Oral examination shall be based on the practical undertaken during the semester. **Design Project 1 (Any one)** 1. Design of gearbox for wind mill application or sluice gate. (Use AGMA approach) 2. Design of gearbox for building Elevator. (Use AGMA approach) 3. Design of gearbox for Hoist. (Use AGMA approach) 4. Design of gearbox for Worm gear box for Sugar Industry. (Use AGMA approach) 5. Design of clutch system for automobile 6. Design of brake system for automobile **Design Project 2** Projects shall be in the form of design of mechanical systems on multi speed spindle gear box including design of belt and pulley, Prime mover selection etc. The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components. **Assignment: Any Two (PPT Presentation and Report)** 1. Application orientated Numerical on HEV 2. Lubricating oils: Properties, additives, selection of lubricating oils 3. Properties & selection of sliding bearing materials 4. Application of belt, rope and chain drives and its selection method for Industry 5. Transmission system of HEV

302052-A: Composite Materials					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Engineering Materials, Metallurgy, Manufacturing Process, Basic Design aspects.

Course Objectives:

1. **DESCRIBE** what are composite materials and their differences with respect to conventional materials.
2. **COMPREHEND** the challenges associated with Polymer Matrix composites.
3. **UNDERSTAND** the requirement of Metal Matrix Composites
4. **RECOGNIZE** design and properties aspect of composites
5. **UNDERSTAND** the testing, inspection and standard in Composites
6. **ORIENT** to the specific Application of Composites

Course Outcomes:

On completion of the course, learner will be able to

CO1. **DEFINE & COMPARE** composites with traditional materials.

CO2. **IDENTIFY & ESTIMATE** different parameters of the Polymer Matrix Composite

CO3. **CATEGORISE** and **APPLY** Metal Matrix Process from possessions landscape.

CO4. **DETERMINE** volume/weight fraction and strength of Composites.

CO5. **SELECT** appropriate testing and inspection method for composite materials.

CO6. **SELECT** composites materials for various applications.

Course Contents

Unit 1	**Introduction to Composites**	**07 Hrs.**

Definitions, Need of Composites, Classification of Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Natural Composites, Carbon Fiber composites, Properties of composites in comparison with standard materials. Advantages and Disadvantages. Natural Composites, Hybrid materials and their difference with Composite materials, Applications.

Unit 2	**Polymer Matrix Composite**	**08 Hrs.**

Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibers – roving's – woven fabrics – non woven random mats – various types of fibers. PMC processes – hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fiber reinforced plastics (FRP), Glass Fiber Reinforced Plastics (GFRP). Laminated Composites.

Unit 3	**Metal Matrix Composite**	**07 Hrs.**

Characteristics and types of MMC, advantages and limitations of MMC, Reinforcements – particles – fibers. Effect of reinforcement – volume fraction – rule of mixtures. Processing of MMC – powder metallurgy process – diffusion bonding – stir casting – squeeze casting, a spray process, Liquid infiltration In-situ reactions-Interface-measurement of interface properties.

Unit 4	Mechanics of Composite Materials	08 Hrs.
Geometrical aspects – volume and weight fraction (Numerical). Large particle composites and the rule of mixtures for elastic constants, failure, fatigue, and long-term strength, methods of optimum design of materials and structures, Micromechanics of a Lamina, Unidirectional continuous fiber, discontinuous fibers, short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear (Numerical).		
Unit 5	**Testing, Inspection & Standards in Composites**	**07 Hrs.**
Test Environments, Mechanical Test (Tensile, compression, shear & Fatigue) Bond Strength / Ply Adhesion ASTM F904, Testing Techniques for Composite Double Cantilever Beam, End Notch Flexure, Inter laminar Share Strength, Materials Nondestructive Inspection (NDI) of Composites, Thermographic testing of composites. ASTM & ISO standards for composites materials.		
Unit 6	**Application of Composite Materials**	**08 Hrs.**
Applications of Composites material for Aerospace and Transportation application, viz LCA/LCH, Automobile Industry -lightweight, cost-effective, multi-material technology, compatibility with automation systems and rapid processing. Energy Applications-Ecofriendly Prime movers, Infrastructure and Building Applications, Maine Applications- Boats and Ships, Ecofriendly storage Tanks Sports Industry-Protective Equipment's.		

Books and other resources

Text Books:

1. Chawla K.K., Composite materials Science and Engineering, Springer – Springer New York-2016
2. Daniel Gay- Composite Materials- Design and Applications, CRC Press, 2014
3. Autar Kaw- Mechanics of Composite Materials, Taylor and Francis, Second Edition- 2006
4. Robert M Jones-Mechanics of Composite Material, CRC Press, 2018
5. Madhujit Mukhopadhyay - Mechanics of Composite Materials and Structure, University Pres, 2004
6. S.C. Sharma -Composite Materials, Narosa Publishing House—2000

References Books:

1. A Bent Strong- Fundamentals of Composites Manufacturing-Materials, Methods and Applications, Society of Manufacturing Engineers, 2008
2. Clyne T.W. and Withers P.J-Introduction to Metal Matrix Composites, Cambridge University Press, 1995
3. Agarwal B. D. and Broutmen L. J-Analysis and performance of Fiber Composites, Wiley Publicaions-Fourth Edition, 2017
4. M. W. Hyer, Scott R. White- Stress Analysis of Fiber-reinforced Composite Materials, DEStech Publications, Inc., 2009
5. Carl T. Herakovich- Mechanics of Fibrous Composites, Wiley Publicaions, 1998
6. Erich Fitzer, Lalit M. Manocha - Carbon Reinforcements and Carbon /carbon Composites, Springer-Verlag, 1998
7. Murray Schwartz, Mel M. Schwartz- Composite Materials Handbook, McGraw-Hill, 1992
8. Composite Materials Handbook, SAE International, 2017

Web References:

1. Introduction of Composite - https://nptel.ac.in/courses/112/104/112104229/
2. Advanced Composite - https://nptel.ac.in/courses/112/104/112104249/
3. Polymer Process - https://nptel.ac.in/courses/113/105/113105077/
4. Manufacturing of composite - https://nptel.ac.in/courses/112/104/112104221/
5. Processing of Polymer composite - https://nptel.ac.in/courses/112/107/112107221/
6. Composite materials - https://nptel.ac.in/courses/101/106/101106038/
7. Mechanics of laminated of composite - https://nptel.ac.in/courses/112/104/112104161/
8. Composite Materials and Structure - https://nptel.ac.in/courses/101/104/101104010/

302052-B: Surface Engineering					
Teaching Scheme		**Credits**		**Examination Scheme**	
Theory	**3Hrs./Week**	**Theory**	**3**	**In-Semester**	**30 Marks**
				End-Semester	**70 Marks**

Prerequisites: Basic Chemistry, Engineering Materials & Basic Metallurgy concepts

Course Objectives:

1. **DEVELOP** fundamental understanding and role of materials to allow surface selection for mechanical contact surfaces
2. **UNDERSTAND** surface modification and coating method to enhance surface performance
3. **RECOGNIZE** method for testing surface properties

Course Outcomes:

On completion of the course, learner will be able to-

CO1. **DEFINE** the basic's principle & mechanism of surface degradation.

CO2. **ANALYSE & SELECT** correct corrosion prevention techniques for a different service condition.

CO3. **DEMONSTRATE** the role of surface engineering of materials to modify/improve the surface properties.

CO4. **SELECT** the suitable surface heat treatments to improve the surface properties.

CO5. **APPLY** the surface modification technique to modify surface properties.

CO6. **ANALYSE & EVALUTE** various surface coating defects using various testing/characterization method.

Course Contents

Unit 1	Introduction to Surface Engineering and Surface Degradation	08 Hrs.

Introduction to engineering components, surface dependent properties and failures, importance and scope of surface engineering; surface and surface energy; Structure and type of interfaces, surface and related equations; Surface engineering: classification, definition, scope and general principles. Adhesive wear, Abrasive wear, Erosion wear, Polishing wear; Corrosion: definition; Various Forms of Corrosion; Corrosion Triangle, Pilling and Bedworth rule, Formation and growth of films, Concept of Electrode Potential, Concept of Polarization, Electrochemical and galvanic series of metals.

Unit 2	Corrosion Testing and Prevention methods	07 Hrs.

Corrosion Testing –Introduction of Corrosion Testing by Physical (only weight loss & salt spray method) and Electrochemical Methods such as ASTM standard methods only G-5&A262-A.

Corrosion Prevention methods –Metallurgical and Environmental aspects of corrosion, Inhibitors, Internal & External coating, Cathodic & Anodic protection, use of special alloys, Improvement in design/ changes in design to control corrosion.

Unit 3	Surface Treatment Methods	08 Hrs.

Diffusion: Principles of diffusion, Fick"s law, diffusion in solids, Diffusion in liquids; Surface hardening: Carburizing, Carburizing atmosphere and Heat treatment after Case Hardening, Depth of carburization, Case depth measurement, ASTM E1077-01 Depth of carburization, ASTM standard

G105, G95, Bainite control in case, Drip Feed Carburizing, dimensional changes during case hardening; Nitriding, Carbonitriding, Tufftriding, Nitrocarburising, Plasma Nitriding; Induction Hardening, Flame Hardening, Laser Hardening, Selection of steels for these treatments and their applications.		
Unit 4	**Advance Surface Modification Techniques**	**07 Hrs.**
Surface modification processes: ion beam surface treatment; sol-gel coating technology; laser surface alloying. Coating for corrosion resistance: conversion coatings; compound coatings - diamond-like nanocomposites, nitrides, silicides, and carbides. Coating for wear resistance: carbon nitride thin films; sputter deposited nanostructured ceramic coatings; dielectric coatings of Si-C alloy films. Electroless coating.		
Unit 5	**Surface Coating Techniques**	**07 Hrs.**
Introduction; importance of coating; types of coating: metal, inorganic, and organic. Processes of metal coatings: electrodeposition; flame spraying; Cold spray coating; cladding; hot dipping; vapor deposition. Processes of inorganic coatings: spraying; diffusion coating; chemical conversion. Processes of organic coatings: surface preparation; priming coat; top coats, Antidust coating, Hardfacing; Coatings for high temperature, Coatings for aerospace and aircrafts.		
Unit 6	**Surface Evaluation and Characterizations**	**08 Hrs.**
Coating Defects & remedies: Crawling, cratering & related defects; Flooding, wrinkling, Bubbling and Pin-holing, Overspray and Dry Spray, Blushing, foaming, blistering, checking and cracking, blooming, chalking, embrittlement, orange peel, yellowing etc. Measurement of coating thickness; porosity and adhesion of surface coating; measurement of residual stress and stability; Surface microscopy and topography by scanning probe microscopy; spectroscopic analysis of modified surfaces; Surface roughness, Atomic force microscopy.		

Books and other resources

Text Books:

1. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
2. M. Ohring, The Materials Science of Thin Films, Academic Press Inc, 2005.
3. Peter Martin, " Introduction to Surface Engineering and Functionally Engineered Materials", John Willey
4. M. G. Fontana - Corrosion Engineering, 3rd Edition, TATA Mc Graw Hill, 2008.
5. J. R. Davis-Surface Engineering for Corrosion and Wear Resistance, ASM International, 2001
6. R. W. Revie & H.H. Uhlig - Corrosion and Corrosion Control, An Introduction to Corrosion Science & Engineering, 4th Edition, Wiley Inter science , 2008.

References Books:

1. Mircea K. Bologa, "Surface Engineering and Applied Electrochemistry", Springer.
2. Devis, J.R.," Surface Engineering for Corrosion & Wear Resistance", 2001 Maney Publicsing
3. D.R. Jones - Principals and Prevention of Corrosion, 2nd International Edition, Prentice Hall International Singapore, 1995.
4. L. L. Shreir- Corrosion Volume I & II, Butterworths, London, 1994.
5. ASM Handbook Volume 5: Surface Engineering, ASM International, USA, 1994.

Web References:

1. Aqueous Corrosion and Its Control - Course (nptel.ac.in): By Dr. V. S. Raja
2. Corrosion Failures and Analysis - Course (nptel.ac.in):By Dr. KallolMandol
3. Surface Engineering of Nanomaterials - Course (nptel.ac.in): By Prof. Kaushik Pal
4. Fundamentals of Surface Engineering: Mechanisms, Processes and Characterizations - Course (nptel.ac.in)by Prof. D.K. Dwivedi

302053: Measurement Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Basics of Linear measurements and working principles of Electrical and Electronics devices.

Course Objectives:

1. **DEVELOP** necessary skills for calibration and testing of instruments
2. **APPLY** fundamentals of measuring methods by collecting data ,analysis and interpretation
3. **APPLY** knowledge of Designing limiting gauges
4. **APPLY** knowledge of Electronic/Electrical measuring instruments

Course Outcomes:

On completion of the course, learner will be able to-

CO1. **EVALUATE** causes of errors in Vernier calipers, micrometers by performing experiments in standard metrological conditions, noting deviations at actual and by plotting cause and effect diagram, to reduce uncertainty in measurement.

CO2. **ANALYZE** strain measurement parameters by taking modulus of elasticity in consideration to acknowledge its usage in failure detection and force variations.

CO3. **EXAMINE** surface Textures, surface finish using equipment's like Talysurf and analyze surface finish requirements of metrological equipment's like gauges, jaws of vernier calipers, micrometers, magnifying glasses of height gauge and more, to optimize surface finish accuracy requirements and cost of measurement.

CO4. **MEASURE** the dimensional accuracy using Comparator and limit gauges and appraise their usage in actual measurement or comparison with standards set to reduce measurement lead time.

CO5. **PERFORM** Testing of Flow rate, speed and temperature measurements and their effect on performance in machines and mechanisms like hydraulic or pneumatic trainers, lathe machine etc. to increase repeatability and reproducibility.

CO6. **COMPILE** the information of opportunities of entrepreneurships/business in various sectors of metrology like calibrations, testing, coordinate and laser metrology etc in an industry visit report.

Term Work

The student shall complete the following activity as a Term Work

1. Fundamentals of measurements and Calibration process by using Dead weight Tester/Strain Gauges/Pressure Gauge.
2. Linear and angular Measurement: Demonstration and calculations using Vernier Caliper, Screw gauge, Dial gauge, height gauge, Bevel protector etc. and plotting cause and effect diagram for their errors in measurement with the help of OER software's or software's like Minitab or in excel sheet.
3. Limit Gauges: Concepts, uses and applications of Go –No Go Gauges, Taylor's principle and Design of gauges (Numerical and student activity)
4. Surface roughness measurement of a given sample using surface tester. Students should also

plot of flow chart of its usage.

5. Determination of geometry and dimensions of given composite object / single point tool, by using Optical Projector / Tool makers' Microscope and differentiate between its usefulness in real life.
6. Verification of dimensions and geometry of given components using Electric/Mechanical/Optical/Pneumatic comparator in context of manufacturing.
7. Determination of modulus of elasticity of a mild steel specimen using strain gauges and its improvement to reduce cost of measurement.
8. Calibration of Thermocouple for temperature measurement / Experimentation by using Gear Tooth Vernier Caliper
9. Speed Measurement and calibration of photo and magnetic speed pickups for the measurement of speed by using Stroboscope.
10. Calibration for Flowrate measurement by using Anemometers, Ultrasonic flow meters and plotting of Risk Priority Number (RPN) of any of the used equipments.
11. Determination of geometry of a given sample by using Coordinate Measuring Machine as per NPL standard and also acknowledge requirements of ISO 10360-5:2020 in CMM measurement.
12. Applications of Open Education Resources like Scilab in measurement / Students should develop any online calculator/app for calculations/numerical analysis relevant to metrology.

Important Note:

1. Relevant theory to be taught during practical hours
2. Sr. No. 1, 2, 3 and 12 are mandatory and any 4 from Sr. No. 4 to 11.
3. Practical's are to be performed under the guidance of concerned faculty member.

Industry Visit to provide exposure to students (Anyone to be covered to fulfil CO6 essentially)

- Demonstration of CMM with the help of software and its futuristic improvements as per Industry 4.0 requirements.
- Design of Go –No Go gauges and Senor applications with modernization as per IOT and Industry 4.0
- Calibration Process as per NABL accreditation norms
- Laser Metrology and its relevant setup functions to be carried out by engineers along with safety precautions to reduce measurement lead time and uncertainty.
- Temperature Measurements of Furnaces, Boilers etc with its cost analysis
- Flow Measurements of Air, Fluids to reduce measurement lead time

Text Books:

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. D.S.Kumar, Mechanical Measurements and Control Metropolitan Book Co.Pvt.Ltd.
3. I.C.Gupta, Engineering Metrology, Dhanpath Rai.
4. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, McGraw hill Publication.

Reference Books:

1. Narayana K.L., Engineering Metrology.
2. Galyer J.F &Shotbolt C.R., Metrology for engineers
3. Judge A.W., Engineering Precision Measurements, Chapman and Hall
4. Francis T. Farago, Mark A. Curtis, Handbook of dimensional measurement

5. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.
6. Connie Dotson, Fundamentals of Dimensional Metrology, ThamsonPubln. 4th Edition.

Online Education resources: viz. NPTEL web site:

1. nptel.ac.in/courses/112106179
2. www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html
3. https://nptel.ac.in/courses/112/107/112107242/
4. freevideolectures.com › Mechanical › IIT Madras
5. https://nptel.ac.in/courses/112/106/112106139/

302054: Fluid Power & Control Laboratory					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**2 Hrs./Week**	**Practical**	**1**	**Term Work**	**50 Marks**

Prerequisites: Hydraulic fluids, Relay logic and Ladder Logic/PLC programming

Course Objectives:

1. **UNDERSTAND** working principles of control devices and accessories.
2. **SELECT** different components from manufactures' catalogues.
3. **DEMONSTRATE** the capabilities to simulate and design fluid power systems.
4. **UNDERTAKE** digitalization of fluid power system.

Course Outcomes:

On completion of the course, learner will be able to

CO1.**DEFINE** working principle of components used in hydraulic and pneumatic systems.

CO2.**IDENTIFY & EXPLAIN** various applications of hydraulic and pneumatic systems.

CO3.**SELECT** an appropriate component required for hydraulic and pneumatic systems using manufactures' catalogues.

CO4.**SIMULATE & ANALYSE** various hydraulic and pneumatic systems for industrial/mobile applications.

CO5.**DESIGN** a hydraulic and pneumatic system for the industrial applications.

CO6.**DESIGN & DEMONESTRATE** various IoT, PLC based controlling system using hydraulics and pneumatics.

Practical

The student shall complete the following Practical in laboratory

1. Study of fluid power control systems
   a. Fluid Power Engineering Fundamentals
      - Fluid power basics (governing laws used in fluid power systems)
      - Discuss fluid power transmission and explain basic methods of transmission of power
      - Advantages and disadvantages of fluid power systems
      - Explain role of fluid power engineering in today's industrial automation
      - Clarify the aims of automation
   b. Components of Fluid Power System
      - Components of hydraulic system
      - Components of pneumatic systems
      - Draw symbols of hydraulic and pneumatic components
2. Study and trial on actuators
   a. Study of actuators used in hydraulics and pneumatics
      - Introduction
      - Types of actuators
        - Linear actuators
        - Rotary actuators
        - Limited rotary actuators
   b. Test on linear /rotary actuator. Calculate force/speed/rpm/torque as per case.

3. A) Study and trial on Gear/Vane/Piston pump

a. Study of hydraulic pumps.
  - Introduction and classification
  - Advantages of positive displacement pumps
  - Types of pumps
    - External and internal gear pump
    - Vane pumps
    - Piston pumps
      - Axial pumps
      - Radial piston pumps

b. Trial Gear/Vane/Piston pump.

OR

B) Study and testing of pressure control valve.

a. Circuits with pressure control valve i.e. pressure reducing/counterbalance/brake valve/Sequencing circuit

b. Test on pressure relief valve

4. Study and design of compressed air generation and distribution system

a. Reservoir
b. Driers
c. Types of Regulators
d. Filters
e. Lubricators
f. FRL
g. Loop piping system
h. Assignment on calculation (manual/excel sheet/simulation tool) of pressure loss in piping system

5. Study of control valves

a. Introduction
b. Types of control valves
  - Directional control valves
  - Pressure control valves
  - Flow control valves
  - Cartridge valves
  - Proportional control valves/Electro-hydraulics/proportional valves
  - Demonstration of cut-section/transparent/dismantling of any one valve

c. Regenerative circuit
d. Speed control circuits
e. Transverse and feed circuit.

6. Study of accessory used in hydraulic systems

a. Reservoirs
b. Accumulators: weight loaded, spring loaded, gas loaded.
c. Intensifier
d. Fluid conductors/pipes; pipe fittings
e. Demonstration of electro hydraulic circuit/accumulator/intensifier

7. Following experiments to be done on pneumatic trainer

a. Automatic reciprocating circuit
b. Speed control circuit/Flow control valve
c. Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve
d. Electro pneumatic circuits

8. a) Simulation of hydraulic and pneumatic circuits: Design of any two industrial hydraulics and two pneumatic circuits using manufacturers' catalogue and analysis using any open source/free/commercial software or application.

OR

b) Design of industrial hydraulic and pneumatic circuits, selection of components using the manufacturer's catalogue and analysis using any open source/free/commercial software or application.

9. A) Industrial visit. (Automotive workshop, small or medium scale /automation industry)
B) Trouble shooting of fluid power system.

10. Study and implementation of IoT based system to operate electro-pneumatic/hydraulic circuit from a remote location.
i.e. Demonstration of one cycle of operation of cylinder extension by actuation of solenoid and then retraction by deactivation of the solenoid through proximity sensor.

OR

Demonstration of counting and stopping a cycle once the number of the cycle's are completed (using PLC)

OR

any other application of relay ladder logic or PLC. (Equipments required for implementation include Smart Phone, Node MCU, Relay 5 volt to 24 volt and account on cloud.)

Assessment of Term Work

The student shall complete the above mentioned activities and prepare a Term Work Journal;

Important Note:
Term Work of the Student shall be evaluated based on the completion of Practical, Industrial Visit Report and Group Assignment. Continuous evaluation by the faculty shall be done for the award of the Credit associated with the course.

No practical examination shall be conducted for the award of the credit

Books and other resources

Text Books:

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References Books:

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
4. ISO - 1219, Fluid Systems and components, Graphic Symbols
5. Standard manufacturing catalogues
6. Fundamentals of Pneumatics, Vol I, II and III. FESTO
7. Fundamentals of fluid power control, John Watton Cambridge University press 2012
8. Introduction to Fluid power, Thomson Prentcie Hall 2004
9. Hydraulic Control Systems Herbert E. Merritt John Wiley and Sons, Inc

Web References:

URL links:

1. https://nptel.ac.in/courses/112/106/112106175/
2. http://ndl.iitkgp.ac.in/document/QXBqK1czOUpyM3FlamVjTmREMWFEUFdEb25sZ01FZVRtZmhWNXlobUZ0MFJ0Zk1kU1dSYmEwK1RSZG1FMUNDNQ
   Fluid Power Control: Web-Course Module-01 Module-02 Module-03 Module-04

Links of Video Lectures:

1. https://nptel.ac.in/courses/112/106/112106300/
2. https://www.digimat.in/nptel/courses/video/112105047/L01.html

Recommended on line courses: https://nptel.ac.in/course.html

302055: Internship/Mini project				
Teaching Scheme**		Credits	Examination Scheme	
		04	TW	100 Marks

Prerequisites: Knowledge of design, manufacturing processes, modeling, and mechanical systems

Course Objectives:

Internship provides an excellent opportunity to learner to see understand the conceptual aspects learned in classes and deployed into the practical world. Industry/on project experience provides much more professional experience as value addition to classroom teaching.

1. To encourage and provide opportunities for students to get professional/personal experience through internships.
2. To learn and understand real life/industrial situations.
3. To get familiar with various tools and technologies used in industries and their applications.
4. To nurture professional and societal ethics.
5. To create awareness of social, economic and administrative considerations in the working environment of industry organizations.

Course Outcomes:

On completion of the course, learners should be able to

CO1. **DEMONSTRATE** professional competence through industry internship.

CO2. **APPLY** knowledge gained through internships to complete academic activities in a professional manner.

CO3. **CHOOSE** appropriate technology and tools to solve given problem.

CO4. **DEMONSTRATE** abilities of a responsible professional and use ethical practices in day to day life.

CO5. **DEVELOP** network and social circle, and **DEVELOPING** relationships with industry people.

CO6. **ANALYZE** various career opportunities and **DECIDE** career goals.

****Guidelines:**

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply conceptual knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

Duration:
Internship is to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.
Internship work Identification:
Student may choose to undergo Internship at Industry/Govt. Organizations/NGO/MSME/Rural Internship/ Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry. Students must get Internship proposals sanctioned from college authority well in advance. Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/ internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination and before academic schedule of semester VI. Student can take internship work in the form of the following but not limited to: 1. Working for consultancy/ research project, 2. Contribution in Incubation/ Innovation/ Entrepreneurship Cell/ Institutional Innovation Council/ startups cells of institute / 3. Learning at Departmental Lab/Tinkering Lab/ Institutional workshop, 4. Development of new product/ Business Plan/ registration of start-up, 5. Industry / Government Organization Internship, 6. Internship through Internshala, 7. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship, 8. Research internship under professors, IISC, IIT's, Research organizations, 9. NGOs or Social Internships, rural internship, 10. Participate in open source development.
Internship Diary/ Internship Workbook:
Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed every day by the supervisor. Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.
Internship Work Evaluation:
Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by Program Head/Cell In-charge/ Project Head/ faculty mentor or Industry Supervisor based on- Overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities. Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External – a supervisor from place of internship.

Recommended evaluation parameters-Post Internship Internal Evaluation -50 Marks + Internship Diary/Workbook and Internship Report - 50 Marks
Evaluation through Seminar Presentation/Viva-Voce at the Institute
The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria: • Depth of knowledge and skills • Communication & Presentation Skills • Team Work and Creativity • Planning & Organizational skills • Adaptability • Analytical Skills • Attitude & Behavior at work • Societal Understanding • Ethics • Regularity and punctuality • Attendance record • Diary/Workbook • Student's Feedback from External Internship Supervisor
After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. Internship Diary/workbook may be evaluated on the basis of the following criteria: • Proper and timely documented entries • Adequacy & quality of information recorded • Data recorded • Thought process and recording techniques used • Organization of the information The report shall be presented covering following recommended fields but limited to, • Title/Cover Page • Internship completion certificate • Internship Place Details- Company background-organization and activities/Scope and object of the study / Supervisor details • Index/Table of Contents • Introduction • Title/Problem statement/objectives • Motivation/Scope and rationale of the study • Methodological details • Results / Analysis /inferences and conclusion • Suggestions / Recommendations for improvement to industry, if any • Attendance Record • Acknowledgement • List of reference (Library books, magazines and other sources)

Feedback from internship supervisor(External and Internal)

Post internship, faculty coordinator should collect feedback about student with recommended parameters include as- Technical knowledge, Discipline, Punctuality, Commitment, Willingness to do the work, Communication skill, individual work, Team work, Leadership…

Reference:

1. https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf
2. https://internship.aicte-india.org/

IMPORTANT NOTE:

The student shall be encouraged to undertake the industrial internships however the Industry may provide opportunity to a limited few amongst the students available. In such scenario it becomes the moral responsibility of the faculty to create opportunity for such group of students (similar to the ones in Industry) by assigning them some real life problem as a part of the mini project and encouraging/mentoring them to attempt viable solutions. Hence the provision of Mini project is being done to accommodate such students and expose them with the Industrial practices in house. The students can be encouraged to consider analysis of the global patents available as a mini project,

Mini project					
Teaching Scheme		**Credits**		**Examination Scheme**	
Practical	**4 Hrs./Week**	**Practical**	**4**	**Term work**	100

Course Objectives:

Students shall UNDERTAKE and EXECUTE a Mini Project through a group of students to

1. **UNDERSTAND** the "Product Development Cycle", through Mini Project.
2. **PLAN** for various activities of the project and distribute the work amongst team members.
3. **LEARN** budget planning for the project.
4. **INCULCATE** mechanical/interdisciplinary implementation skills.
5. **DEVELOP** students' abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
6. **UNDERSTAND** the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcomes:

On completion of the course, learner will be able to

CO1. **EXPLAIN** plan and execute a Mini Project with team.

CO2. **IMPLEMENT** hardware/software/analytical/numerical techniques, etc.

CO3. **DEVELOP** a technical report based on the Mini project.

CO4. **DELIVER** technical seminar based on the Mini Project work carried out.

Course Contents

Maximum Group Size: Minimum 2 and maximum 4 students can form a group for the mini project.

Project Type: (The selected mini project must be based on any of the following)

1. Development of a prototype mechanical system/product.
2. Investigate performance of mechanical systems using experimental method

3. Parametric analysis of components/systems/devices using suitable software **4.** Investigation of optimum process/material for product development using market survey. **5.** Solution for society/industry problems
The Assessment Scheme will be: *a.* **Continuous Assessment 50 marks** *(based on regular interaction, circuit development)* b. **End Semester 50 marks** *(based on poster presentation, demonstration / Seminar)*
Project domain may be from the following, but not limited to: 1.Thermal Systems 2. Robotics Mechanisms/design systems 3. Production/advance manufacturing 4. Materials: Composite/Nano 5. Automation and Control Systems 6. Mechatronic Systems 7. Agriculture system. 8. Smart systems using AI-ML
A project report with following contents shall be prepared: 1. Title 2. Objectives 3. Relevance and significance 4. Methodology 5. Analysis-Simulation/experimentation/survey/testing etc. 6. Result and Discussion 7. Conclusion

302056: Audit Course VI		
Teaching Scheme	**Credits**	**Examination Scheme**
	Non-Credit	

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from third year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course VI

- Business and Sustainable Development
- Management Information System
- International Business

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BOS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary. • During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the mark-sheet.

Savitribai Phule Pune University

Syllabus for SE (Civil Engineering) 2019 course

(To be implemented from June 2020)

Board of Studies in Civil Engineering

Faculty of Science and Technology

SPPU June 2020

SE Civil

Savitribai Phule Pune University, Pune SE(Civil Engineering) 2019 Course (With effect from Academic Year 2020-21)														
Semester-III														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**			
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
201001	Building Technology and Architectural Planning	03	-	-	30	70	--	-	-	100	03	--	--	03
201002	Mechanics of structure	03	-		30	70		-	-	100	03	-	-	03
201003	Fluid Mechanics	03	-	-	30	70	-	-	-	100	03	-	-	03
207001	Engineering Mathematics III	03	--	01	30	70	25	--	--	125	03		01	04
207009	Engineering Geology	03	-	-	30	70	-	-	-	100	03	-	-	03
201004	Building Technology and Architectural Planning **Lab**	-	04	-	-	-	50		-	50	-	02	-	02
201005	Mechanics of structure **Lab**	-	04	-	-	-	-	-	50	50	-	02	-	02
201006	Fluid Mechanics **Lab**	-	02	-	-	-	-		50	50		01		01
207010	Engineering Geology **Lab**	-	02	-	-	-	25		-	25	-	01	-	01
201007	**Audit Course 1 Awareness to civil Engineering Practices / Road Safety Management / Foreign Language**	--	01	-	-	Grade	-	-	-	Grade	--	--	-	--
Total		15	13	01	150	350	100	--	100	700	**15**	**06**	**01**	**22**

Abbreviations:
H : Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note: Interested students of S.E. (Civil) can opt any one of the audit course from the list of audit courses prescribed by BoS (Civil Engineering)

Note: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self study, NPTEL course lecture and/or using relevant ICT technique

Semester-IV																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
201008	Geotechnical Engineering	03	-	-	30	70	--	-	-	100	03	--	--	03
201009	Survey	03	-		30	70		-	-	100	03	-	-	03
201010	Concrete Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
201011	Structural Analysis	03	-	01	30	70	25	-	-	125	03	-	01	04
201012	Project management	03	--	-	30	70	--	--	--	100	03		-	03
201013	Geotechnical Engineering **Lab**	-	02	-	-	-	-	-	50	50	-	01	-	01
201014	Survey **Lab**	-	04	-	-	-	-	50	-	50		02		02
201015	Concrete Technology **Lab**	-	02	-	-	-	25		-	25	-	01	-	01
201017	Project Based Learning	-	04	-	-	-	50		-	50	-	02	-	02
Total		15	12	01	150	350	100	50	50	700	**15**	**06**	**01**	**22**

Abbreviations:
TH : Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self study, NPTEL course lectures and/or using relevant ICT technique

SEMESTER I

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201001 Building Technology and Architectural Planning
Credits: 3

Teaching Scheme:	**Examination Scheme:**
Theory : 03hrs/week	In-semester : 30 Marks
Practical : 04 hrs/week	End- semester : 70 Marks

Prerequisites:

Fundamentals of Engineering Graphics

Course Objectives:

1. To enumerate different types of structure and their requirement.
2. To describe all basic activities of construction.
3. To study different types of materials, byelaws and Architectural aspects used in construction for civil engineering projects.
4. To plan different building units, Town planning parameters and safety of buildings.

Course Outcomes:

On completion of the course, learner will be able to:

1. Identify types of building and basic requirements of building components.
2. Make use of Architectural Principles and Building byelaws for building construction.
3. Plan effectively various types of Residential Building forms according to their utility, functions with reference to National Building Code.
4. Plan effectively various types of Public Buildings according to their utility functions with reference to National Building Code.
5. Make use of Principles of Planning in Town Planning, Different Villages and Safety aspects.
6. Understand different services and safety aspects

Course Contents

Unit I: Introduction to Building Construction and Masonry. (06 Hours)

a) Introduction to building construction– definition, types of building as per National Building Code. Building components and their basic requirements i.e substructure and superstructure requirements. Introduction to automation in construction

b) Masonry– Introduction of stone masonry and brick masonry, characteristics of good building bricks, IS specification and tests, classification of bricks, types of bonds: English, Flemish, Header, Stretcher, construction procedure, supervision. Recent trends in light weight construction

Form work and casting procedure for reinforced concrete columns, R.C.C. beams, R.C.C. slabs, Slip form work, introduction of underpinning and Scaffolding.

Unit 2: Building bye laws and introduction to Architectural drawing (06Hours)

a) Building Byelaws

Necessity of bye-laws, plot sizes, road width, open spaces, floor area ratio (F.A.R.), concept of

V.P.R. Marginal distances, building line, control line, height regulations, room sizes, Area calculations (built-up area, carpet area etc.), Rules for ventilation, lighting, Vertical circulation, Sanitation and Parking of vehicles.Minimum Standard Dimensions

b) Introduction to Architectural drawing : Principles of Building Planning and Principles of Architectural design relation between form and function, utility, aesthetics, Concept of Line plan, Developed Plan, Elevation, Section, Selection of scales for various drawings, dimensioning, abbreviations and symbols as per IS 962, Elements of perspective drawings, parallel and angular perspective of small building elements.

Unit 3: Building Components: (06 Hours)

a) Doors and Windows: Definition of technical terms, installation of doors and window frames and their size specifications, fixtures and fastenings. Different types of doorsand windows: Ventilators: purpose and types.

b) Arches and Lintels – Introduction of arch construction, **Lintels:** necessity and types, chajja or weather shade necessity and types.

Functional requirement of flooring, types of floor finishes and their suitability, Types of flooring.

Roofing Materials – galvanized iron pre-coated aluminium sheets, fiber sheets. Roof construction types and their suitability, method of construction, Protective Coatings with plastering and finishing.

Unit 4: Residential Buildings and green buildings (06Hours)

a) **Residential Buildings-** Functional requirements and dimensions of Residential Buildings like Bungalows, Twin bungalows, Row houses, Apartment. Prepare Developed Plan, Elevation and Sectional Elevation of above mentioned categories. Design of staircase : Dog legged /Quarter turn

b) **Green Building -**Salient features, benefits, planning concepts of Green Building (site selection, orientation, sun path and wind diagram etc.), introduction to Leadership in Energy and Environmental Design (LEED)

Unit 5: Planning of Public Buildings (06Hours)

Functional requirements and dimensions and planning of Public Buildings like industrial buildings, commercial buildings, School, Colleges , Hostel, Auditorium, Restaurant/ Hotel building, Primary Health Center/ Hospital, Shopping complex, Sports complex, Vegetable market, Post office, and Bank buildings.

Unit 6 (ONLINE): Town Planning and Legal Aspects: (06 Hours)

a) Town Planning and legal aspects: Necessity of town planning. Development plan and its importance, Land use zoning, N.A. Sanction procedure, Introduction to different zones of land in town planning, Aspects of zoning.7/12 abstract, meaning of different terms of 7/12 abstract, Form 6 and its types, Concept of TDR, List of documents to be submitted to local authority. , Introduction to RERA act. Introduction to Maharashtra Regional and Town Planning (MRTP) Act

b) Safety aspects and services –Fire load, grading of occupancies by fire loads, Evacuation Time, fire escape elements, Need for earthquake resistant structures.

Noise and Acoustics – Sound insulation, Acoustical defects, Reverberation time, Sabine's formula, sound absorbents, planning for good acoustics.

Ventilation – Necessity and types of Ventilation.

Lighting -Principles of day lighting,Solar energy systems for lighting (BIPV). **Plumbing** –Types of plumbing system.
Books
Text books: 1. Building Construction by B.C. Punmia, Laxmi Publications. 2. Building Materials by S.V.Deodhar, Khanna Publication. 3. Building Construction by Bindra and Arora, DhanpatRai Publications. 4. Building Drawings with an integrated Approach to Built-Environment by M. G. Shah, C. M. Kale and S. Y. Patki, New Delhi, Tata McGraw Hill. (5th edition.) **Reference books:** 1. Building Materials by S. K. Duggal, New Age International Publishers. 2. Building Construction by S.C. Rangwala, Charotdar Publications. 3. The construction of buildings; seventh edition, Vol.1 & Vol.2 by R. Barry, Oxford: Blackwell Science. 4. Building Materials Technology by Ruth T. Brantley & L. Reed Brantley, Tata McGraw Hill. 5. National Building Code (latest). 6. Building Design and construction by Frederick Merrit, Tata McGraw Hill. 7. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings. 8. Development plan and DCP Rules of urban local body, New Delhi, Volume 12.

Savitribai Phule University of Pune
Second Year Civil Engineering (2019 Course)
201002 Mechanics of Structures

Credit : **3**

Teaching Scheme:
Theory : 03hrs/ week
Practical : 04 hrs/week

Examination Scheme:
In-semester : 30 Marks
End-semester : 70 Marks

Prerequisites:

Fundamentals of Physics, Mathematics and Engineering Mechanics.

Course Objectives:

1. To study various types of stresses for determinate structural members.
2. To learn concept of Shear Force and Bending Moment Diagram for determinate beams.
3. To learn the concept of slope and deflection for determinate structural members.

Course Outcomes:

On completion of the course, learner will be able to:

1. Understand concept of stress-strain and determine different types of stress, strain in determinate, indeterminate homogeneous and composite structures.
2. Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate shear force and bending moment diagram.
3. Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
4. Use theory of torsion to determine the stresses in circular shaft and understand concept of Principal stresses and strains.
5. Analyze axially loaded and eccentrically loaded column.
6. Determine the slopes and deflection of determinate beams and trusses.

Course Contents:

Unit I: Simple Stresses and Strains **(06 Hours)**

a) Materials used in construction and their nature, Hook's Law, Stress-Strain Diagram for elastic, plastic materials and brittle material, Idealized stress-strain diagram , Concept of axial stresses (compression, tension), strains(linear, lateral, shear and volumetric), Elastic constants and their relations. Stresses and strains due to change in temperature.

b) Stresses, strains and deformations in determinate and indeterminate structures for homogeneous and composite structures under concentrated loads and temperature changes.

Unit II: Shear Force and Bending Moment Diagram **(06Hours)**

Concept of shear force and bending moment. Relation between shear force, bending moment and intensity of loading. Shear force and bending moment diagrams for determinate beams due to concentrated, uniformly distributed, uniformly varying loads and couples. Bending moment and loading diagram from given shear force diagram.

Unit III: Shear and Bending Stresses **(06Hours)**

a) Shear stresses in beams: concept of shear, complimentary shear, derivation of shear stress formula, shear stress distribution for various cross sections, maximum and average shear stress for circular and rectangular sections.

b) Bending stresses in beams: theory of simple or pure bending, assumptions, derivation of flexure formula, bending stress distribution diagrams, Moment of Resistance of cross-section.

Unit IV: Torsion of Circular Shaftsand Principal Stresses and Strains **(06Hours)**

a) Torsion of circular shafts: theory of torsion, assumptions, derivation of torsion formula. Stresses, strains and deformations in determinate and indeterminate shafts of hollow, solid, homogeneous cross-sections subjected to twisting moments. Power transmitted by shafts.

b) Principal stresses and strains: concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude and orientation of principal stresses andmaximum shear stress.

Unit V: Axially and Eccentrically Loaded Columns. **(06 Hours)**

a) Axially loaded columns: concept of critical load and buckling, Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions, Rankine's formula, safe load on column and limitations of Euler's formula.

b) Direct and bending stresses for eccentrically loaded short column and other structural components such as retaining walls, dams, chimneys, etc. Effect of lateral force and self-weight. Resultant stress diagrams due to axial loads, uni-axial, and bi-axial bending. Concept of core of section for solid and hollow rectangular and circular sections.

Unit VI: Slope and Deflection of Beams and Trusses **(06Hours)**

a) Slope and deflection of determinate beams by Macaulay's method and Strain energy method, Castigliano's first theorem. Joint displacement of determinate trusses by Unit load method.

Note: Only the concept explanation can be taught through Online teaching mode, however, the problem solving is to be done in offline mode.

Books:

Text books:

1. Mechanics of Structures Vol. I &II by S. B. Junnarkar and Dr. H. J. Shah, Twenty second edition, Charotar Publishing House Pvt Ltd.
2. Strength of Materials by R. Subramanian, Oxford University Press.
3. Strength of Materials by S. S. Ratan, Tata McGraw Hill.

Reference books:

1. Elements of Strength of Materials by Timoshenko and Young, East-West Press Ltd.
2. Strength of Materials by F.L. Singer and Andrew Pytel, Harper and Row Publication.
3. Mechanics of Materials by Beer and Johnston, McGraw Hill Publication.
4. Introduction to Mechanics of Solids by E.P. Popov, Prantice Hall Publication.
5. Mechanics of Materials by Gere & Timoshenko, CBC publisher.
6. Elementary Structural Analysis by Norris, Wilbur and Utku, Tata McGraw Hill Publisher.
7. Intermediate Structural Analysis by R. C. Hibbler, Pearson Education Publishers.

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Pattern)

201003 : Fluid Mechanics

Credits : 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03 hrs/week	In-semester	: 30 Marks
Practical	: 02hrs/week	End-Semester	: 70 Marks

Prerequisites:

Engineering Physics, Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To understand conceptually the properties of fluid, fluid statics, fluid kinematics and fluid dynamics, dimensional analysis, boundary layer theory, open channel flow and fluid flow around submerged objects.
2. Apply principles of continuity, mass, momentum and energy as applied to fluid at rest as well as for fluid flow in open channel.
3. To apply fundamental principles of fluid mechanics for the solution of practical Civil Engineering problems.

Course Outcomes:

At the end of the course, the learners will be able to

1. Understand the use of Fluid Properties, concept of Fluid statics, basic equation of Hydrostatics, measurement of fluid pressure, buoyancy & floatation and its application for solving practical problems.
2. Understand the concept of fluid kinematics with reference to Continuity equation and fluid dynamics with reference to Modified Bernoulli's equation and its application to practical problems of fluid flow
3. Understand the concept of Dimensional analysis using Buckingham's π theorem, Similarity & Model Laws and boundary layer theory and apply it for solving practical problems of fluid flow.
4. Understand the concept of laminar and turbulent flow and flow through pipes and its application to determine major and minor losses and analyze pipe network using Hardy Cross method.
5. Understand the concept of open channel flow, uniform flow and depth-Energy relationships in open channel flow and make the use of Chezy's and Manning's formulae for uniform flow computation and design of most economical channel section.
6. Understand the concept of gradually varied flow in open channel and fluid flow around submerged objects, compute GVF profile and calculate drag and lift force on fully submerged body.

Course Contents:

Unit I: **(07 hours)**

a) <u>Properties of Fluids:</u> <u>Definition of fluid and fluid mechanics: examples and practical</u>

applications, classification of fluids: Real and Ideal, , physical properties of fluids: mass density, specific weight, specific volume, relative density, viscosity, Newton's law of viscosity Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure. **b) Fluid Statics**: Basic equation of hydrostatics, concept of pressure, pressure head, Pascal's Law, measurement of pressure (absolute, gauge), principle of manometers: Balancing liquid column, dead weight, pressure transducers and their types, total pressure and centre of pressure: on plane horizontal, vertical, inclined and curved surfaces: practical applications, **Buoyancy and Floatation:** Principle of floatation and buoyancy, stability of floating and submerged bodies
Unit II: (07 Hours) **a) Fluid Kinematics** Eulerian and Lagrangian approach, velocity and acceleration, and theircomponents in Cartesian co-ordinates, Classification of flows, stream line, stream tube, path line, streak line, control volume. Equation of continuity for 3-D flow in Cartesian co-ordinates, components of rotation, velocity potential, stream function and flow net. **b) Fluid Dynamics:** Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration to get Bernoulli's equation and its limitations, Modified Bernoulli's equation, concept of HGL and TEL, Application of Bernoulli's equation to measure discharge and velocity of flow: Venturimeter, Orifice meter, Rotameter and Pitot tube.
Unit III: (07 Hours) **a) Dimensional Analysis and Model Studies** Dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric, kinematic and dynamic similarity, important dimensionless Numbers (Reynolds No., Froude No., Euler No., Mach no. and Weber No) and their significance, Model Laws (Reynold's law and Froude's Law) **b) Boundary layer Theory** Concept, development of boundary layer on flat plate and factors affecting growth, Boundary layer thickness, displacement thickness, momentum and energy thickness, Laminar sub layer, Local and mean drag coefficients, Hydrodynamically smooth and rough boundary, boundary layer separation and methods to control separation
Unit IV (07Hours) **a) Laminar & Turbulent Flow through Pipe:** Characteristics of laminar flow**,** laminar flow through a circular pipe: Hagen Poiseuille equation**,**Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory, velocity distribution equation, variation of friction factor for laminar flow and for turbulent flow, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram. **b)Flow through pipes:** Energy losses in pipe flow, Equation for major loss and minor losses in pipe, flow through pipes in simple and compound pipe, pipes in series, parallel, Dupit's equation, pipe network analysis by Hardy Cross method, Introduction to siphon.
Unit V (07 Hours) **a) Introduction to Open channel flow:** Classification of channels, channel flows and geometric

elements of channel, Basic governing equations of Channel flow viz. continuity equation, energy equation and momentum equation, One dimensional approach, Velocity distribution in open channel flow.

b) Uniform flow in open channels: Uniform flow formulae: Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient; Important terms pertaining to uniform flow, viz. normal depth, conveyance, section factor, concept of second hydraulic exponent, Uniform flow computations. Most efficient channel sections: rectangular, triangular and trapezoidal. **Depth-Energy Relationships in Open Channel Flow:** Specific energy and Specific force diagram, Depth discharge Diagram, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Important terms pertaining to critical flow viz. section factor, concept of first hydraulic exponent

Unit VI **(07 Hours)**

a) Gradually Varied Flow (GVF) in Open Channel Flow: Theory and Computation

Basic Assumptions of GVF; Dynamic equation of GVF - Alternative forms; Classification of channel bed slopes,Various GVF profiles, Methods of GVF computations: Direct Step method. (mention of other method)

b) Fluid Flow around Submerged Objects:

Practical problems involving fluid flow around submerged objects, Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Introduction to Drag on sphere, cylinder, flat plate and Aerofoil, Karman's vortex street, Development of lift, Introduction to Magnus effect**,** Lift on cylinder and Aerofoil, Polar diagram.

Books:

Text books:

1 Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr P. N. Modi & S. M. Seth Pub: Standard book house, Delhi-6
2. Flow in Open Channels by K Subramanya, Pub: Tata McGraw Hill, New Delhi
3. A Text Book on Fluid Mechanics and Hydraulic Machines by Sukumar Pati Pub: McGraw Hill, New Delhi

Reference books:

1. Engineering Fluid Mechanics by R. J. Garde and A.J Mirajgaonkar, Pub: SCITECH Publications(India)Pvt.Ltd, Chennai
2. Fluid Mechanics and its Applications, Vijay Gupta, Santosh K Gupta, New Age international pvt. Ltd, New Delhi,
3. Fluid Mechanics, Fundamentals and applications by Yunus. A Cengel and John.M Cimbala, Mc Graw Hill International, New Delhi.
4. Fluid Mechanics by Streeter, Wylie and Bedford – Pub: McGraw Hill International, New Delhi.
5. Open Channel Hydraulics by Ven Tee Chow, Pub: Mcgraw- Hill Book Company- Koga.
6. A Text Book of Fluid Mechanics and Hydraulic Machines- by Dr. R K Rajput Pub: S Chand and Co Ltd. New Delhi

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207001 Engineering Mathematics III

Credits: **04**

Teaching Scheme:	**Examination Scheme:**
Theory : 03hrs/ week	In-semester : 30 Marks
Tutorial : 01hrs/week	End-semester : 70 Marks
	Term Work : 25 marks

Prerequisites:

Differential and Integral Calculus, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Permutations & combinations and Vector algebra.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Numerical methods, Statistical methods, Probability theory and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

At the end of this course, students will be able to

1. Solve Higher order linear differential equations and its applications to modelling and analysing Civil engineering problems such as bending of beams, whirling of shafts and mass spring systems.
2. Solve System of linear equations using direct & iterative numerical techniques and develop solutions for ordinary differential equations using single step & multistep methods applied to hydraulics, geotechnics and structural systems.
3. Apply Statistical methods like correlation, regression and probability theory in data analysis and predictions in civil engineering.
4. Perform Vector differentiation &integration, analyze the vector fields and apply to fluid flow problems.
5. Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents:

Unit I: Linear Differential Equations (LDE) and Applications (08 Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Modelling of problems on bending of beams, whirling of shafts andmass spring systems.

Unit II: Numerical Methods (08 Hours)

Numerical solutions of system of linear equations: Gauss elimination method, Cholesky, Jacobi and Gauss-Seidel methods.

Numerical solutions of ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} order and Predictor-Corrector methods.

Unit III: Statistics and Probability **(07 Hours)**

Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test, t-test.

Unit IV: Vector Differential Calculus **(08 Hours)**

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications **(08 Hours)**

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) **(07 Hours)**

Basic concepts, modeling of Vibrating String, Wave equation, One and two dimensional Heat flow equations, method of Separation of variables, use of Fourier series, Applications of PDE to problems of Civil and allied Engineering.

Books:

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Numerical Methods for Engineers,7e by S. C. Chapra and R. P. Canale (McGraw-Hill Education)
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press)
6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993)

Guidelines for Tutorial and Term Work:

Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.

Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207009 Engineering Geology

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Theory	: 03 hrs/week	In-semester	:30 Marks
Practical	: 02 hrs/week	End-semester	: 70 Marks

Prerequisites:

Course Objectives:

1. To get the knowledge of the physical properties of mineral and differentiate between the rocks types, their inherent characteristics with Civil Engineering applications.
2. To learn geomorphic features formed by fluvial, marine processes and their role, Indian stratigraphy and historical geology in civil engineering projects.
3. To comprehend Structural geology applied to civil engineering projects and to get idea about plate tectonics.
4. To acquire and apply knowledge of PGE essential for civil engineering projects.
5. To identify and to enable the Students to examine favorable & unfavorable conditions for the proposed construction of dams, reservoir and tunnels. Precautions and treatments required to improve the site conditions of dams, reservoir and tunnels.
6. To learn the role played by the effect of Ground water, Geological hazards and the requirement and utility of good building stone.

Course Outcomes:

After successful completion of course, students will be able to :

1. Explain about the basic concepts of engineering geology, various rocks, and minerals both in lab and on the fields and their inherent characteristics and their uses in civil engineering constructions.
2. Exploring the importance of mass wasting processes and various tectonic processes that hampers the design of civil engineering projects and its implications on environment and sustainability.
3. Recognize effect of plate tectonics, structural geology and their significance and utility in civil engineering activities.
4. Incorporate the various methods of survey, to evaluate and interpret geological nature of the rocks present at the foundations of the dams, percolation tanks, tunnels and to infer site / alignment/ level free from geological defects.
5. Assess the Importance of geological nature of the site, precautions and treatments to improve the site conditions for dams, reservoirs, and tunnels.
6. Explain geological hazards and importance of ground water and uses of common building stones.

Course Contents:

Unit I: General Geology, Mineralogy and Petrology **(07 Hours)**

a) Introduction to the subject, scope and sub divisions. **General Geology:** The Earth as a planet, Interior & General composition of the Earth, The rock cycle

b) Introduction to mineralogy: Physical Properties of Minerals, Classification of Minerals, silicate and non-silicate minerals, Rock forming minerals.

c) Introduction to petrology and Broad classification of rocks.

Igneous Petrology: Plutonic, Hypabyssal and Volcanic rocks, Structures, Textures and Classification of Igneous rocks. Study of common rock types prescribed in practical work and their engineering applications.

Secondary Petrology: Rock weathering, Sedimentary Structures, lithification and digenesis Process, Genetic classification of secondary rocks and grain size classification and Textures, Study of common rock types prescribed in practical work and their civil engineering applications.

Metamorphic Petrology: Agents, Types of metamorphism, Texture and structures. Study of common rock types prescribed in practical work and their civil engineering applications.

Unit II: Geomorphology and Historical Geology. **(07 Hours)**

a) Geomorphology: Endogenic and Exogenic processes, Geological action by fluvial process i.e. river and Landforms formed it, Aeolian and glacial process, Coastal geomorphology.

b) Historical Geology: General principles of Stratigraphy, Geological time scale w.r.t. Indian geological time scale, Physiographic divisions of India, Archean's&Dharwar formation, Cudappah formations, Vindhyan formations, Gondwana formations, Deccan Trap formations, significance of their structural characters in major civil engineering activities.

Unit III: Structural Geology, Plate Tectonics **(07 Hours)**

a) Introduction to plate tectonics and Mountain building activity.

b) Structural Geology: Out crop, dip and strike, conformable series, unconformity, its types and overlap, faults and their types, folds and their types, inliers and outlier. Civil engineering importance of faults and folds with examples.

c) Structures of rocks: Igneous intrusions and their types, joints and their types, stratification and lamination.

Unit IV: Remote Sensing and G.I.S., Preliminary Geological Studies **(07 Hours.)**

a) Remote sensing (RS): Definition, Stages of Remote sensing, Remote sensing platforms, Active & Passive Remote sensing, Electromagnetic spectrum, visible band, scattering & absorption of EMR in atmosphere and its effect on Satellite Imagery; resolution of satellite images, Elements of remote sensing for Visual interpretation viz.Tone, shape, size, pattern, texture, shadow and Association.

b) Geographical Information System (GIS): Introduction, Definition, tools, applications of remote sensing and geographical information system in Civil Engineering.

c) Preliminary Geological Exploration: reconnaissance survey, Desk Study, surface and subsurface Geological Investigations: Direct methods likeTest& trial pits, pilot trenches, Drilling, Core inspection significance and limitations of it. Indirect methods like Resistivity, seismic survey and its significance and limitations.

Unit V: Role of Engineering Geology in Dams, Reservoirs and Tunneling. (07 Hours.)

a) Geology of Dams & Reservoir: Strength, stability and water tightness of foundation rocks, influence of geological conditions on the choice and type of dam, preliminary geological work on dam and reservoir sites, precautions to be taken to counteract unsuitable conditions and their relevant treatments with case studies.

b) Tunneling: Preliminary geological investigations, important geological considerations while choosing alignment, difficulties during tunneling as encountered due to various geological conditions, Role of groundwater and suitability of common rock types for excavation and tunneling and important case studies in Kasara and BorGhat sections of central railway in Maharashtra and in India, particularly in Himalayas etc.

Unit VI: Geological Hazards, Ground Water and Building Stones. (07 Hours)

a) Geological Hazards: Volcanism, Earthquakes & Seismic zones of India, Landslides and stability of hill slopes and preventive measures.

b) Groundwater: Types of ground water, water table and depth zones, influence of hydro geological properties of rocks, types of aquifers, artesian wells and its geological conditions, artificial recharge of groundwater. Geological work of groundwater, levels, effects of dams and canals, effect of pumping, cone of depression, circle of influence, fluctuations in water table Methods of conservation of groundwater and its management; introduction of watershed management.

c) Building stones: Requirements of good building stone: strength, durability, ease of dressing, appearance, mineral composition, textures and field structures, suitability of common rocks as building stone.

Books:

Text Books:

1. Text Book of Engineering Geology by R.B. Gupte , 2001, P.V.G. Publications, Pune.
2. A Text Book of Engineering Geology by N. ChennaKesavulu. 2010, McMillan India Ltd.
3. Principles of Engineering Geology by D. Venkat Reddy. 2010, Vikas Publishers.

Reference Books:

1. Geology P. K. Mukerjee, World Press
2. Engineering Geology by F. G. H Blyth and De Frietus, Reed Elsevier India
3. Geology for geotechnical engineers, J. C. Harvey, Cambridge University Press
4. Principals of Engineering Geology,S.K. Garg, VikasPublishe
5. Engineering Geology, Parbin Singh
6. Geology and Engineering, K. V. G. K. Gokhale, D. M. Rao ,Tata McGraw Hill.
7. Structural Geology, M. P. Billings, Pearson India Pvt. Ltd.

Any Other book of prominent publisher that is recommended by Geology faculty.

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

201004 Building Technology and Architectural Planning –Lab

Credits: 01

Teaching Scheme:	**Examination Scheme:**
Practical : 04 hrs/week	Term Work : 50 Marks

List of Laboratory Assignments

1. Students shall prepare drawings of types of masonry and Brick bonds (Quarter plate)
2. Prepare sheet showing details of at least two Doors, windows and Arches.(Quarter plate)
3. Draw the line plans of any one residential building and any two Public Buildings (Graph Paper)
4. Perspective drawing of a small building element (Total 2 problems - 1 based on one point and two point each)
5. Floor Plan/ Typical floor plan with construction notes, schedule of openings, of any type of building, Plan, Elevation and Section on separate sheet **(Full Imperial sheet)**
6. Developing typical floor plan drawing exercise completed in assignment number 5, using CAD and Printout of the same.
7. Layout/ Site plan indicating water supply and drainage line (with area statement, make max. four students in one group).
8. **Site Visit** : Any on-going Construction Site (visit report should contain: details of the project, stage of construction, sketches of components with cross section & dimensions, materials used and site plan, etc.)

OR

8. Site Visit : **Green Building**, Salient features like materials used/technology etc, benefits, planning concepts of Green Building (site selection, orientation, sun pathand wind diagram etc.),
9. Document collection: Different sanction forms and at least six brochures of building materials

Report file:

1. It shall consist of data given for the project, Planning considerations and line plans, Design calculations.
2. Terminology of Perspective drawing
3. Dimension standards of Residential building and Public building
4. Visit Report

<table>
<tr><td colspan="2" align="center">Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
201005 Mechanics of Structures-Lab
Credits: 02
Teaching Scheme: Examination Scheme:
Practical : 04 hrs/week   Oral : 50 Marks</td></tr>
<tr><td colspan="2" align="center">List of Laboratory Experiments</td></tr>
<tr><td>Sr. No.</td><td align="center">Group A</td></tr>
<tr><td>1</td><td>Metals
1. Tension test on mild and TMT steel.
2. Shear (Single & Double)test on mild steel.
3. Torsion test on mild steel.
4. Impact (Izod&Charpy) test on mild steel, aluminum, brass.</td></tr>
<tr><td></td><td align="center">Group B</td></tr>
<tr><td>2</td><td>Timber & Ply wood
1. Compression test on timber (Parallel & Perpendicular)
2. Bending test on timber and plywood.</td></tr>
<tr><td></td><td align="center">Group C</td></tr>
<tr><td>3</td><td>Bricks &Tiles
1. Field tests on bricks
2. Water absorption test on bricks.
3. Efflorescence test on bricks.
4. Compressive strength test on bricks
5. Flexural strength of flooring tiles.
6. Abrasion test of flooring tiles.</td></tr>
<tr><td>5</td><td>One Assignment on each unit of this subject.</td></tr>
<tr><td>6</td><td><u>Assignment on Influence Line Diagram (ILD) of Reactions, Shear Force and Bending moment of determinate beams.</u></td></tr>
<tr><td>7</td><td>Market survey of structural materials including its costing.</td></tr>
<tr><td colspan="2">Oral : Based on above syllabus</td></tr>
</table>

*** The concept explanation part can be taught through Online teaching mode, however, the problem solving needs offline mode.**

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
201006 : Fluid Mechanics - Lab
Credits : 01

Teaching Scheme:
Practical : 02hrs/week

Examination Scheme:
Oral : 50 Marks

The Term work shall consists of Experiments (09), Assignments(02) and Visit Report (01)

Term work:

A) Any nine experiments of below mentioned experiments, out of which **first seven are compulsory:**

1. Measurement of viscosity of fluid by Redwood/Saybolt viscometer.
2. Experimental verification of Bernoulli's theorem with reference to loss of energy.
3. Calibration of Venturimeter / Orifice meter.
4. Determination of Darcy-Weisbach friction factor (*f*) for a given pipe and study of variation of *f* with Reynolds Number (*Re*).
5. Flow around a Circular Cylinder/Aerofoil.
6. Study of Uniform Flow Formulae for Open channel.
7. Velocity Distribution in Open Channel Flow.
8. Calibration of Rectangular and Triangular Notch.
9. Determination of Stability of Floating Bodies using Ship Model
10. Drawing Flow net by Electrical Analogy for flow below Weir (with & without sheet pile)
11. Measurement of Pressure using different Pressure Measuring Devices (including Transducers /state of arts Digital Instruments also).
12. Measurement of Surface Tension.
13. Determination of Minor Losses inPpipes

B) Assignments: Any two assignments of below mentioned**. First assignment is compulsory.**
1. Analysis of pipe network using Hardy Cross Method (minimum two loops) – both by hand calculations and using computer any language/software solution.
2. Developing a Demo Model related to any fluid flow phenomenon (physical model/soft model).
3. Demonstration of any Software related to Fluid Mechanics/Hydraulics.
4. GVF computation using any computer Language/Software.

C) Site visit : Report on Site visit to any one of the Research Institute like **CWPRS, WALMI, MERI etc.**

Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
207010 Engineering Geology - Lab
Credits: 01

Teaching Scheme:	**Examination Scheme:**
Practical : 02 hrs/week	Term Work : 25 Marks

List of Laboratory Assignments:

Following experiments are to be compulsorily performed. Term work shall consist of journal giving details of the experiments performed.

1. Megascopic identification of following mineral specimens (around 50).

Rock Forming Minerals, Economic Minerals and Ore Minerals such as:

Silica group: Rock Crystal, Rosy Quartz, Transparent Quartz, Milky Quartz, Smoky Quartz, Amethyst, Chalcedony, different varieties of Agate, Jasper Banded Hematite Jasper

Feldspar group: Orthoclase, Microcline, Plagioclase **Mica group**: Muscovite, Biotite

Olivine group: Olivine **Pyroxene group:** Augite, Diopside, Hypersthene, **Amphibole group**: Hornblende, Asbestos, **Zeolite and other group:** Apophyllite, Stilbite, different varieties of Calcite, Gypsum Tourmaline, Chromite, Limonite, Laterite, Kyanite, Graphite, Hematite, Micaceous Haematite, Pyrite, Garnet etc.

2. Megascopic identification of following different rock specimens.(Around 50).

a) Igneous Petrology: Plutonic, Hypabyssal, Volcanic Rocks and their varieties like Granites , Syenite, Pegmatite, Graphic Granite, Dolerite,Andesite,Diorite, Gabbro, Rhyolite, Pumice, Trachyte, All varieties of Basalt like Compact, Giant Phenocryst Basalt (GPB),Amygdaloidal, Pipe A.B, Volcanic Breccia, Tachylytes,Tuff breccia.

b) Sedimentary Rocks: Rudaceous, Areanceous, Argillaceous, Chemical and Organic Deposits: Laterite, Bauxite, Conglomerates, Secondary Breccia, varieties of Sandstones (Red), Grit,Arkose sandstone, Sandstone with Ripple marks, Sandstone (Current Bedding), Shahabad Limestone, Black Limestone (Cudappah), Stalactite Limestone, Oolitic limestone, Shelly Limestone, Mudstone, Shale (White), Shale (Yellow), Shale (Black).

c) Metamorphic Petrology: Contact Metamorphic rocks, Dynamothermal Metamorphic rocks: Quartzite's, Marbles, Phyllite, Slate, varieties of Schists (Mica Schist, Biotite Schist with Garnet, Muscovite Schist, Chlorite Schist, Hornblende Schist, Chlorite Schist, Talc Schist, Quartz Sericite Schist), varieties of Gniesses (Augen Gneiss, Hornblende Biotite Gneiss, Hornblende Gneiss), Khondalite, Charnockite, Amphibolite.

3. **Interpretation and construction of geological sections from contoured geological maps (A. G. Series—IV Total 8 maps and 2 maps to be constructed by the faculty members.)**

4. Solution of engineering geological problems such as alignment of dams, tunnels, roads, canals, bridges, etc. based on geological maps.

5. Logging of drill core and interpretation of drilling data with graphical representation of core log.

6. Two Site visits are desirable to study various geological features.

7. GRAM++ software and open source software like QGIS, ARCGIS software may be optional to perform.

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Pattern)

Awareness to Civil Engineering Practices

Audit Course I

Teaching Scheme:

Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Civil Engineering is the oldest engineering profession comprising of a variety of sub-disciplines such as Structural Engineering, Geotechnical, Water resources, Environmental Engineering, Construction technology, Transportation Engineering etc. Undergraduate programs are designed with different theoretical approaches on the application of basic sciences to solve different societal problems by engineering knowledge. However, there is a need to make the students aware about how the Civil Engineering industry operates and how theories taught in different courses are applied in practice. The students can learn from the experience gained from different workplaces such Civil Engineering consultancies, contracting companies, construction sites etc. The course aims to provide insight of the different practices followed by the industry such as use of different documents & contracts in Civil Engineering practice, drawings required, engineering ethics, duties and responsibilities of the engineers, site records and diaries, health and safety practices on site.

Course Objectives:

1. To provide basic overview of functioning of different Civil Engineering related industries / firms.
2. To create awareness about application of different drawings, contract documents in Civil Engineering.
3. To provide insight of code of ethics, duties and responsibilities, health and safety as a Civil Engineer.

Course Outcomes:

On completion of the course, learner will be able to…

CO1: Describe functioning/working of different types of industries/sectors in Civil Engineering.

CO2: Describe drawings and documents required and used in different Civil Engineering works.

CO3: Understand the importance of Code of Ethics to be practiced by a Civil Engineer and also understand the duties and responsibilities as a Civil Engineer.

CO4: Understand different health and safety practices on the site.

Course Contents (During 1hr. Practical Session per week)

Unit I: Sectors in Civil Engineering **(03 Hours.)**

Details of different Sectors/sub-disciplines in Civil Engineering along with the following details: description, eminent institutes in India & abroad, related research institutes, noteworthy projects, higher education, latest & ongoing research in the domain, jobs opportunities in government as well as private sector.

Suggestion for effective content delivery:

Lecture cum interaction by alumni of your college working in different sectors of Civil Engineering

Unit II: Drawings and Documents **(03 Hours.)**

Types of drawings in different construction projects. Contract agreement & other documents in different construction projects.

Suggestion for effective content delivery:

i.] Visit to various construction sites/ architectural firms/ structural engineering firms etc. to understand drawings, documents & working culture.

ii.] Lecture by professional practitioner

Unit III: Engineering Ethics **(03 Hours.)**

Introduction, moral issues and moral dilemmas. Code of ethics in Civil Engineering followed by Construction Industry Development Council (CIDC) of India, national & international associations and institutes. Effective case studies (Minimum 2 case studies).

Suggestion for effective content delivery:

Case study based content delivery menthod, Lecture by professional practitioner

Unit IV: Construction Site Safety **(03 Hours.)**

Importance of site safety. Different health and safety parameters during actual execution of Civil Engineering constructions. Safety measures: conventional and modern.

Suggestion for effective content delivery:

On site visit & lecture by professional practicing Safety Engineer.

Guidelines for Assessment (Any one or more of following but not limited to)

1. Group discussion
2. Presentation
3. Mini Project / Activity
4. Site visit report
5. Guest lecture report

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
Road Safety Management
Audit Course I

Teaching Scheme:
Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory implementation of regulations have been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the world statistics; but the comparable proportion for accidents is substantially large. The need for strict enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the important stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Objectives:

1. To provide basic overview on road safety & traffic management issues in view of the alarming increase in vehicular population of the country.
2. To explain the engineering & legislative measures for road safety.
3. To discuss measures for improving road safety education levels among the public.

Course Outcomes:

On completion of the course, learners will be able to…

CO1: Summarize the existing road transport scenario of our country

CO2: Explain the method of road accident investigation

CO3: Describe the regulatory provisions needed for road safety

CO4: Identify the safety issues for a road and make use of IRC's road safety manual for conducting road safety audit.

Course Contents (During 1hr Practical Session per week)

Unit I: Existing Road Transport Scenario **(02 Hours.)**

Introduction, national & international statistics related to road transport. Factors responsible for increase in vehicle growth. Share of public transport: importance and current scenario (national & international)

<u>Suggestion for effective content delivery:</u> Displaying updated and authentic statistics & real time scenario images during the session.

Unit II: Road Accidents & its Investigation **(03 Hours.)**

Definition of road accident. National & international statistics related to road accidents. Causes of road accident. Remedies / Measures for control road accidents. Methods for accident investigation. Condition diagram & collision diagram. Black spots & its identification based on accident data.

Suggestion for effective content delivery:

i.] Activity related to drawing condition & collision diagram based on actual accident data.

ii.] Activity related to identification of black spots based on actual accident data

Unit III: Motor Vehicle Act & Central Motor Vehicle Rules (03 Hours.)

The Motor Vehicle Act of 1988. Central Motor Vehicle Rules (CMVR) of 1989. Amendments to CMVR – 2017 & 2019.

Suggestion for effective content delivery:

i.] Guest lecture by RTO Officer / Traffic Police Officer.

ii.] Public awareness campaign

Unit IV: Road Safety Audit (RSA) (04 Hours.)

Introduction & importance of RSA. Methodology, phases and checklists for Road Safety Audit as per IRC SP: 88 – 2010 (Manual on Road Safety Audit)

Suggestion for effective content delivery:

Mini project – Conducting Road Safety Audit on minimum 2 km (both directions included) road stretch in the nearby vicinity.

Guidelines for Conduction(Any one or more of following but not limited to)

1. Guest Lectures.
2. Visits and reports.
3. Assist government authorities like Municipal corporations, RTO in Road Safety Audits
4. Mini Project

Guidelines for Assessment(Any one or more of following but not limited to)

1. Written Test
2. Practical Test
3. Presentation
4. Report

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Pattern)

Foreign Language

Audit Course I

Teaching Scheme:

Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

The institute can offer any foreign language as audit course as per the teaching scheme depending upon the demand of the students and availability of the faculty

SEMESTER II

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201008 Geotechnical Engineering
Credits: 03

Teaching Scheme:	**Examination Scheme:**
Theory : 03 hrs/week	In-semester : 30 Marks
Practical : 02hrs/week	End-Semester : 70 Marks

Prerequisites :

Fundamentals of Physics, Mathematics, Engineering Mechanics

Course Objectives:

1. To describe soil properties, classification and its behavior under stress.
2. To learn methods for measurements and determination of index & engineering properties of soil.
3. To study the interaction between water and soil and the effects of static vs flowing water on soil strength

Course Outcomes:

On completion of the course, learner will be able to,

1. Identify and classify the soil based on the index properties and its formation process
2. Explain permeability and seepage analysis of soil by construction of flow net.
3. Illustrate the effect of compaction on soil and understand the basics of stress distribution.
4. Express shear strength of soil and its measurement under various drainage conditions.
5. Evaluate the earth pressure due to backfill on retaining structures by using different theories.
6. Analysis of stability of slopes for different types of soils.

Course Contents

Unit I: Introduction and Index Properties **(06 Hours)**

a) Introduction to Geotechnical Engineering and its applications to Civil Engineering.(Types of soil structure, major soil deposits of India), Field identification of soils. {Introduction to soil exploration: objective and purpose.}

b) Three phase soil systemweight **–** volume relationships, Index properties of soil: Methods of determination and their significance. [IS and Unified Soil classification systems.]

Unit II: Permeability and Seepage. **(06 Hours)**

a)Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. (Laboratory measurement of permeability: Constant head method and Falling head method as per IS 2720.) {Field test for determination of permeability- Pumping in test and Pumping out test as per IS 5529 Part-I.}Permeability of stratified soil deposits.

b) Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation).[Flow Net, properties and application]Flow Net construction for flow under sheet pile and earthen dam.

Unit III: Compaction and Stress Distribution. **(06 Hours)**

a) Compaction – Introduction, Comparison between compaction and consolidation.[Compaction tests- Standard Proctor test, Modified Proctor test]. Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. (Field compaction methods and compaction equipment for different types of soil), Placement water content, Field compaction control- use of compaction test result. {Proctor needle in field compaction control.}

b) Stress Distribution in Soils – Geostatic stress, Boussinesq's theory with assumptions for point load and circular load (with numerical), Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method.Approximate stress distribution method.

Unit IV: Shear Strength of Soil. **(06 Hours)**

a) Introduction – Shear strength an Engineering Property. Mohr's stress circle, Mohr- Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. [Peak and Residual shear strength], {factors affecting shear strength.} (Stress-strain behaviour of sands and clays.)

b) Measurement of Shear Strength – Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. Their suitability for different types of soils, advantages and disadvantages. Different drainage conditions for shear tests. (Sensitivity and thixotropi of cohesive soils.)

Unit V: Earth Pressure. **(06 Hours)**

a) Earth Pressure – Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. [Rankine's Theory: Earth pressure on Retaining wall due to submerged backfill.]

b) Backfill with uniform surcharge, backfill with sloping surface, layered backfill.

(Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure.)

Unit VI: Stability of Slopes. **(06 Hours)**

a) Stability of Slopes – Classification of slopes and their modes of failure, Stability of slope: i) Taylor's stability number, ii) Swedish slip circle method, iii) Friction circle method, iv) Bishop's method. (Infinite Slopes in cohesive and cohesion less soil,) {Landslides- Causes and remedial measures.}

Books:
Text Books: 1. Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Laxmi Publications. 2. GeotechnicalEngineeringbyShashiK.Gulati&ManojDatta,TataMcGrawHill. 3. Geotechnical Engineering by T N Ramamurthy & T G Sitharam, S Chand Publications. **Reference Books:** 1. GeotechnicalEngineeringbyC.Venkatramaiah,NewAgeInternationalPublishers. 2. Principles of Geotechnical Engineering by Braj M. Das, Cengage Learning. 3. Geotechnical Engineering by P.Purushothma Raj, Tata Mc GrawHill. 4. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education. 5. Basic and Applied Soil Mechanics by GopalRanjan and A. S. R. Rao, Newage International. 6. Physical and Geotechnical Properties of Soils by Joseph E. Bowles, International StudentsEdition. **e-Resources:** 1. http://ascelibrary.org/page/books/s-gsp. 2. http://accessengineeringlibrary.com/browse/geotechnical-engineersportable-handbook-second edition. 3. http://nptel.ac.in/courses/105101084/ 4. http://nptel.ac.in/courses/105106142/

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201009 Surveying
Credit : 3

Teaching Scheme:
Theory: 03hrs/ week
Practical: 04 hrs/week

Examination Scheme:
In-semester : 30 Marks
End-semester : 70 Marks

Pre- requisites:

Basic Introduction to Civil Engineering field,Engineering Mathematics

Course Objectives:

With the successful completion of the course, the student should have the capability to:

1 Describe the function of surveying in civil engineering construction,
2 Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
3 Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
4 Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments.
5 Be able to identify hazardous environments and take measures to insure one's personal and team safety
6 Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and plotting.
7 Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
8 Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
9 Calculate, design and establish curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Course Outcomes:

On successful completion of this course, Student will be able to:

1. Define and Explain basics of plane surveying and differentiate the instruments used for it.
2. Express proficiency in handling surveying equipment and analyse the surveying data from these equipment.
3. Describe different methods of surveying and find relative positions of points on the surface of earth.
4. Execute curve setting for civil engineering projects such as roads, railways etc.
5. Articulate advancements in surveying such as space based positioning systems

6. Differentiate map and aerial photographs, also interpret aerial photographs.

Course Contents

Unit I: Compass and Levelling. **(08 Hours)**

a) Definition and Importance of Surveying; Principles of Surveying,

b) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Construction and use of prismatic compass, Concept of bearing &, types of bearings such as Whole Circle Bearing, Quadrental Bearing, meridian and their types, local attraction and correction for local attraction, dip, declination and calculation of true bearings, including numericals of all types.

c) Equipment required for plane table surveying, uses, advantages and disadvantages and errors in plane table surveying. Methods of plane table Survey Radiation, intersection, traversing and resection –

d) Introduction to leveling, Types of leveling, Types of benchmarks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principal axes of dumpy level, testing and permanent adjustments reciprocal leveling, curvature and refraction corrections, distance to the visible horizon. Collimation Plane Method, Rise & Fall Method

Unit II: Theodolite Surveying **(08 Hours)**

a) Study of vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

b) Theodolite traversing – computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

Unit III: Tacheometry and Contouring. **(06 Hours)**

a) **Tacheometry –** applications and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring. Numericals

b) **Contouring** – Definition of Contours, Characteristics of Contours, Contour Patterns for various natural features, direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications

Unit IV: Curves. **(07 Hours)**

Introduction to horizontal and vertical curves (including numericals but derivation not expected), different types of curves and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), Transition curves: necessity.

Unit V: Construction Survey & Modern Techniques such as Space Based Positioning System (SBPS) (06 Hours)

a. Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals)., Setting out of a bridge, Determination of the length of the central line and the location of piers. Setting out of a tunnel – Surface setting out and transferring the alignment underground.

b. Introduction to SBPS, SBPS systems - GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

Unit VI: Introduction to Geodetic Survey, Hydrograph Survey & Aerial Photogrammetry (07 Hours)

Introduction to Geodetic Survey, Objects, Methods of Geodetic Surveying, Introduction to triangulation and trilateration, Objective of triangulations surveys, Classification of triangulation systems, Triangulation figures, Strength of figure, Study and use of one second theodolite and Electronic Total Station,

Introduction to Hydrographic Survey Objects, Applications, Shore line survey, Sounding, Sounding equipment, Methods of Sounding & Sounding Equipment, Stream gauging,

Three point problem

Aerial Photogrammetry Objects, Classification- qualitative & quantitative photogrammetry, Applications, comparison of Map and aerial photographs, Flight Planning , Calculation of no of Photographs.

Books:

Text Books:

1. Surveying and Levelling Vol. I and Vol. II by T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan.
2. Surveying, Vol. I & II by Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain, Laxmi Publications.
3. Plane Surveying & Higher Surveying by Dr A. M. Chandra, New age international publishers New Delhi.

Reference Books:

1. GPS Satellite Surveying—Alfred Leick—Wiley
2. Principles of Geographical Information System—Burrough-- Oxford University Press
3. Surveying—M. D. Saikia—PHI Learning Pvt .Ltd. Delhi
4. Advanced Surveying -Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathikumar and N. Madhu , Pearson publication
5. Surveying & levelling by R. Subramanian, Oxford Publication.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering
201010 Concrete Technology
Credits: 03

Teaching Scheme:	**Examination Scheme:**
Theory : 03 hrs/week	In-semester : 30 Marks
Practical : 02 hrs/week	End-semester : 70 Marks

Course Objectives:

1. To know properties of various ingredients of concrete and concept of mix design.
2. To learn the behavior and propertiesof concrete infresh and hardened state.
3. To understand special concrete and their applications.
4. To understand the durability aspects and preventive measures to enhance the fife of concrete.

Course Outcomes:

1. Able to select the various ingredients of concrete and its suitable proportion to achieved desired strength.
2. Able to check the properties of concrete in fresh and hardened state.
3. Get acquainted to concreting equipments, techniques and different types of special concrete.
4. Able to predict deteriorations in concrete and get acquainted to various repairing methods and techniques.

Course Contents

Unit I: Introduction to Concrete and Ingredients of Concrete. **(06 Hours)**

a) Cementand Aggregate– Manufacture, chemical composition, hydration, physical and mechanical properties, classification, types and application of cement, tests on cement, Classification of aggregate, physical and mechanical properties of aggregate, deleterious materials in aggregate, alkali-aggregate reaction, Fineness and gradation of aggregates using sieve analysis, tests on aggregates.

b) Water and Admixtures –Quality of water for use in concrete, role of admixture, classification and types of admixtures like accelerators, retarders, plasticizers, super plasticizers, mineral admixtures-fly ash, silica fume, ground granulated blast furnace slag.

Unit II: Production, Properties and Testing of Fresh Concrete **(06 Hours)**

a) Production and Properties of Fresh Concrete: Nominal mixes, Water-cement ratio, Process of manufacturing fresh concrete-batching, mixing, transportation, compaction, curing of concrete, curing methods, influence of temperature, maturity rule, workability and factors affecting workability, cohesion and segregation.

b) Tests on fresh concrete – Workability by slump cone, compaction factor, Vee-Bee consistometer and flow table apparatus, Effect of admixture on workability of concreteand optimum dosage of admixture by Marsh cone test.

Unit III: Properties and Testing of Hardened Concrete **(06 Hours)**

a) Hardened concrete – Strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, relation between tensile and compression strength, impact strength, abrasion resistance, creep and shrinkage.

b) Testing of hardened concrete –Destructive tests -compression strength, flexural strength, indirect tensile strength, core test. Nondestructive tests: rebound hammer, ultrasonic pulse velocity, pullout test and impact echo test.

Unit IV: Concrete Mix Design and Methods of Mix Design **(06 Hours)**

a)Concrete Mix Design– Concept and objectives of concrete mix design, factors affecting the mix design, quality control, variability of laboratory test result, acceptance criteria, Grade designation and IS requirements as per IS 456 (Exposure conditions, minimum & maximum cement content and maximum W/C ratio

b) Methods of Mix Design: IS code method and DOE method (with and without mineral admixture), Use of spreadsheet/programming/ software for concrete mix design.

Unit V: Concreting Equipments, Techniques and Special concretes **(06 Hours)**

a) Concreting Equipments and Techniques–Batching plants, concrete mixers, hauling, pumps, concrete vibrators and compaction equipments. Special concreting techniques- ready mix concrete, under water concreting, roller compacted concrete, cold and hot weather concreting.

b) Special concretes – Light weight concrete and its types, foam concrete, no fines concrete, self compacting concrete, high density concrete, fiber reinforced concrete,geo-polymer concrete and Ferrocement technique.

Unit VI: Deterioration and Repairs in Concrete **(06 Hours)**

a) Deterioration –Durability, factors affecting the durability of concrete, Permeability, sulphate attack, acid attack, chloride attack, corrosion of reinforcement, carbonation of concrete

b) Repairs – Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects using various types and techniques – shotcrete and grouting. Introduction to retrofitting of concrete structures by fiber reinforced polymer (FRP), polymer impregnated concrete. Corrosion monitoring and preventive measures.

Books:

Text Books:

1. Concrete Technology by M. S. Shetty, S Chand,New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.
3. Concrete technology by A. M. Neville, J.J. Brooks, Pearson.

Reference Books:

1. Concrete Technology by A. R. Shantakumar, Oxford University Press, 2018.
2. Properties of Concrete by A. M. Neville, Longman Publishers.
3. Concrete Technology by R.S. Varshney, Oxford and IBH.
4. Microstructure and Properties of Concrete by P. Kumar Mehta, Prentice Hall.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
6. Concrete Structures, Repair, Rehabilitation and Retrofitting by J. Bhattacharjee, CBS Publishers & Distributors Pvt. Ltd.
7. Durability Design of Concrete Structures, by A. Sarja and E. Vesiari, E & FN Spon Publication, 1996.

IS Codes : Latest revised editions of IS codes: IS 456, IS 269, IS 1489, IS 4031, IS 383, IS 2386, IS 9103, IS 516, IS 1199, IS 10262, SP 23.IS 13311.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201011: Structural Analysis
Credits : 03

Teaching Scheme:		**Examination Scheme :**	
Theory	: 03 hrs/week	In-semester	: 30 Marks
Tutorial	: 01 hrs/week	End-semester	: 70 Marks
		Term Work	: 25 Marks

Prerequisites:

Fundamentals of Physics, Mathematics, Engineering Mechanics andMechanics of Structures

Course Objectives:

1. This subject will build on the concepts from Engineering Mechanics and Mechanics of Structures.
2. This will create a foundation for analyzing real life structures by imparting knowledge about various methods involved in the analysis of indeterminate structures.

Course Outcomes:

On completion of the course, learner will be able to:

1. Understand the basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.
2. Analyze redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.
3. Implement application of the slope deflection method to beams and portal frames.
4. Analyze beams and portal frames using moment distribution method.
5. Determine response of beams and portal frames using structure approach of stiffness matrix method.
6. Apply the concepts of plastic analysis in the analysis of steel structures.

Course Contents

Unit I: Fundamentals of structure and analysis of redundant beams. (07 Hours)

a)Types and classification of structures based on structural forms, concept of indeterminacy, static and kinematics degree of indeterminacy.

b) Analysis of propped cantilever, fixed beam and continuous beams with indeterminacy up to second degree by strain energy method.

Unit II: Analysis of redundant pin jointed frames and multi-storied multi-bay 2-D rigid jointed frames. (07Hours)

a) Analysis of redundant trusses by unit load method for external loading, lack of fit, sinking of support and temperature changes (indeterminacy up to second degree).

b) Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Cantilever method and Portal method.

Unit III: Slope-Deflection Method. **(07 Hours)**

a) Slope-deflection equations, equilibrium equation of Slope-deflection method, application of Slope deflection method to beams with and without joint translation and rotation, yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid joint rectangular single bay single storey portal frames using Slope-deflection method. (Involving not more than three unknowns)

Unit IV: Moment Distribution Method. **(07 Hours)**

a) Stiffness factor, carry over factor, distribution factor, application of Moment distribution method of analysis to beams with and without joint translation and yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid jointed rectangular single bay single storey portal frames using Moment distribution method (Involving not more than three unknowns).

Unit V: Stiffness method. **(07Hours)**

a) Fundamental concepts of flexibility and stiffness, relation between them. Stiffness method of analysis- Structure approach only. Application to beams (Involving not more than three unknowns).

b) Application of Stiffness structure approach to rigid jointed rectangular portal frames (Involving not more than three unknowns).

Unit VI: Plastic Analysis of Structure. **(07Hours)**

True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, static and kinematic methods of analysis, upper bound, lower bound and uniqueness theorem. Plastic modulus of section, Plastic moment, shape factor. Plastic analysis of determinate and indeterminate beams, single bay single storied portal frame.

Books:

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Ltd.
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
3. Structural Analysis: A Matrix Approach by G.S.Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited.

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd.
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd.
4. Structural Analysis by R. C. Hibbler, Pearson Education.
5. The Plastic Methods of Structural Analysis by B. G. Neal, Champman& Hall.
6. Structural Analysis by AslamKassimali, Cengage Learning India Private Limited
7. Matrix Analysis of Framed Structures by William Weaver Jr. and James M. Gere, Springer

Tutorial: Every student should solve at least five problems on each unit covering all the topics listed in syllabus. The TW marks will be based on the tutorial.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201012 Project Management
Credit : 3

Teaching Scheme:	**Examination Scheme:**
Theory:3hrs / week	In-semester : 30 Marks
	End-semester : 70 Marks

Prerequisites:

Fundamentals of Management, Indian Construction Industry, Economics.

Course Objectives:

Students will be able to:

1. **Describe** the various concepts involved in Project Management.
2. **Explain** scientific methods of planning and management
3. **Segregate** the materials as per their annual usage and **explain** process to find production rate of construction equipment
4. **Demonstrates** methods of manpower planning and **Use** various project monitoring methods.
5. **Discuss** engineering economics and different laws associated with project management.
6. **Differentiate** the methods of project selection and **recommend** the best economical project.

Course Outcomes:

On completion of the course, student will:

1. **Describe** project life cycle and the domains of Project Management.
2. **Explain** networking methods and their applications in planning and management
3. **Categorize** the materials as per their annual usage and also **Calculate** production rate of construction equipment
4. **Demonstrates** resource allocation techniques and **apply** it for manpower planning.
5. **Understand** economical terms and different laws associated with project management
6. **Apply** the methods of project selection and **recommend** the best economical project.

Course Contents:

UNIT I Introduction to Project Management (06 Hours)

Importance, Objectives & Functions of Management, Principles of Management, Categories of Project, Project Failure, Project--- Life Cycle Concept and Cost Components, Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and Certified Project Management Professionals (PMP). Importance of Organizational Structure in Management- Authority / Responsibility Relation, Management By Objectives (MBO)

UNIT II Project Planning and Scheduling (06 Hours)

WBS – Work Breakdown Structure, Gantt / Bar chart & its Limitations, Network Planning, Network analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical Path and Type of Floats, Precedence Network Analysis (A.O.N.), Types of Precedence Relationship, P. E. R.T. Analysis

UNIT III Project Resources and Site Planning (06 Hours)

Objectives of Materials Management – Primary and Secondary Material Procurement Procedures -

Material Requirement - Raising of Indents, Receipts, Inspection, Storage, Delivery, Record Keeping – Use of Excel Sheets, ERP Software, Inventory Control - ABC Analysis, EOQ, Introduction to Equipment Management – Fleet Management, Productivity Studies, Site Layout and Planning, Safety Norms – Measures and Precautions on Site, Implementation of Safety Programs

UNIT IV Project Monitoring and Control **(06 Hours)**

Resource Allocation – Resource Smoothening and Leveling, Network Crashing – Time- Cost – Resource Optimization, Project Monitoring - Methods, Updating and Earned Value Analysis, Introduction to Use of Project Management Software's – MS Project / Primavera, Case study on Housing Project Scheduling for a Small Project with Minimum 25 Activities.

UNIT V Project Economics **(06 Hours)**

Introduction to Project Economics - Definition, Principles, Importance in Construction Industry, Difference between Cost, Value, Price, Rent, Simple and Compound Interest, Profit, Cash flow Diagram, Annuities and its Types, Demand, Demand Schedule, Law of Demand, Demand Curve, Elasticity of Demand and Supply, Supply Schedule, Supply Curve, Elasticity of Supply Equilibrium, Equilibrium Price, Equilibrium Amount, Factors Affecting Price Determination, Law of Diminishing Marginal Utility, Law of Substitution, Concept of Cost of Capital, Time Value of Money, Sources of Project Finance.

UNIT VI Project Appraisal **(06 Hours)**

Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility Report and Detailed Project Report (DPR), Role of Project Management Consultants in Pre-Tender and Post-Tender.

Books:

Text Books:

1.Project planning and Control with PERT and CPM by DR. B.C. Punmia and K.K.Khadelwal Publisher: Firewall Media, Laxmi publication New Delhi.

2.Project management Principles and Techniques by B.B. Goel Publisher: Deep and Deep publisher

Reference Books:

1. Project Management—Khatua—Oxford University
2. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
4. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
5. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
6. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
7. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.
8. Engineering Economics by R.Panneerselvam Publisher-PHI Learning; 2nd edition (2014)

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201013 Geotechnical Engineering-Lab

Credit : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs / week	Oral : 50 Marks

List of Laboratory Experiments / Assignments

The term work shall consist of a journal giving details of at least 11 out of 13 of the following experiments.

1. Water content determination by any two methods a) Oven drying method, b) Infrared moisture method, c) calcium carbide method
2. Specific gravity determination by Pycnometer /density bottle.
3. Sieve analysis, particle size determination and IS classification as per I.S. Codes.
4. Determination of Consistency limits and their use in soil classification as per I.S. Codes.
5. Field density test by a) Core cutter b) Sand Replacement and c) Clod method
6. Determination of coefficient of permeability by a) Constant head and b) Variable head method.
7. Direct shear test.
8. Unconfined compression test.
9. Vane Shear test.
10. Triaxial test
11. Standard Proctor test / Modified Proctor test.
12. Differential free swell test.
13. Swelling Pressure test
14. **Assignments on the following topics** (Any 2):
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.
    c) Collection of sample soil investigation report for any construction project.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201014 : Surveying - Lab
Credit : 01

Teaching Scheme:	Examination Scheme:
Practical: 4 hrs / week	Practical : 50 Marks

List of Laboratory Experiments

a) Perform any Eight Experiments out of 1 to 10 and Any 02 assignments & projects are mandatory:

1. Measurement of magnetic bearings of sides of a triangle or quadrilateral, correction for local attraction and calculations of true bearings using prismatic compass.
2. Plane table survey consisting of both Radiation and Intersection method. Actual mapping of small structure like an area map from central commanding area / small building using combination of both methods.
3. Finding horizontal distance and vertical elevation using a Tacheometer.
4. Simple and differential levelling with at least three change points using digital level.
5. Measurement of horizontal angles (by repetition method) and vertical angles using 1" and 20" Vernier Transit Theodolite. Setting the required horizontal and vertical angles
6. Setting out a circular curve by Rankine's method of deflection angles.
7. Setting out a building from a given foundation plan (minimum six co-ordinates)
8. Study and use of nautical sextant and measurement of horizontal angles
9. Study of the instruments used in hydrographic surveying.
10. Practical based on various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stakeout.

Mandatory Assignments: (Minimum 02)

1. Spatial database creation by using GIS software like Google earth or any other.
2. Brief Introduction to City Survey.
3. Study of aerial photograph and finding out the scale of the photograph.
4. Determination of air base distance using mirror stereoscope.

b) Projects:(Minimum Two)

1. Road project using Auto level for a minimum length of 100 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-section.

2. Tachometric contouring project on hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours using both methods, manual as well as using any suitable software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).

3. Total Station Traversing

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201015 Concrete Technology - Lab
Credit : 01

Teaching Scheme: Practical: 2 hrs / week

Examination Scheme: Term work : 25 Marks

List of Laboratory Assignments

The term work shall consist of a journal giving details of all the following experiments.

A] Cementitious materials:

1. Fineness of cement and fly ash (by sieve method)
2. Standard consistency Initial and final setting time and Soundness of cement.
3. Compressive strength of cement
4. Tensile strength of cement (**Optional**)

* Fineness of cement by Blains Air permeability method (**<u>Video demo</u>**)
* Soundness of cement by Autoclave method (**<u>Video demo</u>**)

B] Filler Materials (Fine & coarse aggregate)

1. Fineness modulus, Moisture content, silt content, bulk density and specific gravity of fine aggregate.
2. Fineness modulus, Moisture content, water absorption, bulk density and specific gravity of coarse aggregate.

C] Concrete

1. Concrete mix design by IS code method and DOE **<u>using spread sheet/excel sheet</u>**.
2. Workability of concrete with and without admixture by slump cone, compaction factor, and or Vee-BeeConsistometer apparatus.
3. Compressive strength test of concrete on cubes by destructive and non-destructive method rebound Hammer and Quality of concrete by ultra-sonic pulse velocity (**<u>demo Video</u>**).
4. Compressive strength test of concrete on cylinder (Stress –strain behavior- **<u>demo Video</u>**).
5. Indirect tensile strength and flexural strength of hardened concrete.
6. Site visit to RMC plant.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201017 Project Based Learning
Credits: 02

Teaching Scheme:	**Examination Scheme:**
Practical : 04hrs/week	Term Work: 50 Marks

Preamble:

Project Based Learning (PBL) was introduced in curriculum of First Year Engineering in Semester II (Course code- 110013) in 2019 course. In that course, students in group might have planned, managed and completed a task/ project/ activity which addressed the stated problem. In a continuation with this, PBL is introduced in core course of Civil Engineering. PBL demonstrates the power of student projects to develop college, community connections, applied research skills and higher levels of student thinking. PBL is a dynamic approach to teaching in which students explore real-world problems and challenges simultaneously developing 21st century Civil Engineering skills while working in collaborative groups. The aim of this course is to demonstrate the important attributes like communication, presentation, organization, time management, research, inquiry, self-assessment, group participation, leadership and critical thinking. Performance assessed on an individual basis and takes into account the quality of task/project/activity completed, the depth of content understanding demonstrated and the contributions made to the ongoing process of project realization. PBL allows students to reflect upon their own ideas and opinions and make decisions that affect project outcomes and the learning process in general.

Course Objectives:

1. To engage students in constructive learning environment and develop self-learning abilities.
2. To develop critical thinking and solving civil engineering problems by exploring and proposing sustainable solutions.
3. To integrate knowledge and skills from civil and other engineering areas.
4. To develop professional skills and project management.

Course Outcomes:

After completion of course the students will be able to

1. Identify the community/ practical/ societal needs and convert the idea into a product/ process/ service.
2. Analyse and design the physical/ mathematical/ ICT model in order to solve identified problem/project.
3. Create, work in team and applying the solution in practical way to specific problem.

Course Content

- <u>Introduction to Project Based Learning, Traditional vs. Cognitive Learning, Why PBL? , Principles of Problem Design Seven Steps of Problem Design, Online PBL, Applications and Research Trends Case Studies in Civil Engineering.</u>

Group Structure:

- Working in mentor – monitored groups. The students identify, plan, manage and complete a task/ project/ activity which address the stated problem related to civil engineering.
- There should be team/group of maximum four students.
- A supervisor / mentor faculty teacher assigned to individual groups.

Selection of Project/Problem:

At start of course revision of PBL, significance, guidelines and evaluation parameters should be discussed commonly at start of semester. In this session basics PBL, in brief research methodology points relevant to PBL, sample case studies related to civil engineering and brief information about patent, copy right and publications should be given.

Selection of project/problem related to any technical aspect of civil engineering is recommended or if any project/problem selected in first year engineering related to civil engineering can be continued if enough potential is there. Give preference to select project/problem related to solving any problem/ issue for which suitable model can be developed or software can be used. The project/problem selected could have different alternative solutions which could be theoretical, practical, working model, demonstration or software analysis. The project/problem selected may have multi-disciplinary approach to get the solution. Problem needs to refer back to a particular practical, scientific, or technical domain. It is recommended to include hands-on activities, organizational and field visits, expert consultation to make students aware with current use of technologies. Proper representation of project/problem, course work and report on the results and conclusion is important for assessment of course.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both students' performance and program effectiveness. Progress and review of PBL is monitored regularly on weekly basis. It is recommended to appoint one teaching faculty as a mentor per group/ batch and it will be duty of mentor to perform monitoring and continuous assessment of individual students as well as entire group for their performance. College/ Department is required to provide necessary assistance. It is the responsibility of students to follow guidelines of their group mentor, maintain self-discipline, authentic collaboration, peer learning and personal responsibility, motivation and adopt interactive learning environment. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes. Intermittent review and assessment of each group should be done after six weeks from the start of the semester. Each group has to submit their work at end of semester during the end review. Group may demonstrate their knowledge and skills through presentation by developing a model/product/poster and report. Individual assessment for each student (Understanding individual capacity, role and involvement in the project). Group assessment (roles defined, distribution of work, intra-team communication and togetherness).

Evaluation and Continuous Assessment:

Prepare "**PBL Log Book**" which includes record of activities performed and evaluation carried out with appropriate remarks. Maintain regular record on weekly basis. Records and documents must also be maintained at student level. Continuous assessment sheet must be prepared by each faculty which consists assessment made on weekly basis also performance made during mid-review and end-review. PBL log book must be maintained as a record even after completion of semester. It will serve as document which will reflect the punctuality, accountability, technical writing ability and project workflow.

Recommended parameters for assessment, evaluation and weightage:

Evaluation criteria and respective percentage weightage for marks.

1. Idea Inception = 5%
2. Solution provided/ final product at end of course = 50% (Individual assessment and team assessment).
3. Documentation in the form of PBL report (typed, hard copy) = 15%
4. Presentation/ Demonstration of model/ PPT/ poster = 10%
5. Participation/ involvement in group activity =10%
6. Publication/ participation on technical platform = 10%

Course assessment rubrics can be prepared based on the given evaluation parameters for excellent, moderate, acceptable and not acceptable.

References:

1. M. Savin-Baden and C. Howell Major, Foundations of Problem-based Learning. McGraw-Hill Education, 2004
2. T. J. Newby, D. A. Stepich, J. D. Lehman and J. D. Russell, Instructional technology for teaching and learning: Designing instruction, integrating computers, and using media. Englewood Cliffs, NJ: Merrill/Prentice-Hall, 1996
3. S. N. Alessi and S. R. Trollip, Multimedia for learning: methods and development. Needham Heights, MA: Allyn& Bacon, 2001
4. Guerra, Aida, Ulseth, Ronald, Kolmos, Anette, PBL in Engineering Education: International Perspectives on Curriculum Change, Springer, 2017
5. MahnazMoallemWoei Hung Nada Dabbagh, The Wiley Handbook of Problem-Based Learning, Wiley, 2019
6. Jane I. Krauss, Suzanne K. Boss, Thinking Through Project-Based Learning: Guiding Deeper Inquiry.
7. John Larmer, David Ross, John R. Mergendollar, Project Based Learning (PBL) Starter Kit.
8. William N. Bender, Project-Based Learning: Differentiating Instruction for the 21st Century.
9. Bob Lenz, Justin Wells, Sally Kingston, Transforming Schools Using Project-Based Learning, Performance Assessment, and Common Core Standards.
10. Suzie Boss with John Larmer (ASCD/Buck Institute for Education), Implementing Project-Based Learning Solutions by Suzie Boss

Website for references

1. www.pblwork.org
2. www.my.pblworks.org
3. www.swayam.gov.in/nd2_ntr20_ed12/preview
4. www.schoology.com

Format of PBL report: Sequence of pages:

i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Synopsis v) Contents vi) List of

Figures vii) List of Tables vii) Notations

Chapter 1 Introduction (This consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives and 1.4 Scope of the Project Works, 1.5 Research Methodology, 1.6 Limitations of study, 1.7 Expected outcome.

Chapter 2 Literature Review (It shall include theoretical support, details regarding work done by various persons, methods established, any new approach.

Chapter 3 Planning Schedule/ Flow Chart for Completion of Project

Chapter 4 Conclusion

References and Bibliography (The references and bibliography shall include name of author/code/manual/book, title of paper/code/manual/book, name of the journal, month & year of publication, volume number/ISBN number, page number x-y. The references and bibliography shall be as per universal standards as mentioned in any international journal of professional body).

Report Printing details:

1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on **Both** sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Faculty of Science and Technology
Savitribai Phule Pune University
Maharashtra, India

http://unipune.ac.in

Curriculum
for
Second Year of Computer Engineering
(2019 Course)
(With effect from 2020-21)

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Table of Contents

Savitribai Phule Pune University

Bachelor of Computer Engineering

Program Outcomes (POs)

Learners are expected to know and be able to–

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1	**Professional Skills**-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying complexities.
PSO2	**Problem-Solving Skills**- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.
PSO3	**Successful Career and Entrepreneurship**- The ability to employ modern computer languages, environments and platforms in creating innovative career paths to be an entrepreneur and to have a zest for higher studies.

Savitribai Phule Pune University

Second Year of Computer Engineering (2019 Course)

(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
210241	Discrete Mathematics	03	-	-	30	70	-	-	-	100	03	--	-	03
210242	Fundamentals of Data Structures	03	-	-	30	70	-	-	-	100	03	-	-	03
210243	Object Oriented Programming (OOP)	03	-	-	30	70	-	-	-	100	03	-	-	03
210244	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
210245	Digital Electronics and Logic Design	03	-	-	30	70	-	-	-	100	03	-	-	03
210246	Data Structures Laboratory	-	04	-	-	-	25	50	-	75	-	02	-	02
210247	OOP and Computer Graphics Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210248	Digital Electronics Laboratory	-	02	-	-	-	25	-	-	25	-	01	-	01
210249	Business Communication Skills	-	02	-	-	-	25	-	-	25	-	01	-	01
210250	Humanity and Social Science	-	-	01	-	-	25	-	-	25	-	-	01	01
210251	Audit Course 3													
										Total Credit	15	06	01	22
	Total	**15**	**12**	**01**	**150**	**350**	**125**	**75**	**-**	**700**	**-**	**-**	**-**	**-**

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Term work	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
207003	Engineering Mathematics III	03	-	01	30	70	25	-	-	125	03	--	01	04
210252	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
210253	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
210254	Microprocessor	03	-	-	30	70	-	-	-	100	03	-	-	03
210255	Principles of Programming Languages	03	-	-	30	70	-	-	-	100	03	-	-	03
210256	Data Structures and Algorithms Laboratory	-	04	-	-	-	25	25	-	50	-	02	-	02
210257	Microprocessor Laboratory	-	02	-	-	-	25	-	25	50	-	01	-	01
210258	Project Based Learning II	-	04	-	-	-	50	-	-	50	-	02	-	02
210259	Code of Conduct	-	-	01	-	-	25	-	-	25	-	-	01	01
210260	Audit Course 4													
										Total Credit	15	05	02	22
	Total	**15**	**10**	**02**	**150**	**350**	**150**	**25**	**25**	**700**	**-**	**-**	**-**	**-**

General Guidelines

1. Every undergraduate program has its own objectives and educational outcomes. These objectives and outcomes are furnished by considering various aspects and impacts of the curriculum. These **Program Outcomes (POs)** are categorically mentioned at the beginning of the curriculum (ref: NBA Manual). There should always be a rationale and a goal behind the inclusion of a course in the curriculum. Course Outcomes though highly rely on the contents of the course; many-a-times are generic and bundled. The **Course Objectives**, **Course Outcomes** and **CO-PO mappings matrix** justifies the motives, accomplishment and prospect behind learning the course. The Course Objectives, Course Outcomes and CO-PO Mapping Matrix are provided for reference and these are indicative only. The course instructor may modify them as per his or her perspective.

2. @:**CO and PO Mapping Matrix** (Course Outcomes and Program Outcomes)- The **expected** attainment mapping matrix at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The mark '-' indicates that there is no correlation between the respective CO and PO.

3. **#:Elaborated examples/Case Studies-** For each course, contents are divided into six units-I, II, III, IV, V and VI. Elaborated examples/Case Studies are included at the end of each unit to explore how the learned topics apply to real world situations and need to be explored so as to assist students to increase their competencies, inculcating the specific skills, building the knowledge to be applicable in any given situation along with an articulation. One or two sample exemplars or case studies are included for each unit; instructor may extend the same with more. **Exemplar/Case Studies** may be assigned as self-study by students and to be excluded from theory examinations.

4. *:For each unit contents, the desired content attainment mapping is indicated with Course Outcome(s). Instructor may revise the same as per their viewpoint.

5. For laboratory courses, set of suggested assignments is provided for reference. Laboratory Instructors may design suitable set of assignments for respective course at their level. Beyond curriculum assignments and mini-project may be included as a part of laboratory work. The Inclusion of few optional assignments that are intricate and/or beyond the scope of curriculum will surely be the value addition for the students and it will satisfy the intellectuals within the group of the learners and will add to the perspective of the learners.

6. For each laboratory assignment, it is essential for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set and comparative/complexity analysis (as applicable). Batch size for practical and tutorial may be as per guidelines of authority.

7. For each course, irrespective of the examination head, the instructor should motivate students to read and publish articles, research papers related to recent development and invention in the field.

8. For laboratory, instructions have been included about the conduction and assessment of laboratory work. These guidelines are to be strictly followed. Use of open source software is appreciated.

9. **Term Work**[1]–Term work is continuous assessment that evaluates a student's progress throughout the semester[1]. Term work assessment criteria specify the standards that must be met and the evidence that will be gathered to demonstrate the achievement of course outcomes. Categorical assessment criteria for the term work should establish unambiguous

standards of achievement for each course outcome. They should describe what the learner is expected to perform in the laboratories or on the fields to show that the course outcomes have been achieved. It is recommended to conduct internal monthly practical examination as part of continuous assessment.

Students' work will be evaluated typically based on the criteria like attentiveness, proficiency in execution of the task, regularity, punctuality, use of referencing, accuracy of language, use of supporting evidence in drawing conclusions, quality of critical thinking and similar performance measuring criteria.

10. **Laboratory Journal-** Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD or similar media containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Submission of journal/ term work in the form of softcopy is desirable and appreciated.

11. **Tutorial**[1] - Tutorials can never be an individual course but an additional aid to the learners. Tutorials help the learners to inculcate the contents of the course with focused efforts on small group of the learners. Tutorial conduction should concentrate more on simplifying the intricacies converging to clear understanding and application. **Assessment of tutorial work is to be done in a manner similar to assessment of term-work; do follow same guidelines.**

12. **Audit Course**[1]: The student registered for audit course shall be awarded the grade AP/PP (Audit Course Pass) and the grade 'AP'/'PP' shall be included in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP'/'PP'' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

13. **$**:For courses 210249: Business Communication Skills, 210250: Humanity and Social Science and 210260: Code of Conduct, one credit can be earned by student if student successfully completes the Swayam course as listed in curriculum of respective course in this document.

UGC has issued the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016 advising the Universities to identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. AICTE has also put out gazette notification in 2016 and subsequently for adoption of these courses for credit transfer [2].

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. This is done through a platform that facilitates hosting of the courses to be accessed by anyone, anywhere at any time. Courses delivered through SWAYAM are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However, learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated center on specified dates. Eligibility for the certificate is generally announced on the course page. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.[2]

Note: For Examination rules, pattern and assessment please refer [1]

[1]http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202019/Rules%20and%20Regulations%20F.E.%202019%20Patt_10.012020.pdf
[2] https://swayam.gov.in/about

Abbreviations		
TW: Term Work	**TH: Theory**	**PR: Practical**
OR: Oral	**TUT: Tutorial**	**Sem: Semester**

Semester III

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210241: Discrete Mathematics

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisites: Basic Mathematics

Companion Course : ---

Course Objectives:

To introduce several Discrete Mathematical Structures found to be serving as tools even today in the development of theoretical computer science.

- To introduce students to understand, explain, and apply the foundational mathematical concepts at the core of computer science.
- To understand use of set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
- To acquire knowledge of logic and proof techniques to expand mathematical maturity.
- To learn the fundamental counting principle, permutations, and combinations.
- To study how to model problem using graph and tree.
- To learn how abstract algebra is used in coding theory.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.

CO2: Apply appropriate mathematical concepts and skills to solve problems in both familiar and unfamiliar situations including those in real-life contexts.

CO3: Design and analyze real world engineering problems by applying set theory, propositional logic and to construct proofs using mathematical induction.

CO4: Specify, manipulate and apply equivalence relations; construct and use functions and apply these concepts to solve new problems.

CO5: Calculate numbers of possible outcomes using permutations and combinations; to model and analyze computational processes using combinatorics.

CO6: Model and solve computing problem using tree and graph and solve problems using appropriate algorithms.

CO7: Analyze the properties of binary operations, apply abstract algebra in coding theory and evaluate the algebraic structures.

Course Contents

Unit I	Set Theory and Logic	(07 Hours)

Introduction and significance of Discrete Mathematics, **Sets–** Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. **Types of Sets** – Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set, **Propositional Logic-** logic, Propositional Equivalences, Application of Propositional Logic- Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.

#Exemplar/Case Studies	Know about the great philosophers- Georg Cantor, Richard Dedekind and Aristotle
*Mapping of Course Outcomes for Unit I	CO1, CO2, CO3

Unit II	Relations and Functions	(07 Hours)

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Relations and their Properties, n-ary relations and their applications, Representing relations, Closures of relations, Equivalence relations, Partial orderings, Partitions, Hasse diagram, Lattices, Chains and Anti-Chains, Transitive closure and Warshall's algorithm. **Functions-** Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.		
#Exemplar/Case Studies	Know about the great philosophers-Dirichlet	
***Mapping of Course Outcomes for Unit II**	CO2,CO4	
Unit III	**Counting Principles**	**(07 Hours)**
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.		
#Exemplar/Case Studies	Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hank-shake Puzzle and algorithm to solve it.	
***Mapping of Course Outcomes for Unit III**	CO2,CO5	
Unit IV	**Graph Theory**	**(07 Hours)**
Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path-Dijkstra's Algorithm, Planar Graphs, Graph Colouring.		
#Exemplar/Case Studies	Three utility problem, Web Graph, Google map	
***Mapping of Course Outcomes for Unit IV**	CO1,CO2,CO6	
Unit V	**Trees**	**(07 Hours)**
Introduction, properties of trees, Binary search tree, tree traversal, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network).		
#Exemplar/Case Studies	Algebraic Expression Tree, Tic-Tac-Toe Game Tree	
***Mapping of Course Outcomes for Unit V**	CO1,CO2,CO6	
Unit VI	**Algebraic Structures and Coding Theory**	**(07 Hours)**
The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and Congruence relations, Rings, Integral Domains and Fields, Coding theory, Polynomial Rings and polynomial Codes, Galois Theory –Field Theory and Group Theory.		
#Exemplar/Case Studies	Cryptography used in world war II	
***Mapping of Course Outcomes for Unit VI**	CO1, CO2, CO7	
Learning Resources		

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics"‖, TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.

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Reference Books:

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”‖, Tata McGraw-Hill, ISBN 978-0-07-288008-3
2. Bernard Kolman, Robert C. Busby and Sharon Ross, “Discrete Mathematical Structures”‖, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
3. Narsingh Deo, “Graph with application to Engineering and Computer Science”, Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Eric Gossett, “Discrete Mathematical Structures with Proofs”, Wiley India Ltd, ISBN:978-81-265-2758-8.
5. Sriram P.and Steven S., “Computational Discrete Mathematics”, Cambridge University Press, ISBN 13: 978-0-521-73311-3.

e-Books:

- https://www.ebookphp.com/discrete-mathematical-structures-6th-edition-epub-pdf/
- http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf
- https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
- http://home.iitk.ac.in/~arlal/book/mth202.pdf

MOOC/ Video Lectures available at:

- https://www.nptel.ac.in/courses/106/106/106106094/
- https://nptel.ac.in/courses/106/106/106106183/
- https://nptel.ac.in/courses/106/103/106103205/
- https://nptel.ac.in/courses/106/105/106105192/
- https://nptel.ac.in/courses/111/106/111106050/
- https://nptel.ac.in/courses/111/106/111106102/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	2	-	-	-	-	-	-	-	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-
CO4	1	2	-	2	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-	-
CO6	-	2	1	2	-	-	-	-	-	-	-	-
CO7	1	2	2	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210242: Fundamentals of Data Structures		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: Data Structures Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To understand the standard and abstract data representation methods.
- To acquaint with the structural constraints and advantages in usage of the data.
- To understand various data structures, operations on it and the memory requirements
- To understand various data searching and sorting methods.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Design** the algorithms to solve the programming problems, **identify** appropriate algorithmic strategy for specific application, and **analyze** the time and space complexity.

CO2: **Discriminate** the usage of various structures, **Design/Program/Implement** the appropriate data structures; use them in implementations of abstract data types and Identity the appropriate data structure in approaching the problem solution.

CO3: **Demonstrate** use of sequential data structures- Array and Linked lists to store and process data.

CO4: **Understand** the computational efficiency of the principal algorithms for searching and sorting and choose the most efficient one for the application.

CO5: **Compare** and **contrast** different implementations of data structures (dynamic and static).

CO6: **Understand, Implement and apply** principles of data structures-stack and queue to solve computational problems.

Course Contents

Unit I	Introduction to Algorithm and Data Structures	(07 Hours)

Introduction: From Problem to Program (Problem, Solution, Algorithm, Data Structure and Program). Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures).

Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart. **Complexity of algorithm:** Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic. **Algorithmic Strategies:** Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

#Exemplar/Case Studies	Multiplication technique by the mathematician Carl Friedrich Gauss and Karatsuba algorithm for fast multiplication.
*Mapping of Course Outcomes for Unit I	CO1, CO2

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Unit II	Linear Data Structure Using Sequential Organization	(07 Hours)
Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, Multidimensional Arrays: Two-dimensional arrays, n-dimensional arrays. Concept of Ordered List, **Single Variable Polynomial**: Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication. **Sparse Matrix:** Sparse matrix representation using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.		
#Exemplar/Case Studies	Study use of sparse matrix in Social Networks and Maps. Study how Economists use polynomials to model economic growth patterns, how medical researchers use them to describe the behaviour of Covid-19 virus.	
***Mapping of Course Outcomes for Unit II**	CO1, CO2, CO3	
Unit III	**Searching and Sorting**	**(07 Hours)**
Searching: Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search- Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search. **Sorting:** Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.		
#Exemplar/Case Studies	Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. Timsort as a hybrid stable sorting algorithm	
***Mapping of Course Outcomes for Unit III**	CO1, CO2, CO4	
Unit IV	**Linked List**	**(07 Hours)**
Introduction to Static and Dynamic Memory Allocation, **Linked List:** Introduction, of Linked Lists, Realization of linked list using dynamic memory management,operations, Linked List as ADT, **Types of Linked List:** singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List- Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Polynomial Manipulations-Polynomial addition. Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.		
#Exemplar/Case Studies	Garbage Collection	
***Mapping of Course Outcomes for Unit IV**	CO1, CO2, CO3, CO5	
Unit V	**Stack**	**(07 Hours)**
Basic concept, stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations. **Recursion-** concept, variants of recursion- direct, indirect, tail and tree, backtracking algorithmic strategy, use of stack in backtracking.		
#Exemplar/Case Studies	Android- multiple tasks/multiple activities and back-stack, Tower of Hanoi, 4 Queens problem.	
***Mapping of Course Outcomes for Unit V**	CO1, CO2, CO3, CO5, CO6	

Unit VI	Queue	(07 Hours)
Basic concept, Queue as Abstract Data Type, Representation of Queue using Sequential organization,Queue Operations, Circular Queue and its advantages, Multi-queues,Linked Queue and Operations. **Deque**-Basic concept, types (Input restricted and Output restricted), Priority Queue-Basic concept, types (Ascending and Descending).		
#Exemplar/Case Studies	Priority queue in bandwidth management	
***Mapping of Course Outcomes for Unit VI**	CO1, CO2, CO3, CO5, CO6	

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Learning Resources

Text Books:

1. Horowitz and Sahani, "Fundamentals of Data Structures in C++", University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publication, ISBN: 978-1-118-29027-9

Reference Books:

1. Steven S S. Skiena, "The Algorithm Design Manual", Springer, 2nd ed. 2008 Edition, ISBN-13: 978-1849967204, ISBN-10: 1849967202.
2. Allen Downey, Jeffery Elkner, Chris Meyers, "How to think like a Computer Scientist: Learning with Python", Dreamtech Press, ISBN: 9789351198147.
3. M. Weiss, "Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.
4. Brassard and Bratley, "Fundamentals of Algorithmic", Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
5. Yashwant Kanetkar & A. Kanetkar, "Let us Python", BPB Publisher, ISBN: 9789389845006

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC Links/Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

Other:

3. Know Thy Complexities! (https://www.bigocheatsheet.com/) (https://github.com/RehanSaeed/.NET-Big-O-Algorithm-Complexity-Cheat-Sheet)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	1	-	1	-	-	-	-	-	-	-	-
CO6	1	1	1	1	1	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210243: Object Oriented Programming(OOP)

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The course is intended to provide the foundations and in-depth understanding of a modern object-oriented language and develop skills in software development, through an algorithmic approach and the application of principles of objected oriented programming.

- To learn the object-oriented programming paradigm, focusing on the definition and use of classes along with the fundamentals of object-oriented design.
- To learn the syntax and semantics of the C++ programming language.
- To understand the concept of data abstraction and encapsulation, how to design C++ classes for code reuse, how to implement copy constructors and class member functions, to overload functions and operators in C++.
- To learn how inheritance and virtual functions implement dynamic binding with polymorphism.
- To learn how to design and implement generic classes with C++ templates and how to use exception handling in C++ programs.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Apply** constructs- sequence, selection and iteration; classes and objects, inheritance, use of predefined classes from libraries while developing software.

CO2: **Design** object-oriented solutions for small systems involving multiple objects.

CO3: **Use** virtual and pure virtual function and complex programming situations.

CO4: **Apply** object-oriented software principles in problem solving.

CO5: **Analyze** the strengths of object-oriented programming.

CO6: **Develop** the application using object oriented programming language(C++).

Course Contents

Unit I	Fundamentals of Object Oriented Programming	(07 Hours)

Introduction to object-oriented programming, Need of object-oriented programming, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Benefits of OOP, C++ as object oriented programming language.

C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, Access specifiers, separating interface from implementation. **Functions**- Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor, Objects and Memory requirements, Static members: variable and functions, inline function, friend function.

#Exemplar/Case Studies	Story of C++ invention by Bjarne Stroustrup
*Mapping of Course Outcomes for Unit I	CO1, CO5

Unit II	Inheritance and Pointers	(07 Hours)

Inheritance- Base Class and derived Class, protected members, relationship between base Class and

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derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class, Nested Class. **Pointers:** declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.		
#Exemplar/Case Studies	Know about Firefox and Thunderbird as one of the popular softwares developed using C++	
***Mapping of Course Outcomes for Unit II**	CO2, CO4	
Unit III	**Polymorphism**	**(07 Hours)**
Polymorphism- Introduction to Polymorphism, Types of Polymorphism, Operator Overloading-concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Function overloading, **Run Time Polymorphism**- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.		
#Exemplar/Case Studies	Study about use of C++ SDKs wrappers for Java and .Net.	
***Mapping of Course Outcomes for Unit III**	CO2, CO3, CO4	
Unit IV	**Files and Streams**	**(07 Hours)**
Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output.		
#Exemplar/Case Studies	Study features used for Microsoft Office, Internet Explorer and Visual Studio that are written in Visual C++	
***Mapping of Course Outcomes for Unit IV**	CO2, CO4	
Unit V	**Exception Handling and Templates**	**(07 Hours)**
Exception Handling- Fundamentals, other error handling techniques, simple exception handling-Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance. **Templates**- The Power of Templates, Function template, overloading Function templates, and class template, class template and Nontype parameters, template and friends Generic Functions, The type name and export keywords.		
#Exemplar/Case Studies	Study about use of exception handling in Symbian Operating System (discontinued mobile operating system) that was developed using C++.	
***Mapping of Course Outcomes for Unit V**	CO2, CO4, CO6	
Unit VI	**Standard Template Library (STL)**	**(07 Hours)**
Introduction to STL, STL Components, Containers- Sequence container and associative containers, container adapters, Application of Container classes: vector, list, **Algorithms**- basic searching and sorting algorithms, min-max algorithm, set operations, heap sort, **Iterators**- input, output, forward, bidirectional and random access. Object Oriented Programming – a road map to future		
#Exemplar/Case Studies	Study MySQL open source C++ code available at GitHub.	
***Mapping of Course Outcomes for Unit VI**	CO2, CO4, CO6	

Learning Resources

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Text Books:

1. Deitel,"C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2
2. Robert Lafore, "Object-Oriented Programming in C++‖", fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

Reference Books:

1. Herbert Schildt, "C++-The complete reference"‖, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Matt Weisfeld, "The Object-Oriented Thought Process", Third Edition Pearson ISBN-13:075-2063330166
3. E.Balagurusamy, "Object-Oriented Programming with C++", 7th edition, Graw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
4. Cox Brad, Andrew J. Novobilski, "Object –Oriented Programming: An Evolutionary Approach"‖, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

e-Books:

- https://www.springer.com/gp/book/9781852334505
- https://www.ebookphp.com/object-oriented-programming-in-c-epub-pdf/
- https://www.springer.com/gp/book/9781447133780

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/105/106105151/
- https://swayam.gov.in/nd1_noc20_cs07/preview
- https://www.classcentral.com/course/swayam-programming-in-c-6704

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	**1**
CO3	2	1	2	2	-	-	-	-	-	-	-	-
CO4	2	1	2	1	-	-	-	-	-	-	-	**1**
CO5	-	1	-	1	-	-	-	-	-	-	-	-
CO6	-	-	1	-	-	-	-	-	-	-	-	**1**

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210244: Computer Graphics		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite : Basic Mathematics

Companion Course : 210247: OOP and Computer Graphics Laboratory

Course Objectives:

The Computer Graphics course prepares students for activities involving the design, development, and testing of modeling, rendering, and animation solutions to a broad variety of problems found in entertainment, sciences, and engineering.

- **Remembering:** To acquaint the learner with the basic concepts of Computer Graphics.
- **Understanding:** To learn the various algorithms for generating and rendering graphical figures.
- **Applying:** To get familiar with mathematics behind the graphical transformations.
- **Understanding:** To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting.
- **Creating:** To generate Interactive graphics using OpenGL.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Identify the basic terminologies of Computer Graphics and interpret the mathematical foundation of the concepts of computer graphics.

CO2: Apply mathematics to develop Computer programs for elementary graphic operations.

CO3: Illustrate the concepts of windowing and clipping and **apply** various algorithms to fill and clip polygons.

CO4: Understand and **apply** the core concepts of computer graphics, including transformation in two and three dimensions, viewing and projection.

CO5: Understand the concepts of color models, lighting, shading models and hidden surface elimination.

CO6: Create effective programs using concepts of curves, fractals, animation and gaming.

Course Contents

Unit I	Graphics Primitives and Scan Conversion Algorithms	(07 Hours)

Introduction, graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computer graphics.

Introduction to OpenGL - OpenGL architecture, primitives and attributes, simple modelling and rendering of two- and three-dimensional geometric objects, GLUT, interaction, events and call-backs picking. (**Simple Interaction with the Mouse and Keyboard)**

Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

#Exemplar/Case Studies	Study about OpenGL Architecture Review Board (ARB)
*Mapping of Course Outcomes for Unit I	CO1, CO2

Unit II	Polygon, Windowing and Clipping	(07 Hours)

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Polygons: Introduction to polygon, types: convex, concave and complex. Inside test. **Polygon Filling:** flood fill, seed fill, scan line fill. **Windowing and clipping:** viewing transformations, 2-D clipping: Cohen – Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman Polygon clipping algorithm, Weiler Atherton Polygon Clipping algorithm.		
#Exemplar/Case Studies	Study Guard-band clipping Technique and it's use in various rendering softwares, Use of 3D pipeline/ polygonal modelling and applications.	
***Mapping of Course Outcomes for Unit II**	CO2, CO3	
Unit III	**2D, 3D Transformations and Projections**	**(07 Hours)**
2-D transformations: introduction, homogeneous coordinates, 2-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary point. **3-D transformations:** introduction, 3-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary axis. **Projections :** Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)		
#Exemplar/Case Studies	Study use of transformations and projections in education and training software.	
***Mapping of Course Outcomes for Unit III**	CO2, CO4	
Unit IV	**Light, Colour, Shading and Hidden Surfaces**	**(07 Hours)**
Colour models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY. **Illumination Models**: Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model, **Shading Algorithms**: Halftone, Gauraud and Phong Shading. **Hidden Surfaces** Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock)		
#Exemplar/Case Studies	Study any popular graphics designing software	
***Mapping of Course Outcomes for Unit IV**	CO5	
Unit V	**Curves and Fractals**	**(07 Hours)**
Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, **Fractals**: Introduction, Classification, Fractal generation: snowflake, Triadic curve, Hilbert curve, Applications.		
#Exemplar/Case Studies	Case study on measuring the length of coastline using fractals	
***Mapping of Course Outcomes for Unit V**	CO2, CO6	
Unit VI	**Introduction to Animation and Gaming**	**(07 Hours)**
Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. **Animation:** Introduction, Conventional and computer based animation, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification. **Gaming:** Introduction, Gaming platform (NVIDIA, i8060), Advances in Gaming.		
#Exemplar/Case Studies	Study of any open source tools- Unity/Maya/Blender	
***Mapping of Course Outcomes for Unit VI**	CO6	

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Learning Resources

Text Books:

1. S. Harrington, "Computer Graphics"‖, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. Donald D. Hearn and Baker, "Computer Graphics with OpenGL", 4th Edition, ISBN-13: 9780136053583.
3. D. Rogers, "Procedural Elements for Computer Graphics", 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Reference Books:

1. J. Foley, V. Dam, S. Feiner, J. Hughes, "Computer Graphics Principles and Practice"‖, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
2. D. Rogers, J. Adams, "Mathematical Elements for Computer Graphics"‖, 2nd Edition, Tata McGraw Hill Publication, 2002, ISBN 0 – 07 – 048677 – 8.

e-Books:

- https://open.umn.edu/opentextbooks/textbooks/introduction-to-computer-graphics
- http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/106/106106090/
- https://nptel.ac.in/courses/106/102/106102065/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	3	-	1	1	-	-	-	-	-	-	-	-
CO3	1	2	-	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	-	-	-	-	-	-	-	-
CO5	1	-	1	-	-	-	-	-	-	-	-	-
CO6	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210245: Digital Electronics and Logic Design		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 104010: Basic Electronics Engineering

Companion Course : 210249: Digital Electronics Lab

Course Objectives:

The goal of this course is to impart the fundamentals of digital logic design; starting from learning the basic concepts of the different base number systems, to basic logic elements and deriving logical expressions to further optimize a circuit diagram. Objective is to see that learners are not only able to evaluate different combinational logic designs, but also design their own digital circuits given different parameters.

- To study number systems and develop skills for design and implementation of combinational logic circuits and sequential circuits
- To understand the functionalities, properties and applicability of Logic Families.
- To introduce programmable logic devices and ASM chart and synchronous state machines.
- To introduce students to basics of microprocessor.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Simplify Boolean Expressions using K Map.
CO2: Design and implement combinational circuits.
CO3: Design and implement sequential circuits.
CO4: Develop simple real-world application using ASM and PLD.
CO5: Differentiate and Choose appropriate logic families IC packages as per the given design specifications.
CO6: Explain organization and architecture of computer system

Course Contents

Unit I	**Minimization Technique**	**(07 Hours)**
Logic Design Minimization Technique: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.		
#Exemplar/Case Studies	Digital locks using logic gates	
***Mapping of Course Outcomes for Unit I**	CO1	
Unit II	**Combinational Logic Design**	**(07 Hours)**
Code converter -: BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX): MUX (IC 74153, 74151), Cascading multiplexers, Demultiplexers (DEMUX)- Decoder (IC 74138, IC 74154), Implementation of SOP and POS using MUX, DMUX, Comparators (2 bit), Parity generators and Checker.		
#Exemplar/Case Studies	Combinational Logic Design of BCD to 7-segment display Controller	
***Mapping of Course Outcomes for Unit II**	CO2	

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Unit III	Sequential Logic Design	(07 Hours)
Flip-Flop: SR, JK,D,T, Preset and Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flip-Flop. Registers: SISO, SIPO, PISO, PIPO, Shift Registers, Bidirectional Shift Register, Ring Counter , Universal Shift Register Counters: Asynchronous Counter, Synchronous Counter, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490),Synchronous Sequential Circuit Design :Models- Moore and Mealy, State diagram and State Table ,Design Procedure, Sequence Generator and detector.		
#Exemplar/Case Studies	Electronic Voting Machine (EVM)	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Algorithmic State Machines and Programmable Logic Devices**	**(07 Hours)**
Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits. PLDS:PLD, ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.		
#Exemplar/Case Studies	Wave form generator using MUX controller method	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Logic Families**	**(07 Hours)**
Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Fan-in, Fan-out, Current and voltage parameters, Noise immunity, Propagation Delay, Power Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements. **Transistor**-Transistor Logic: Operation of TTL NAND Gate (Two input), TTL with active pull up, TTL with open collector output, Wired AND Connection, Tristate TTL Devices, TTL characteristics. CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs.		
#Exemplar/Case Studies	To study the various basic gate design using TTL/CMOS logic family	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Introduction to Computer Architecture**	**(07 Hours)**
Introduction to Ideal Microprocessor – Data Bus, Address Bus, Control Bus. Microprocessor based Systems – Basic Operation, Microprocessor operation, Block Diagram of Microprocessor. Functional **Units of Microprocessor** – ALU using IC 74181, Basic Arithmetic operations using ALU IC 74181, 4-bit Multiplier circuit using ALU and shift registers. Memory Organization and Operations, digital circuit using decoder and registers for memory operations.		
#Exemplar/Case Studies	Microprocessor based system in Communication /Instrumentation Control	
*Mapping of Course Outcomes for Unit VI	CO6	

Learning Resources

Text Books:

1. R.P.Jain, " Modern Digital Electronics", Tata McGraw Hill 4th Edition, ISBN 978-0-07-06691-16
2. Moris Mano, "Digital Logic and Computer Design", Pearson , ISBN 978-93-325-4252-5
3. G. K. Kharate, "Digital Electronics", Oxford Press, ISBN-10: 0198061838

Reference Books:

1. John Yarbrough, "Digital Logic applications and Design", Cengage Learning, ISBN – 13: 978-81-315-0058-3

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2. D. Leach, Malvino, Saha, "Digital Principles and Applications"‖, Tata McGraw Hill, ISBN –13:978-0-07-014170-4.
3. Anil Maini, "Digital Electronics: Principles and Integrated Circuits"‖, Wiley India Ltd, ISBN:978-81-265-1466-3.
4. Norman B and Bradley, "Digital Logic Design Principles", Wiley, ISBN:978-81-265-1258

eBooks:

- https://www.springer.com/gp/book/9783030361952
- https://www.mheducation.co.uk/ebook-fundamentals-of-digital-logic-9780077144227-emea

MOOC/ Video Lectures available at:

- Digital Circuits, by Prof. Santanu Chattopadhyay, https://swayam.gov.in/nd1_noc19_ee51/preview (Unit I, II, III, IV)
- Digital Circuits and Systems, Prof. S. Srinivasan https://nptel.ac.in/courses/117/106/117106086/ (Unit I, II, III, IV)
- Microprocessors and Interfacing By Prof. Shaik Rafi Ahamed | IIT Guwahati https://swayam.gov.in/nd1_noc20_ee11/preview (Unit VI)
- Switching Circuits And Logic Design By Prof. Indranil Sengupta w https://swayam.gov.in/nd1_noc20_cs67/preview (Unit V)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	2	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	-
CO3	2	1	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	1	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210246: Data Structures Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks	
Practical: 04 Hours/Week	02	Term Work:	25 Marks
		Practical:	50 Marks

Companion Course : 210242: Fundamentals of Data Structures

Course Objectives:

To understand basic techniques and strategies of algorithm analysis, the memory requirement for various data structures like array, linked list, stack, queue etc using concepts of python and C++ programming language.

Course Outcomes:

On completion of the course, learner will be able to–

- **CO1: Use** algorithms on various linear data structure using sequential organization to solve real life problems.
- **CO2: Analyze** problems to **apply** suitable searching and sorting algorithm to various applications.
- **CO3: Analyze** problems to **use variants of** linked list and solve various real life problems.
- **CO4:** Designing and implement data structures and algorithms for solving different kinds of problems.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts

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learned. Instructor may also set one assignment or mini-project that is suitable to respective branch **beyond the scope of syllabus.**

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments (at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E.)

Group A and B assignments should be implemented in Python without using built-in methods for major functionality of assignment. Use List data structure of Python as array. Group C, D and E assignments should be implemented in C++ language.

Operating System recommended:- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python, Programming tool like Jupyter Notebook, Pycharm, Spyder, G++/GCC.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	In second year computer engineering class, group A student's play cricket, group B students play badminton and group C students play football. Write a Python program using functions to compute following: - a) List of students who play both cricket and badminton b) List of students who play either cricket or badminton but not both c) Number of students who play neither cricket nor badminton d) Number of students who play cricket and football but not badminton. (Note- While realizing the group, duplicate entries should be avoided, Do not use SET built-in functions)
2	Write a Python program to store marks scored in subject "Fundamental of Data Structure" by N students in the class. Write functions to compute following: a) The average score of class b) Highest score and lowest score of class c) Count of students who were absent for the test d) Display mark with highest frequency
3	Write a **Python** program for department library which has N books, write functions for following: a) Delete the duplicate entries b) Display books in ascending order based on cost of books c) Count number of books with cost more than 500. d) Copy books in a new list which has cost less than 500.
4	Write a **Python** program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following: D 100 W 200 (Withdrawal is not allowed if balance is going negative. Write functions for withdraw and deposit) D means deposit while W means withdrawal. Suppose the following input is supplied to the program: D 300, D 300 , W 200, D 100 Then, the output should be: 500

<table>
<tr><td>5</td><td>Write a Python program to compute following operations on String:
a) To display word with the longest length
b) To determines the frequency of occurrence of particular character in the string
c) To check whether given string is palindrome or not
d) To display index of first appearance of the substring
e) To count the occurrences of each word in a given string</td></tr>
<tr><td>6</td><td>It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is to be provided to the authority. Write a Python program to store students PRNs with date and month of birth. Let List_A and List_B be the two list for two SE Computer divisions. Lists are sorted on date and month. Merge these two lists into third list “List_SE_Comp_DOB” resulting in sorted information about Date of Birth of SE Computer students</td></tr>
<tr><td>7</td><td>Write a Python Program for magic square. A magic square is an n * n matrix of the integers 1 to n2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case n=5. In this example, the common sum is 65.
<table>
<tr><td>15</td><td>8</td><td>1</td><td>24</td><td>17</td></tr>
<tr><td>16</td><td>14</td><td>7</td><td>5</td><td>23</td></tr>
<tr><td>22</td><td>20</td><td>13</td><td>6</td><td>4</td></tr>
<tr><td>3</td><td>21</td><td>19</td><td>12</td><td>10</td></tr>
<tr><td>9</td><td>2</td><td>25</td><td>18</td><td>11</td></tr>
</table></td></tr>
<tr><td>8</td><td>Write a Python program that determines the location of a saddle point of matrix if one exists. An m x n matrix is said to have a saddle point if some entry a[i][j] is the smallest value in row i and the largest value in j.</td></tr>
<tr><td>9</td><td>Write a Python program to compute following computation on matrix:
a) Addition of two matrices B) Subtraction of two matrices
c) Multiplication of two matrices d) Transpose of a matrix</td></tr>
<tr><td>10</td><td>Write a Python program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices</td></tr>
<tr><td></td><td>Group B</td></tr>
<tr><td>11</td><td>a) Write a Python program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and Sentinel search.
b) Write a Python program to store roll numbers of student array who attended training program in sorted order. Write function for searching whether particular student attended training program or not, using Binary search and Fibonacci search</td></tr>
<tr><td>12</td><td>a) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using binary search (recursive and non-recursive). Insert friend if not present in phonebook
b) Write a Python program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.</td></tr>
<tr><td>13</td><td>Write a Python program to maintain club members, sort on roll numbers in ascending order. Write function “Ternary_Search” to search whether particular student is member of club or not. Ternary search is modified binary search that divides array into 3 halves instead of two.</td></tr>
<tr><td>14</td><td>Write a Python program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using
a) Selection Sort
b) Bubble sort and display top five scores.</td></tr>
</table>

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15	Write a **Python** program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Insertion sort b) Shell Sort and display top five scores
16	Write a **Python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores.
17	Write a **Python** program to store 12^{th} class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using bucket sort and display top five scores.
18	Write **Python** program to store 10^{th} class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using radix sort and display top five scores
	Group C
19	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member's information using singly linked list. Store student PRN and Name. Write functions to: a) Add and delete the members as well as president or even secretary. b) Compute total number of members of club c) Display members d) Two linked lists exists for two divisions. Concatenate two lists.
20	The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand a) The list of available seats is to be displayed b) The seats are to be booked c) The booking can be cancelled.
21	Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for- A) Display free slots B) Book appointment C) Sort list based on time D) Cancel appointment (check validity, time bounds, availability) E) Sort list based on time using pointer manipulation
22	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display- a) Set of students who like both vanilla and butterscotch b) Set of students who like either vanilla or butterscotch or not both c) Number of students who like neither vanilla nor butterscotch
23	Write C++ program for storing binary number using doubly linked lists. Write functions- a) To compute 1's and 2's complement b) Add two binary numbers
24	Write C++ program to realize Set using Generalized Liked List (GLL) e.g. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation.
	Group D

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25	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "poor danisina droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions- a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not
26	In any language program mostly syntax error occurs due to unbalancing delimiter such as (),{},[]. Write C++ program using stack to check whether given expression is well parenthesized or not.
27	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions: 1. Operands and operator, both must be single character. 2. Input Postfix expression must be in a desired format. 3. Only '+', '-', '*' and '/ ' operators are expected.
28	A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an 8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem.
	Group E
29	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
30	Write program to implement a priority queue in C++ using an inorder list to store the items in the queue. Create a class that includes the data items (which should be template) and the priority (which should be int). The inorder list should contain these objects, with operator <= overloaded so that the items with highest priority appear at the start of the list (which will make it relatively easy to retrieve the highest item.)
31	A double-ended queue (deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque.
32	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	1	-	-	-	-	-	-	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-
CO3	-	2	1	1	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210247: OOP and Computer Graphics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 25Marks

Companion Course : 210243: Object Oriented Programming(OOP), 210244: Computer Graphics

Course Objectives:

To understand basics of Computer Graphics, apply various methods and techniques for implementing line-circle drawing, projections, animation, shading, illumination and lighting using concepts of Object Oriented Programming.

Course Outcomes:

On completion of the course, learner will be able to–

- **CO1: Understand** and **apply** the concepts like inheritance, polymorphism, exception handling and generic structures for implementing reusable programming codes.
- **CO2: Analyze** the concept of file and **apply** it while storing and retrieving the data from secondary storages.
- **CO3: Analyze** and **apply** computer graphics algorithms for line-circle drawing, scan conversion and filling with the help of object oriented programming concepts.
- **CO4: Understand** the concept of windowing and clipping and **apply** various algorithms to fill and clip polygons.
- **CO5: Apply** logic to implement, curves, fractals, animation and gaming programs.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a reference and hands-on resource. It should include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of the course, conduction and Assessment guidelines, topics under consideration, concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software and Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided jointly by the internal examiner and external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student‘s understanding of the fundamentals, effective and efficient implementation. This will encourage, transparent evaluation and fair approach, and hence will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of student's academics.

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Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. Use of open source software is encouraged. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC, OPENGL.

Virtual Laboratory:

- http://cse18- iiith.vlabs.ac.in/Introduction.html?domain=Computer%20Scie nce
- http://vlabs.iitb.ac.in/vlabs-dev/labs/cglab/index.php

Part I : Object Oriented Programming

Suggested List of Laboratory Experiments/Assignments

(All assignments are compulsory)

Sr. No.	Group A
1.	Implement a class Complex which represents the Complex Number data type. Implement the following 1. Constructor (including a default constructor which creates the complex number 0+0i). 2. Overload operator+ to add two complex numbers. 3. Overload operator* to multiply two complex numbers. 4. Overload operators << and >> to print and read Complex Numbers.
2.	Develop a program in C++ to create a database of student's information system containing the following information: Name, Roll number, Class, Division, Date of Birth, Blood group, Contact address, Telephone number, Driving license no. and other. Construct the database with suitable member functions. Make use of constructor, default constructor, copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete as well as exception handling.
3.	Imagine a publishing company which does marketing for book and audio cassette versions. Create a class publication that stores the title (a string) and price (type float) of publications. From this class derive two classes: book which adds a page count (type int) and tape which adds a playing time in minutes (type float). Write a program that instantiates the book and tape class, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.
	Group B
4.	Write a C++ program that creates an output file, writes information to it, closes the file, open it again as an input file and read the information from the file.
5.	Write a function template for selection sort that inputs, sorts and outputs an integer array and a float array.
	Group C
6.	Write C++ program using STL for sorting and searching user defined records such as personal records (Name, DOB, Telephone number etc) using vector container. **OR** Write C++ program using STL for sorting and searching user defined records such as Item records (Item code, name, cost, quantity etc) using vector container.

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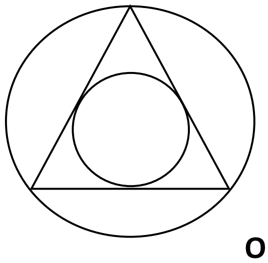
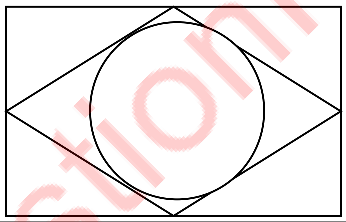
7.	Write a program in C++ to use map associative container. The keys will be the names of states and the values will be the populations of the states. When the program runs, the user is prompted to type the name of a state. The program then looks in the map, using the state name as an index and returns the population of the state.
	Part II : Computer Graphics
	Suggested List of Laboratory Experiments/Assignments (**All assignments are compulsory**)
Sr. No.	**Group A**
1.	Write C++ program to draw a concave polygon and fill it with desired color using scan fill algorithm. Apply the concept of inheritance.
2.	Write C++ program to implement Cohen Southerland line clipping algorithm.
3.	a) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation.  **OR** b) Write C++ program to draw the following pattern. Use DDA line and Bresenham's circle drawing algorithm. Apply the concept of encapsulation. 
	Group B
4.	a) Write C++ program to draw 2-D object and perform following basic transformations, Scaling b) Translation c) Rotation. Apply the concept of operator overloading. **OR** b) Write C++ program to implement translation, rotation and scaling transformations on equilateral triangle and rhombus. Apply the concept of operator overloading.
5.	a) Write C++ program to generate snowflake using concept of fractals. **OR** b) Write C++ program to generate Hilbert curve using concept of fractals. **OR** c) Write C++ program to generate fractal patterns by using Koch curves.
	Group C
6.	a) Design and simulate any data structure like stack or queue visualization using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL. **OR** b) Write C++ program to draw 3-D cube and perform following transformations on it using OpenGL i) Scaling ii) Translation iii) Rotation about an axis (X/Y/Z). **OR** c) Write OpenGL program to draw Sun Rise and Sunset.

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7.	a) Write a C++ program to control a ball using arrow keys. Apply the concept of polymorphism. **OR** b) Write a C++ program to implement bouncing ball using sine wave form. Apply the concept of polymorphism. **OR** c) Write C++ program to draw man walking in the rain with an umbrella. Apply the concept of polymorphism. **OR** Write a C++ program to implement the game of 8 puzzle. Apply the concept of polymorphism. **OR** d) Write a C++ program to implement the game Tic Tac Toe. Apply the concept of polymorphism.

Mini-Projects/ Case Study

8.	Design and implement game / animation clip / Graphics Editor using open source graphics library. Make use of maximum features of Object Oriented Programming.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	-	1	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	1	-	-	-	-	-	-	-	-
CO5	-	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210248: Digital Electronics Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01	Term Work: 25 Marks

Companion Course : 210245: Digital Electronics and Logic Design

Course Objectives:

To understand fundamentals and functionality of electronic circuits, design and implement combinational circuits like MUX, comparator, adder/subtractor, design and implement sequential circuits like flip-flop, registers, and counters using different integrated circuits.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Understand** the working of digital electronic circuits.

CO2: **Apply** the knowledge to appropriate IC as per the design specifications.

CO3: **Design** and **implement** Sequential and Combinational digital circuits as per the specifications.

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.

The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Student should perform at least 12 experiments with all experiments from group A and any 5 assignments from group Band one from group C assignments.

Virtual Laboratory:

- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html
- http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html

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Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	To Realize Full Adder/ Subtractor using a) Basic Gates and b) Universal Gates
2	Design and implement Code Converters-Binary to Gray and BCD to Excess-3
3	Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4	Realization of Boolean Expression for suitable combination logic using MUX 74151 /74153, DMUX 74154/74138
5	To Verify the truth table of two bit comparators using logic gates.
6	Design and Implement Parity Generator and checker using EX-OR.
	Group B
7	Design and Realization: Flip Flop conversion
8	Design of 2 bit and 3 bit Ripple Counter using MS JK flip-flop.
9	Design of Synchronous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop
10	Realization of Mod -N counter using (Decade Counter IC 7490) .
11	Design and implement Sequence generator (for Prime Number/odd and even) using MS JK flip-flop.
12	Design and implement Sequence detector using MS JK flip-flop.
	Group C
13	Study of Shift Registers (SISO,SIPO, PISO, PIPO)
14	Design of ASM chart using MUX controller Method.

@The CO-PO Mapping Matrix

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210249: Business Communication Skills

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	01[$]	Term Work[$]: 25 Marks

Course Objectives:

- To facilitate Holistic growth ;
- To make the engineering students aware, about the importance, the role and the content of business communication skills ;
- To develop the ability of effective communication through individual and group activities;
- To expose students to right attitudinal and behavioural aspects and to build the same through various activities;

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Express** effectively through verbal/oral communication and improve listening skills
CO2: **Write** precise briefs or reports and technical documents.
CO3: **Prepare** for group discussion / meetings / interviews and presentations.
CO4: **Explore** goal/target setting, self-motivation and practicing creative thinking.
CO5: **Operate** effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership qualities.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about University/program/ institute/ department/foreword/preface), curriculum of course, conduction and Assessment guidelines, topics under consideration concept objectives, outcomes, guidelines, references.

Guidelines for Student's Laboratory Journal and Term Work Assessment

The student must prepare the journal in the form of report elaborating the activities performed. Continuous assessment of laboratory work is to be done based on overall performance and performance of student at each assignments. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage.

Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion of assignment, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities- SWOT analysis, presentations, team activity, event management, group discussion, Group exercises and interpersonal skills and similar other activities/assignments and Well presented, timely and complete report.

Recommended Assessment and Weightage Parameters:

(Attendance 30%, Assignments/activities-Active participation and proactive learning 50% and report 20%)

Students must submit the report of all conducted activities conducted. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
    - General information about the activity;
    - Define the purpose of the activity;
    - Detail out the activities carried out during the visit in chronological order;
    - Summarize the operations / process (methods) during the activities;
    - Describe what you learned (outcomes) during the activities as a student;

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Guidelines for Laboratory Conduction

The instructor may frame assignments to enhance skills supporting career aspects. Multiple set of activity based assignments can be prepared and distributed among batches.

Every student must be given adequate opportunity to participate actively in each activity. An exercise can be designed to allow multiple skills exposure for example a group task encouraging discussions, team building, value sharing, leadership and role play all at the same time.

MOOC at Swayam:[$]

https://swayam.gov.in/nd2_imb19_mg14/preview

Virtual Laboratory:

- https://ve-iitg.vlabs.ac.in/

Sr. No.	Suggested List of Laboratory Experiments/Assignments
1	**SWOT analysis** The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects
2	**Personal and Career Goal setting – Short term and Long term** The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.
3	**Public Speaking** Any one of the following activities may be conducted : **1. Prepared speech (**Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) **2. Extempore speech (**Students deliver speeches spontaneously for 5 minutes each on a given topic) **3. Story telling** (Each student narrates a fictional or real life story for 5 minutes each) **4. Oral review** (Each student orally presents a review on a story or a book read by them)
4	**Reading and Listening skills** The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages asked questions on the article by the readers. Students will get marks on various topics to students for evaluating their reading comprehension.
5	**Group discussion** Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedback.
6	**Letter/Application writing** Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
7	**Report writing** The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal.
8	**Resume writing-** Guide students and instruct them to write resume

9	**Presentation Skill** Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
10	**Team games for team building -** Students should make to participate in team activity.
11	**Situational games for role playing as leaders**
12	**Faculty may arrange one or more sessions from following:** Yoga and meditation. Stress management, relaxation exercises, and fitness exercises. Time management and personal planning sessions.
13	**Mock interviews-** guide students and conduct mock interviews
14	**Telephonic etiquettes** -To teach students the skills to communicate effectively over the phone. Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call.
15	**Email etiquettes** -To provide students with an in-depth understanding of email skills. Students will be made to send e-mails for different situations such as sending an e-mail to the principal for a leave, inviting a friend for a party, e-mail to enquire about room tariff of a hotel. Students will be assessed on the basis of e-mail such as clarity, purpose and proof reading of e-mail.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	2	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-	1
CO4	-	-	-	-	-	-	-	-	-	2	-	2
CO5	-	-	-	-	-	-	-	-	3	-	-	2

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210250: Humanity and Social Science		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Tutorial: 01 Hours/Week	01$	**Term work$:** 25 Marks

Course Objectives:

To enable the students to explore aspects of human society and to acquire the intellectual, communication skills and develop characteristics that encourages personal fulfilment, meaningful professional life and responsible citizenship.

- To facilitate Holistic growth;
- To Educate about Contemporary, National and International affairs;
- To bring awareness about the responsibility towards society.
- To give an insight about the emergence of Indian society and the relevance of Economics.

Course Outcomes:

On completion of the course, learner will be–

CO1: **Aware** of the various issues concerning humans and society.

CO2: **Aware** about their responsibilities towards society.

CO3: Sensitized about broader issues regarding the social, cultural, economic and human aspects, involved in social changes.

CO4: **Able** to understand the nature of the individual and the relationship between self and the community.

CO5: **Able** to understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.

Course Contents

Preamble:

As applied sciences, Engineering and Technology are meant to come up with effective solutions to social problems making it imperative that the present generation of engineers and technologists understand the society they live in. Studying the social sciences can provide individuals with crucial answers and observations that could certainly help in understanding of one's life which can alleviate social relations. A broad perspective of nationalistic thinking will provide the students with the ability to be socially conscientious, more resilient and open to building an inclusive society.

Experiencing real-life situations and complex scenarios that arise in each situation will help the budding professions to contribute their skills and knowledge to helping people improve and understand their behaviour or psychological processes. Understanding how the world works begins with an understanding of oneself and gaining hands-on experience and/or thinking about human values and ethics will help trigger a sense of responsibility among the students and lead them to finding effective solutions.

Course Structure: The tutorial sessions to be divided into 2 groups

1. Interactive Sessions to be conducted in classroom
2. Interactive Activities to be conducted Outside Classroom

MOOC/ Video Lectures available at$:

- https://nptel.ac.in/courses/109/103/109103023/
- https://nptel.ac.in/courses/109/107/109107131/

- Teachers will play the role of interventionists and instigating students to apply their thinking abilities on social concepts
- As facilitators and mentors teachers will coax the students to thinking out-of-the-box to come up with creative solutions
- Teachers should focus on instilling a sense of social consciousness through the activities conducted indoors and outdoors.

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Change of Mindset

- Since the course deviates from technical subjects, students will have to be counseled into the importance of social sciences
- A background understanding of the importance of this course in their professional and personal life will have to be enumerated to the students
- Teachers will have to rationalize the course outcomes to get the students invested in the activities being conducted

Designing of Course

- Since students lack prior knowledge, it is imperative that the tutorials conducted be engaging in its activities
- Focus of the sessions should be the learning outcome of each activity conducted either in the class or outside the class
- All activities designed should be as close to real-life making them relatable and applicable
- Student-engagement should be a priority so that the knowledge internalized will be higher
- The activities chosen can be modified to cater to the college location and social context
- The learning should be focused on application of ethics and values during each activity
- The chosen sessions should cater to giving the students the opportunity to be involved and engaged in their role as contributors to society and the nation at large

Basic function of the tutor

- To present a holistic view of the curriculum and the role of this course in it and emphasizing the benefit of the sessions towards developing communications kills, critical thinking and problems solving

Grouping

- The class will be divided into groups of 20 students
- The blend of cultural and social diversity will enhance the learning at the end of each activity
- Teachers will have to be mentored to handle sensitive issues diplomatically while encouraging students to stand up for their beliefs
- The groups will have to have inter-personal sessions so that they get to understand their team members better and work cohesively
- Management support and encouragement to engage students in life-enriching experiences is important

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of each activity
- Assessment of students should be focused on the students' ability to internalize the learning
- Tutors need to understand meaningful ways of assessing students' work to motivate learning

Tutorial Conduction and Term Work guidelines

Interactive Sessions to be conducted during Tutorial (in classroom)

1. PREPARED SPEECH ON CURRENT AFFAIRS
   a. Purpose – Get students to stay abreast and invested in national current affairs
   b. Method – Each student has to read an editorial from any national paper (English), find out more information on the topic and present it to the class; ending the session with his/her opinion on the matter
   c. Outcome – Awareness of national state of affairs. Improve on oratory skills. Instil the thinking and contemplative skills and form non-judgmental opinions about an issue
2. UNDERSTANDING INDIA'S CULTURAL DIVERSITY
   a. Purpose – Expose students to the intricacies of Indian cultural across various states
   b. Method – Each student (or a small group of students in case the number of students is large) has to pick a state and come to the tutorial session prepared with a PPT that will showcase the demographic, sociographic and cultural information of that state
   c. Outcome – Information about the beauty of Indian cultural diversity. Enhance exploratory skill, communication skills and learn to present using technological tools.

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3. WRITING AN ARTICLE ON ANY SOCIAL ISSUE
    a. Purpose – Highlight various social and cultural evil malevolence existing in our country and express one's opinion on how it can be changed
    b. Method – Each student will have to write a 200 word essay on any of existing social malice that is prevalent in society. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
    c. Outcome – Learn to raise one's voice against the wrong doings in communities. Build writing skills, improve language and gain knowledge about how to write an impactful essay
4. GROUP DISCUSSION ON COMMUNAL TOPIC
    a. Purpose – Make students aware of the issues that are pertinent in a society and express a learned opinion about it
    b. Method – Students in groups of 20 each will discuss a relevant and grave issue that is dogging the nation. Alternatively, topics from current affairs (National budget, democratic process, economical strengthening of the country).
    c. Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven arguments making them contributors in any team
5. QUIZ ON SOCIAL BEHAVIOR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills
6. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop
    c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

7. QUIZ ON SOCIAL BEHAVIOR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills
8. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop

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   c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

9. DEBATE ON A TOPIC FROM SOCIAL SCIENCES
   a. Purpose – Educate students about various domains in social sciences and develop an interest towards gaining knowledge about these topics
   b. Method – Various topics from various domains of social sciences can be chosen and students in pairs can pick a topic and present their arguments for or against the topic. Time for each debate will be 10 minutes maximum
   c. Outcome – Recognize the significance of social sciences in our lives. Cultivate the habit to present forceful arguments while respecting the opponents perspective and enhance verbal skills.

Interactive Activities to be conducted during Tutorial (Outside Classroom)

1. WASTE MANAGEMENT and CLEAN CAMPUS
   a. Purpose: Create awareness among students about the significance of a clean environment and social responsibility to deter littering and segregate waste
   b. Method: Students (in groups) will be given charge of areas of campus and will be expected to clean that segment. Also, they will be entrusted with the responsibility to collect, separate waste and hand over to the housekeeping authority
   c. Outcome: Develop the habit to maintain cleanliness at home as well as learn to respect community areas at college or workplace. It will also encourage them become ambassadors among their peers to advocate protection of the environment
2. MAKING A VIDEO ON SOCIAL WASTAGES.
   a. Purpose: Instil among students a sense of responsibility towards judiciously using natural resources like water and electricity
   b. Method: Using their phones / hand-held devices, groups of students will make a 3 – 4 minute short film that will highlight irresponsible behavior in terms of wastage of water, leaving lights, fans and other electrical appliances on when not in use, defacing public and campus property by scribbling on walls and common areas. They will make awareness for the same among students. The creative videos will be posted on the college website and social media as an encouragement
   c. Outcome: Conscientious behavior towards saving public utility resources. Explore the use of audio-visual tools to create more meaningful messages that can effect a change in society
3. RELAY MARATHON (3 – 5 kms)
   a. Purpose: Propagate a social message by way of a sport activity
   b. Method: A group of students will begin the race with banner / placard in hand that contains a social message. The group runs for 500 meters and hands over the banner / placard to the next group of students. This chain of exchange will continue for 3 – 5 kms.
   c. Outcome: Become aware of the need for fitness and encouragement towards healthier lifestyle. Students will also be able to express their creativity in terms of meaningful messages and gain attention towards worthy social causes from the community in and around the campus.
4. TREE PLANTATION ON CAMPUS
   a. Purpose: Involve students to actively participate in environment protection and develop greener surroundings
   b. Method: Each student will plant a sapling and take care of that plant until it is able to sustain itself. Alternatively, students can organize a tree plantation drive in a public area and nurture it
   c. Outcome: Besides increase in plants in the locality, students will feel a sense of empowerment and become social contributors towards protecting the environment.
5. VISIT TO AN OLD AGE HOME / ORPHANAGE
   a. Purpose: Build a sense of responsibility towards the less fortunate in our society and feel privileged to be able to effect real change in the world around us

Home

b. Method: Students have to visit an old age home or orphanage in the vicinity of the college. They can interact with the inmates, probably donate utilities to the charity organization and/or probably stage a few inclusive activities with the residents of the place. After the visit, students can submit a brief report about their experience

c. Outcome: Learn first-hand about the conditions and social situations that the no-so-privileged members of our society have to endure to survive and go beyond their embarrassment to interact with the destitute which will help students appreciate the importance of Indian family values

6. STREET PLAY ACTIVITY

a. Purpose: Create awareness in themselves as well as people in the community on various social evils that need to be eradicated

b. Method: Students will prepare and enact a street play on any pertinent issues in society. The topics suggested can be perils of mobile phones / online fraud / safety for girls / mental and physical health of the youth.

c. Outcome: Allow students to deliberate and think deeply about the looming issues that is dogging our society and the future of the youth. This will also bring out the creative skills among the students and allow them to showcase their talent.

7. BUDDY / BIG BROTHER SYSTEM

a. Purpose: Include and involve the less fortunate children making them feel wanted and cared for as well as use the opportunity to share knowledge among school students.

b. Method: Students have to go to nearby schools after procuring appropriate permissions to teach a particular topic on either technical or non technical domains. Each student can choose to adopt 5 students from the class to be their mentor over a period of 1 year by staying in touch with them and helping them resolve their issues on academic or other matters.

c. Outcome: Appreciation and respect towards the responsibility of teaching. They will learn to be accountable as social contributors and bring about some change in the lives of the young students they mentor as Buddies or Big Brother.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.

The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:

(Attendance 30%, Assignments/Activities-Active participation and proactive learning 50% and report 20%)

Learning Resources

Home

Books:

1. A. Alavudeen, M. Jayakumaran, and R Kalil Rahman, “Professional Ethics and Human Values”
2. Ram Ahuja, “Social Problems in India” (third edition)
3. Shastry, T. S. N., “India and Human rights: Reflections”, Concept Publishing Company India Pvt. Ltd., 2005.
4. Nirmal, C.J., “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford India
5. Rangarajan, “Environmental Issues in India”, Pearson Education.
6. University of Delhi, The Individual and Society, Pearson Education.
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, “Social change in modern India”, 1991, Orient Longman.
9. David Mandelbaum, Society in India, 1990, Popular.
10. Dr. Abha Singh, “Behavioral Science: Achieving Behavioral Excellence for Success”, Wiley.

e-Books:

- https://www.moteoo.org/en/products/social-science-and-humanities-student-book-english
- https://www.springeropen.com/books
  (SpringerOpen open access books; download them free of charge from SpringerLink)
- https://muse.jhu.edu/article/541846/pdf
  (This content has been declared *free* to read by the publisher during the COVID-19)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	2	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	1
CO4	-	-	-	-	-	-	2	2	2	-	-	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210251: Audit Course 3

In addition to credits, it is recommended that there should be audit course, in preferably in each semester starting from second year in order to supplement students' knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credit [1] and clears all the audit courses specified in the curriculum. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 3 Options

Audit Course Code	Audit Course Title
AC3-I	Green Construction and Design
AC3-II	Social Awareness and Governance Program
AC3-III	Environmental Studies
AC3-IV	Smart Cities
AC3-V	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese(Module 1)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier.
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

AC3-I: Green Construction and Design

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Prerequisites: General awareness of environment and eco system.

Course Objectives:

1. To motivate students for undertaking green construction projects, technical aspects of their design, obstacles to getting them done, and future directions of the field.
2. To increase awareness of green construction issues, so that students will know the range of existing knowledge and issues.
3. Proper use of energy, water and other resources without harming environment.
4. To reduce waste pollution and Environment Degradation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the importance of environment friendly society.
CO2: Apply primary measures to reduce carbon emissions from their surroundings.
CO3: Learn role of IT solutions in design of green buildings.
CO4: Understand the use of software systems to complete statutory compliances involved in the design of a new home or office building through green construction.

Course Contents

1. Introduction to Green Construction, need of green construction, Importance, Government Initiatives, your role in the Green Environment.
2. How to do Green Construction, Project Definition, Team Building, Education and Goal Setting, Documents and Specification.
3. Elements of Green Construction, Materials Construction Waste Management, Indoor Air Quality, Energy Efficiency.
4. Indian Green Building Council (IGBC), Introduction to IGBC, IGBC rating system, Green building projects in India, Benefits of green building, effects on natural resources.

Team Projects:

Students will be formed into groups to research green construction and design in a particular construction context and report their results to the class. What are the particular obstacles and opportunities to integrating green construction techniques into the following sectors? Be sure to consider technical, social, political and economic issues:
Hotels (economy, luxury, resorts), Hospitals, Retail(big box, malls, small scale downtown retail), Office, Government, ,Schools, Universities, Housing, Transportation Stations (Airport Terminals, Train Stations).

References :

1. Kibert, C. (2008) Sustainable Construction: Green Building Design and Delivery, 2nd edition(Hoboken, NJ: John Wiley and Sons.
2. Handbook of Green Building Design and Construction 1st Edition, by Sam Kubba, eBook ISBN:9780123851291.

IGBC Green New Buildings Rating System, Version 3.0, Abridged Reference Guide September 2014. Available:https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	2	-	-	3	3	-	-	-	-	-
CO2	-	-	2	-	-	3	3	-	-	-	-	-
CO3	-	-	-	-	3	-	2	-	-	-	-	-
CO4	-	-	1	-	3	-	2	-	-	-	-	-

AC3-II: Social Awareness and Governance Program

Home

Prerequisites:

Awareness about basic terms in Social Science and Governance

Course Objectives:

1. To Increase community awareness about social issues and to promote the practice of good governance in both private and public institutions, through policy advocacy and awareness creation in order to ensure proper utilization of public resources and good service delivery.
2. Increase community awareness on health, education, and human rights.
3. Transferring costs of social activities to other various segments of society.
4. To enhance youth participation in decision-making, democracy and economic development.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand social issues and responsibilities as member of society.
CO2: Apply social values and ethics in decision making at social or organizational level
CO3:Promote obstacles in national integration and role of youth for National Integration
CO4: Demonstrate basic features of Indian Constitution.

Course Contents

1. Indian Society as Pluralistic, Fundamentals of unity in diversity, diversity and disparity in Indian society, women in mass media, disparities due to disability.
2. The Indian constitution as unifying factor, Introduction Making of Indian Constitution, Basic features of Indian Constitution, Strengths of Indian Constitution, and Fundamental Duties.
3. National Integration: Introduction, The Value of Tolerance, Minority Classes And Constitution, Pre-Requisites of National Integration, Obstacles To National Integration, Promotion of National Integration, Role of Youth In Promoting Communal Harmony.
4. Socialization, Ethics, Values and Prejudices, Meaning of Socialization, Functions of Socialization, Agents of Socialization, Importance of Socialization, Role of Ethics In Individual Development, Role of Basic Human Values In Individual Development, Relative Value System.

Activities:

1. Conducting training/workshops/debates on HIV/AIDS prevention and stigma reduction.
2. Public shows on girls' education and empowerment.
3. Conducting campaigns on adult/disabled education.
4. To support the government to develop policy that encourages youth participation in decision-making through government agencies.

References:

1. Devidas M. Muley , S Chand, " Social Awareness and Personality Development", ISBN: 812193074X.
2. Bhagabati Prosad Banerjee, Durga Das Basu, Shakeel Ahmad Khan, V. R. Manohar, "Introduction to the Constitution of India", ISBN : 9788180385599.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	3	2	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-	-

Home

AC3-III: Environmental Studies

Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
4. Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Comprehend the importance of ecosystem and biodiversity

CO2: Correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention

CO3: Identify different types of environmental pollution and control measures

CO4: Correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents

1. **Natural Resources:** Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
2. **Ecosystems:** Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
3. **Biodiversity:** Genetic, Species and ecological diversity, Bio Geographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
4. **Pollution:** Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution #Exemplar/Case Studies, Disaster management

Reference:

1. Bharucha, E.,–Textbook of “Environmental Studies”, Universities Press(2005),ISBN-10:8173715408
2. Mahua Basu, ”Environmental Studies”, Cambridge University Press, ISBN-978-1-107-5317-3

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	3	3	-	-	-	-	1
CO3	-	2	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-

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AC3-IV: Smart Cities

We breathe in a world defined by urbanization and digital ubiquity, where mobile broadband connections outnumber fixed ones, machines dominate a new "internet of things," and more people live in cities than in the countryside. This course enables us to take a broad historical look at the forces that have shaped the planning and design of cities and information technologies from the rise of the great industrial cities of the nineteenth century to the present. This course considers the motivations, aspirations, and shortcomings of them all while offering a new civics to guide our efforts as we build the future together, one click at a time.

Course Objectives

- To identify urban problems
- To study Effective and feasible ways to coordinate urban technologies.
- To study models and methods for effective implementation of Smart Cities.
- To study new technologies for Communication and Dissemination.
- To study new forms of Urban Governance and Organization.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the dynamic behavior of the urban system by going beyond the physical appearance and by focusing on representations, properties and impact factors

CO2: Explore the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows

CO3: Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing

CO4: Knowledge about the latest research results in for the development and management of future cities

CO5: Understand how citizens can benefit from data-informed design to develop smart and responsive cities

Course Contents

Urbanization and Ubiquity - The slow emergence of learning cities in an urbanizing world. Cities as collective learners, what do we know?- Framing a view -A gamut of learning types - Secrets of knowing and accelerating change - Why some cities learn and others do not.

References:

1. Anthony M. Townsend, W. W. Nortonand Company “Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia”, ISBN: 0393082873,9780393082876.
2. Tim Campbell, Routledge, “Beyond Smart Cities: How Cities Network, Learn and Innovate”‖, Routledge, ISBN:9781849714266.
3. StanGeertman, JosephFerreira, Jr.Robert Goodspeed, JohnStillwell, “Planning Support System ms and Smart Cities”, Lecture notes in Geo information and Cartography, Springer.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	2	-	-	2	2	1	-	-	-	-
CO2	1	2	1	-	-	1	1	-	-	-	-	-
CO3	2	1	3	3	2	-	1	-	1	1	1	
CO4	-	3	2	-	-	-	-	-	-	-	1	2

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AC3-V: Foreign Language- Japanese (Module 1)

About course:

With changing times, the competitiveness has gotten into the nerves and "Being the Best"at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best... suited Language!!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market and find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the 'resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it.

The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through anguage.

Course Outcomes:

On completion of the course learner will able to-

CO1: Will have ability of basic communication.

CO2: Will have the knowledge of Japanese script.

CO3: Will get introduced to reading , writing and listening skills

CO4: Will develop interest to pursue professional Japanese Language course.

Course Contents

1. Introduction to Japanese Language. Hiragana basic Script, colors, Days of the week
2. Hiragana : modified Kana, double consonant, Letters combined with ya, yu, yoLong vowels, Greetings and expressions
3. Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating on'sage.

Reference:

1. Minna No Nihongo,"Japanese for Everyone", Elementary Main Text book1-1 (Indian Edition), Goyal Publishers and Distributors Pvt.Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Semester IV

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
207003: Engineering Mathematics III

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week Tutorial: 01 Hour/ Week	Theory: 03 Tutorial: 01	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks Term Work: 25 Marks

Prerequisites: Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, Classification and Representation of data.

Companion Course : ---

Course Objectives:

To make the students familiar with concepts and techniques in Linear differential equations, Fourier transform and Z-transform, Statistical methods, Probability theory and Numerical methods. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance thinking power, useful in their disciplines.

Course Outcomes:

On completion of the course learner will able to-

- CO1: Solve Linear differential equations, essential in modelling and design of computer-based systems.
- CO2: Apply concept of Fourier transform and Z-transform and its applications to continuous and discrete systems and image processing.
- CO3: Apply Statistical methods like correlation and regression analysis and probability theory for data analysis and predictions in machine learning.
- CO4: Solve Algebraic and Transcendental equations and System of linear equations using numerical techniques.
- CO5: Obtain Interpolating polynomials, numerical differentiation and integration, numerical solutions of ordinary differential equations used in modern scientific computing.

Course Contents

Unit I	Linear Differential Equations (LDE)	(08 Hours)

LDE of n^{th} order with constant coefficients, Complementary function, Particular integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Unit II	Transforms	(08 Hours)

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine and Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Discrete Fourier Transform.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	(07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV	Probability and Probability Distributions	(07 Hours)

Probability, Theorems on Probability, Bayes theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergeometric, Sampling distributions, Test of Hypothesis: Chi-Square test, t-test.

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Unit V	Numerical Methods	(08 Hours)

Numerical Solution of Algebraic and Transcendental equations: Bisection, Secant, Regula-Falsi, Newton–Raphson and Successive Approximation Methods, Convergence and Stability.

Numerical Solutions of System of linear equations: Gauss elimination, LU Decomposition, Cholesky, Jacobi and Gauss-Seidel Methods.

Unit VI	Numerical Methods	(08 Hours)

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation. Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error. Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} order methods and Predictor-Corrector methods.

Learning Resources

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Numerical Methods for Scientific and Engineering Computation, by M. K. Jain, S. R. K. Iyengar And R. K. Jain, 5e, (New Age International Publication)

MOOC Link:

1. NPTEL Course "Transform Calculus And its applications in differential equations" https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course on "Numerical Methods" https://nptel.ac.in/courses/111/107/111107105/

Virtual LAB Link:

1. Numerical Methods: http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/index.php

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in batches (batch size as per norms) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

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Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210252: Data Structures and Algorithms		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses: 110005: Programming and Problem Solving
210242: Fundamentals of Data Structures

Companion Course: 210257: Data Structures and Algorithms Laboratory

Course Objectives:

The course is intended to provide the foundations of the practical implementation and usage of Data Structures and Algorithms to ensure that the learner evolves into a competent programmer capable of designing and analyzing implementations of data structures and algorithms for different kinds of problems.

- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Identify and articulate** the complexity goals and benefits of a good hashing scheme for real-world applications.
CO2: **Apply** non-linear data structures for solving problems of various domain.
CO3: **Design and specify** the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.
CO4: **Analyze** the algorithmic solutions for resource requirements and optimization
CO5: **Use** efficient indexing methods and multiway search techniques to store and maintain data.
CO6: **Use** appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Course Contents

Unit I	**Hashing**	**(07 Hours)**
Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining. **Skip List-** representation, searching and operations- insertion, removal		
#Exemplar/Case Studies	Book Call Number and Dictionary	
***Mapping of Course Outcomes for Unit I**	CO1, CO4	
Unit II	**Trees**	**(08 Hours)**

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Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree.		
#Exemplar/Case Studies	Use of binary tree in expression tree-evaluation and Huffman's coding	
*Mapping of Course Outcomes for Unit II	CO2, CO3,CO4	
Unit III	**Graphs**	**(07 Hours)**
Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. **Traversals**-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.		
#Exemplar/Case Studies	Data structure used in Webgraph and Google map	
*Mapping of Course Outcomes for Unit III	CO2,CO3, CO4	
Unit IV	**Search Trees**	**(08 Hours)**
Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree		
#Exemplar/Case Studies	Keyword search in a document using OBST	
*Mapping of Course Outcomes for Unit IV	CO2, CO3, CO5	
Unit V	**Indexing and Multiway Trees**	**(07 Hours)**
Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion, B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree.		
#Exemplar/Case Studies	Heap as a Priority Queue	
*Mapping of Course Outcomes for Unit V	CO2, CO3, CO5	
Unit VI	**File Organization**	**(07 Hours)**
Files: concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.		
#Exemplar/Case Studies	**External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm	
*Mapping of Course Outcomes for Unit VI	CO4, CO6	
Learning Resources		

Text Books:

1. Horowitz, Sahani, Dinesh Mehata, “Fundamentals of Data Structures in C++”‖, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, “File Structures‖, Pearson Education”, ISBN:81-7758-37-5
3. Peter Brass, “Advanced Data Structures”‖, Cambridge University Press, ISBN: 978-1-107-43982-5

Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, “Data Structures and Algorithms”‖, Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, “File Structures an Object Oriented Approach with C++‖”, Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, “Data Structures, Algorithms and Applications in C++”‖, Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, “Data Structures and Algorithms”‖, McGraw-Hill Companies, ISBN -9780070667266.
5. Goodrich, Tamassia, Goldwasser, “Data Structures and Algorithms in Java”‖, Wiley Publication, ISBN: 9788126551903

e-Books:

- https://www.ebooks.com/en-us/book/95777110/Python-data-structures-and-algorithms/benjamin-baka/
- https://www.ebookphp.com/advanced-data-structures-epub-pdf/
- https://www.ebookphp.com/data-structures-and-algorithms-professional-edition-beginners-guide-epub-pdf/

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/102/106102064/
- https://nptel.ac.in/courses/106/105/106105085
- https:// nptel.ac.in/courses/106/106/106106127

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	1	-	-	-	-	-	-	-	-
CO5	1	-	1	1	-	-	-	-	-	-	-	-
CO6	2	1	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210253: Software Engineering		
Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 110005: Programming and Problem Solving

Companion Course : ---

Course Objectives:

The main objective of this course is to introduce the students to software engineering- the fundaments of software engineering principles and practices, including project management, configurations management, requirements definition, system analysis, design, testing, and deployment with hands-on experience in a group software development project.

- To learn and understand the principles of Software Engineering.
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To apply design and testing principles to software project development.
- To understand project management through life cycle of the project.

Course Outcomes:

On completion of the course, learner will be able to-

CO1: Analyze software requirements and formulate design solution for a software.

CO2: Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.

CO3: Apply new software models, techniques and technologies to bring out innovative and novelistic solutions for the growth of the society in all aspects and evolving into their continuous professional development.

CO4: Model and design User interface and component-level.

CO5: Identify and handle risk management and software configuration management.

CO6: Utilize knowledge of software testing approaches, approaches to verification and validation.

CO7: Construct software of high quality – software that is reliable, and that is reasonably easy to understand, modify and maintain efficient, reliable, robust and cost-effective software solutions.

Course Contents

Unit I	**Introduction to Software Engineering and Software Process Models**	**(06Hours)**

Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice. **Software Process:** A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.

#Exemplar/Case Studies	Agile Tools- JIRA
*Mapping of Course Outcomes for Unit I	CO1, CO3, CO7

Unit II	**Software Requirements Engineering and Analysis**	**(07 Hours)**

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Modeling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements.
Suggested Free Open Source tools: StarUML, Modelio, SmartDraw.

#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study Study SRS of Online Voting system (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf), Library management System, Develop use case model for any software applications.
***Mapping of Course Outcomes for Unit II**	CO1, CO3, CO7

Unit III	Estimation and Scheduling	(07 Hours)

Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources, Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix
Project Scheduling: Project Scheduling, Defining a Task for the Software Project, Scheduling.
Suggested Free Open Source Tools: Gantt Project, Agantty, Project Libre.

#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study, Study SRS of Online Voting system, Library management System (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf),
***Mapping of Course Outcomes for Unit III**	CO1, CO3, CO7

Unit IV	Design Engineering	(07 Hours)

Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept, Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for Web Apps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements.
Architectural Design: Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles.
Suggested Free Open Source Tool: Smart Draw

#Exemplar/Case Studies	Study design of Biometric Authentication software
***Mapping of Course Outcomes for Unit IV**	CO1,CO2 CO3, CO7

Unit V	Risks and Configuration Management	(07 Hours)

Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.
Software Configuration Management: Software Configuration Management, The SCM Repository The SCM Process, Configuration Management for any suitable software system.
Suggested Free Open Source Tools: CF Engine Configuration Tool, Puppet Configuration Tool.

#Exemplar/Case Studies	Risk management in Food delivery software

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***Mapping of Course Outcomes for Unit V**	CO1,CO2 CO3, CO7	
Unit VI	**Software Testing**	**(07 Hours)**

A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies forWebApps, Validation Testing, Validation-Test Criteria, Configuration Review.
Suggested Free Open Source Tools: Selenium, JUnit.

#Exemplar/Case Studies	Selemium Testing with any online application
***Mapping of Course Outcomes for Unit VI**	CO1,CO2 CO3, CO6

Learning Resources

Text Books:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach"‖, McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, "Software Engineering"‖, Addison and Wesley, ISBN 0-13-703515-2

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", PHI, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering"‖, PHI, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering"‖, Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering"‖, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, "Handbook of Software Engineering", Clanye International ISBN-10: 1632402939

e-books:

- https://ebookpdf.com/roger-s-pressman-software-engineering

MOOC/ Video Lectures available at:

- https://swayam.gov.in/nd1_noc19_cs69/preview
- https://swayam.gov.in/nd2_cec20_cs07/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	2	2	2	-	-	-	-
CO3	-	-	2	-	-	2	-	-	-	-	-	-
CO4	-	2	2	-	-	-	-	-	-	-	-	
CO5	-	2	2	-	-	-	-	-	-	-	-	-
CO6	-	2	2	-	-	-	-	-	-	-	-	-
CO7	1	-	1	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210254: Microprocessor

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	03	**Mid_Semester(TH):** 30 Marks **End_Semester(TH):** 70 Marks

Prerequisite Courses : 210248: Digital Electronics and Logic Design

Companion Course : 210258: Microprocessor Laboratory

Course Objectives:

The course is intended to provide practical exposure to the students on microprocessors, design and coding knowledge on 80386 and introduction to microcontrollers.

- To learn and distinguish the architecture and programmer's model of advanced processor.
- To identify the system level features and processes of advanced processors.
- To acquaint the learner with application instruction set and logic to build assembly language programs.

Course Outcomes:

After successful completion of the course, the learner will be able to-

CO1: Exhibit skill of assembly language programming for the application.
CO2: **Classify** Processor architectures.
CO3: **Illustrate** advanced features of 80386 Microprocessor.
CO4: **Compare** and **contrast** different processor modes.
CO5: **Use** interrupts mechanism in applications
CO6: **Differentiate** between Microprocessors and Microcontrollers.
CO7: **Identify** and **analyze** the tools and techniques used to design, implement, and debug microprocessor-based systems.

Course Contents

Unit I	Introduction to 80386	(07 Hours)

Brief History of Intel Processors, 80386 DX Features and Architecture, Programmers Model, Operating modes, Addressing modes and data types.
Applications Instruction Set: Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.

#Exemplar/Case Studies	Study-Evolution of Microprocessor
*Mapping of Course Outcomes for Unit I	CO1,CO2

Unit II	Bus Cycles and System Architecture	(07 Hours)

Initialization- Processor State after Reset. Functional pin Diagram, functionality of various pins, I/O Organization, Memory Organization (Memory banks), Basic memory read and writes cycles with timing diagram.
Systems Architecture- Systems Registers (Systems flags, Memory Management registers, Control registers, Debug registers, Test registers), System Instructions.

#Exemplar/Case Studies	Study-Motherboard of Computer and it's components.
*Mapping of Course Outcomes for Unit II	CO3

Unit III	Memory Management	(08 Hours)

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Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, GDTR, LDTR, IDTR. Formats of Descriptors and Selector, Segment Translation, Page Translation, Combining Segment and Page Translation.		
#Exemplar/Case Studies	Try creating an animation by using any of /Study of the tools to create and access all the type of possible segments in 80386DX.	
***Mapping of Course Outcomes for Unit III**	CO1,CO2	
Unit IV	**Protection**	**(08 Hours)**
Need of Protection, Overview of 80386DX Protection Mechanisms: Protection rings and levels, Privileged Instructions, Concept of DPL, CPL, RPL, EPL. Inter privilege level transfers using Call gates, Conforming code segment, Privilege levels and stacks. Page Level Protection, Combining Segment and Page Level Protection.		
#Exemplar/Case Studies	Study about- can the security of the system be compromised using CALL gates?	
***Mapping of Course Outcomes for Unit IV**	CO4, , CO6	
Unit V	**Multitasking and Virtual 8086 Mode**	**(08Hours)**
Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space. **Virtual Mode** – Features, Memory management in Virtual Mode , Entering and leaving Virtual mode.		
#Exemplar/Case Studies	Study about multitasking implemented by using timing interrupt generated by internal clock of the system. Consider three different tasks: One displaying a string at first row accessing VRAM directly; Second Blinking the string with certain time interval and; Third clearing the screen.	
***Mapping of Course Outcomes for Unit V**	CO4, CO5, CO6	
Unit VI	**Interrupts, Exceptions, and Introduction to Microcontrollers**	**(07 Hours)**
Interrupts and Exceptions: Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions. **Introduction to Microcontrollers**: Architecture of typical Microcontroller, Difference between Microprocessor and Microcontroller, Characteristics of microcontrollers, Application of Microcontrollers.		
#Exemplar/Case Studies	Try building a Minimum System using 8051 microcontroller (Provide complete architecture and component selection with rationale). Indicate Memory Map explicitly.	
***Mapping of Course Outcomes for Unit VI**	CO4,CO6, CO7	
Learning Resources		

Text Books:

1. Douglas Hall, “Microprocessors & Interfacing”, McGraw Hill, Revised 2 Edition, 2006 ISBN 0-07-100462-9
2. A.Ray, K.Bhurchandi, ”Advanced Microprocessors and peripherals: Arch, Programming & Interfacing”, Tata McGraw Hill,2004 ISBN 0-07-463841-6
3. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.
4. Intel 80386 Hardware Reference Manual 1986, Intel Corporation, Order no.: 231732-001, 1986.
5. James Turley- “Advanced 80386 Programming Techniques”, McGraw-Hill, ISBN: 10:0078813425, 13: 978-0078813429.

Home

Reference Books:

1. Chris H. Pappas, William H. Murray, “80386 Microprocessor Handbooks”, McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
2. Walter A. Triebel, “The 80386Dx Microprocessor: Hardware”, Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
3. Brey, Barry B, “8086/8088, 80286, 80386 and 80486 Assembly Language Programming”, Prentice Hall, ISBN: 13: 9780023142475.
4. Mohammad Rafiquzzaman, "Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
5. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.
6. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

Intel 80386 Programmer's Reference Manual:

- http://intel80386.com/386htm/toc.htm
- https://css.csail.mit.edu/6.858/2014/readings/i386.pdf

MOOC/ Video Lectures available at:

- https://nptel.ac.in/courses/106/108/106108100/
- https://nptel.ac.in/courses/108/107/108107029/

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-
CO7	2	1	1	1	-	-	-	-	-	-	-	-

Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210255: Principles of Programming Languages

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Lecture: 03 Hours/Week	**03**	**Mid_Semester(TH): 30 Marks** **End_Semester(TH): 70 Marks**

Prerequisite Courses : 110005: Programming and Problem Solving,
210253: Object Oriented Programming

Companion Course : 210257: Data Structures and Algorithms Laboratory

Course Objectives:

- To learn basic principles of programming languages and programming paradigms.
- To learn structuring the data and manipulation of data, computation and program structure.
- To learn Object Oriented Programming (OOP) principles using Java Programming Language.
- To learn basic concepts of logical and functional programming language.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: **Make** use of basic principles of programming languages.
CO2: **Develop** a program with Data representation and Computations.
CO3: **Develop** programs using Object Oriented Programming language : Java.
CO4: **Develop** application using inheritance, encapsulation, and polymorphism.
CO5: **Demonstrate** Multithreading for robust application development.
CO6: **Develop** a simple program using basic concepts of Functional and Logical programming paradigm.

Course Contents

Unit I	Fundamentals of Programming	(06Hours)

Importance of Studying Programming Languages, History of Programming Languages, Impact of Programming Paradigms, Role of Programming Languages, Programming Environments. Impact of Machine Architectures: The operation of a computer, Virtual Computers and Binding Times.
Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic and rule based.

#Exemplar/Case Studies	A case study: Retail Sales application
*Mapping of Course Outcomes for Unit I	CO1

Unit II	Structuring the Data, Computations and Program	(07 Hours)

Elementary Data Types : Primitive data Types, Character String types, User Defined Ordinal Types, Array types, Associative Arrays, Record Types, Union Types, Pointer and reference Type.
Expression and Assignment Statements: Arithmetic expression, Overloaded Operators, Type conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed mode Assignment. **Statement level Control Statements:** Selection Statements, Iterative Statements, Unconditional Branching. **Subprograms:** Fundamentals of Sub Programs, Design Issues for Subprograms, Local referencing Environments, Parameter passing methods.
Abstract Data Types and Encapsulation Construct: Design issues for Abstraction, Parameterized Abstract Data types, Encapsulation Constructs, Naming Encapsulations.

#Exemplar/Case Studies	Data representation and computations in Retail Sales
*Mapping of Course Outcomes for Unit II	CO2

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Unit III	Java as Object Oriented Programming Language- Overview	(07 Hours)
Fundamentals of JAVA, Arrays: one dimensional array, multi-dimensional array, alternative array declaration statements, **String Handling:** String class methods, **Classes and Methods**: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable - length arguments.		
#Exemplar/Case Studies	Demonstrate classes , objects, data, methods for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit III	CO3	
Unit IV	Inheritance, Packages and Exception Handling using Java	(07 Hours)
Inheritances: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator. fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class.		
#Exemplar/Case Studies	Demonstrate inheritance, Packages and interface for Online Banking System using Java.	
*Mapping of Course Outcomes for Unit IV	CO4	
Unit V	Multithreading in Java	(07 Hours)
Concurrency and Synchronization, Java Thread Model: Thread priorities, Synchronization, Messaging, Main Thread, Creating thread: Implementing Thread using thread class and Runnable interface. Creating multiple threads using is Alive() and join(). **Web Based Application in Java:** Use of JavaScript for creating web based applications in Java, Introduction to Java script frameworks- ReactJS, VueJS, AngularJS (open source).		
#Exemplar/Case Studies	Demonstrate Multithreading for Gaming.	
*Mapping of Course Outcomes for Unit V	CO5	
Unit VI	Logical and Functional Programming	(07 Hours)
Functional Programming Paradigm: Understanding symbol manipulation, Basic LISP functions, definitions, predicates, conditionals and scoping, Recursion and iteration, Properties List array and access functions, Using lambda definitions, printing, reading and atom manipulation. **Logic Programming Paradigm:** An Overview of Prolog, Syntax and Meaning of Prolog Programs, Lists, Operators, Arithmetic, Using Structures.		
#Exemplar/Case Studies	Demonstrate Functional and Logic Programming for Software Project Management.	
*Mapping of Course Outcomes for Unit VI	CO6	

Home

Learning Resources

Text Books:

1. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation‖, 4th Ed, PHI, ISBN 81-203-2035-2.
2. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
3. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9.

Reference Books:

1. Deugo, ―Java Gems‖, Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
2. Carl Townsend ,"Programming in turbo PROLOG", Tata-McGraw Hill
3. Ivan Bratko, " Prolog Programming for Artificial Intelligence", Wesley Publishers Limited
4. Winston P., Klaus B., Horn P., "LISP", 3rd Edition, Pearson Education, 81 - 7808 -155-5
5. Carlo Ghezzi, Mehdi Jazayeri, ―Programming Language Concepts‖,3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.

eBooks:

- https://www.springer.com/gp/book/9781848820319
- https://www.springer.com/gp/book/9781848829138

eBooks:

- https://nptel.ac.in/courses/106/102/106102067/
- https://swayam.gov.in/nd1_noc20_cs08/preview
- https://swayam.gov.in/nd2_aic20_sp13/preview
- https://swayam.gov.in/nd1_noc19_cs84/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	-
CO6	2	1	-	-	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210256: Data Structures and Algorithms Laboratory

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 25 Marks Practical: 25 Marks

Companion Course : 210252: Data Structures and Algorithms, 210255:Priciples of Programming Languages

Course Objectives:

- To **understand** practical implementation and usage of non linear data structures for solving problems of different domain.
- To strengthen the ability to identify and **apply** the suitable data structure for the given real world problems.
- To **analyze** advanced data structures including hash table, dictionary, trees, graphs, sorting algorithms and file organization.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the ADT/libraries, hash tables and dictionary to design algorithms for a specific problem.

CO2: Choose most appropriate data structures and **apply** algorithms for graphical solutions of the problems.

CO3: Apply and **analyze** non linear data structures to solve real world complex problems.

CO4: Apply and **analyze** algorithm design techniques for indexing, sorting, multi-way searching, file organization and compression.

CO5: Analyze the efficiency of most appropriate data structure for creating efficient solutions for engineering design situations.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface), curriculum of course, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student's Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory / Term Work Assessment

Continuous assessment of laboratory work should be done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment should be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the

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average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, C, D, E, F and G. Each student must perform at least 12 assignments(at least 02 from group A, 03 from group B, 02 from group C, 2 from group D, 01 from group E, 02 from group F.)

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source Python - Group A assignments, C++ Programming tool like G++/GCC

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. Consequently encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. Therefore adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://cse01-iiith.vlabs.ac.in/Courses%20Aligned.html?domain=Computer%20Science

Suggested List of Laboratory Experiments/Assignments

Sr. No	Group A
1	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number. Make use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers
2	Implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique. Standard Operations: Insert(key, value), Find(key), Delete(key)
3	For given set of elements create skip list. Find the element in the set that is closest to some given value. (note: Decide the level of element in the list Randomly with some upper limit)
4	To create ADT that implement the "set" concept. a. Add (new Element) -Place a value into the set , b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection, d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection, e. Intersection of two sets , f. Union of two sets, g. Difference between two sets, h. Subset
	Group B
5	A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method.
6	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - i. Insert new node, ii. Find number of nodes in longest path from root, iii. Minimum data value found in the tree, iv. Change a tree so that the roles of the left and right pointers are swapped at every node, v. Search a value

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7	Construct an expression tree from the given prefix expression eg. +--a*bc/def and traverse it using post order traversal (non recursive) and then delete the entire tree.
8	Read for the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function?
9	Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm.
10	Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity. _
11	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.
12	Implement a file compression algorithm that uses binary tree. Your program should allow the user to compress and decompress messages containing alphabets using the standard Huffman algorithm for encoding and decoding.
	Group C
13	Represent a given graph using adjacency matrix/list to perform DFS and using adjacency list to perform BFS. Use the map of the area around the college as the graph. Identify the prominent land marks as nodes and perform DFS and BFS on that.
14	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight take to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Check whether the graph is connected or not. Justify the storage representation used.
15	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.
16	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
17	Consider the scheduling problem. n tasks to be scheduled on single processor. Let t1, ...,tn be durations required to execute on single processor is known. The tasks can be executed in any order but one task at a time. Design a greedy algorithm for this problem and find a schedule that minimizes the total time spent by all the tasks in the system. (The time spent by one is the sum of the waiting time of task and the time spent on its execution.)
	Group D
18	Given sequence k = k1 <k2 < … <kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key?

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19	A Dictionary stores keywords and its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
	Group E
20	Consider a scenario for Hospital to cater services to different kinds of patients as Serious (top priority), b) non-serious (medium priority), c) General Checkup (Least priority). Implement the priority queue to cater services to the patients.
21	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language
22	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyze the algorithm.
	Group F
23	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to main the data.
24	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.
25	Implementation of a direct access file -Insertion and deletion of a record from a direct access file
26	Assume we have two input and two output tapes to perform the sorting. The internal memory can hold and sort m records at a time. Write a program in java for external sorting. Find out time complexity.
	Mini-Projects/ Case Study
27	Design a mini project using JAVA which will use the different data structure with or without Java collection library and show the use of specific data structure on the efficiency (performance) of the code.
28	Design a mini project to implement Snake and Ladders Game using Python.
29	Design a mini project to implement a Smart text editor.
30	Design a mini project for automated Term work assessment of student based on parameters like daily attendance, Unit Test / Prelim performance, Students achievements if any, Mock Practical.

@The CO-PO Mapping Matrix

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	-	-	-	-	-	-	-	-
CO2	-	2	2	-	-	-	-	-	-	-	-	-
CO3	-	2	2	1	-	-	-	-	-	-	-	-
CO4	1	2	1	1	-	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210257: Microprocessor Laboratory		
Teaching Scheme **Practical:** 02 Hours/Week	**Credit Scheme** 01	**Examination Scheme and Marks** **Term Work:** 25 Marks **Practical:** 25 Marks

Companion Course : 210254: Microprocessor

Course Objectives:

- To understand assembly language programming instruction set
- To understand different assembler directives with example
- To apply instruction set for implementing X86/64 bit assembly language programs

Course Outcomes:

On completion of the course, learner will be able to–

CO1. **Understand** and **apply** various addressing modes and instruction set to implement assembly language programs

CO2. **Apply** logic to **implement** code conversion

CO3. **Analyze** and **apply** logic to **demonstrate** processor mode of operation

Guidelines for Laboratory /Term Work Assessment

Continuous assessment of laboratory work is based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Use of open source software is encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System: 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM/TASM/NASM/FASM.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student’s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Virtual Laboratory:

- http://209.211.220.205/vlabiitece/mi/MI3.php

Suggested List of Laboratory Experiments/Assignments(any 10)

Sr. No.	Assignments

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1	Write an X86/64 ALP to accept five 64 bit Hexadecimal numbers from user and store them in an array and display the accepted numbers.
2	Write an X86/64 ALP to accept a string and to display its length.
3	Write an X86/64 ALP to find the largest of given Byte/Word/Dword/64-bit numbers.
4	Write a switch case driven X86/64 ALP to perform 64-bit hexadecimal arithmetic operations (+,-,*, /) using suitable macros. Define procedure for each operation.
5	Write an X86/64 ALP to count number of positive and negative numbers from the array.
6	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for: (a) HEX to BCD b) BCD to HEX (c) EXIT. Display proper strings to prompt the user while accepting the input and displaying the result. (Wherever necessary, use 64-bit registers).
7	Write X86/64 ALP to detect protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers also identify CPU type using CPUID instruction.
8	Write X86/64 ALP to perform non-overlapped block transfer without string specific instructions. Block containing data can be defined in the data segment.
9	Write X86/64 ALP to perform overlapped block transfer with string specific instructions Block containing data can be defined in the data segment.
10	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition and add and shift method. (use of 64-bit registers is expected).
11	Write X86 Assembly Language Program (ALP) to implement following OS commands i) COPY, ii) TYPE Using file operations. User is supposed to provide command line arguments
12	Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file. The text file has to be accessed during Program_1 execution and write FAR PROCEDURES in Program_2 for the rest of the processing. Use of PUBLIC and EXTERN directives is mandatory.
13	Write x86 ALP to find the factorial of a given integer number on a command line by using recursion. Explicit stack manipulation is expected in the code.
14	Write an X86/64 ALP password program that operates as follows: a. Do not display what is actually typed instead display asterisk ("*"). If the password is correct display, "access is granted" else display "Access not Granted"
15	Study Assignment: Motherboards are complex. Break them down, component by component, and Understand how they work. Choosing a motherboard is a hugely important part of building a PC. Study- Block diagram, Processor Socket, Expansion Slots, SATA, RAM, Form Factor, BIOS, Internal Connectors, External Ports, Peripherals and Data Transfer, Display, Audio, Networking, Overclocking, and Cooling. 4. https://www.intel.in/content/www/in/en/support/articles/000006014/boards-and-kits/desktop-boards.html

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	2	1	-	-	-	-	-	-	-	-
CO2	2	1	-	1	-	-	-	-	-	-	-	-
CO3	-	1	-	1	-	-	-	-	-	-	-	-

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210258: Project Based Learning II

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 04 Hours/Week	02	Term Work: 50 Marks

Course Objectives:

- To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem.
- To Evaluate alternative approaches, and justify the use of selected tools and methods.
- To emphasizes learning activities that are long-term, inter-disciplinary and student-centric.
- To engages students in rich and authentic learning experiences.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
- To develop an ecosystem that promotes entrepreneurship and research culture among the students.

Course Outcomes:

CO1: Identify the real life problem from societal need point of view
CO2: Choose and compare alternative approaches to select most feasible one
CO3: Analyze and synthesize the identified problem from technological perspective
CO4: Design the reliable and scalable solution to meet challenges
CO5: Evaluate the solution based on the criteria specified
CO6: Inculcate long life learning attitude towards the societal problems

Course Contents

Preamble:

Project-based learning is an instructional approach designed to give students the opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. PBL, is more than just projects. With PBL students "investigate and respond to an authentic, engaging, and complex problem, or challenge" with deep and sustained attention. PBL is "learning by doing." The truth is, many in education are recognizing we live in a modern world sustained and advanced through the successful completion of projects. In short, If students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Project based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development. The PBL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It Brings what students should academically know, understand, and be able to do and requires students to present their problems, research process, methods, and results.[1]

Project based learning (PBL) requires regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per batch. For the faculty involved in PBL , teaching workload of 4 Hrs/week/batch needs to be considered. The Batch should be divided into sub-groups of 4 to 5 students. Idea implementation /Real life problem/Complex assignments / activities / projects. under project based learning is to be carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester

Group Structure:

Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.

1. There should be team/group of 4-5 students
2. A supervisor/mentor teacher assigned to individual groups

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Selection of Project/Problem:

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated interdisciplinary or subject frame.

A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.

By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and structure of the activity.

A few hands-on activities that may or may not be multidisciplinary.

Use of technology in meaningful ways to help them investigate, collaborate, analyse, synthesize, and present their learning.

Activities may include- Solving real life problem, investigation, /study and Writing reports of in depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.

Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation of the individual and the team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
3. Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at college end by both students as well as mentor (PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment/evaluation and weightage:

1. Idea Inception and Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (10%)
2. Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (Individual assessment and team assessment) (40%)
3. Documentation (Gathering requirements, design and modelling, implementation/execution, use of technology and final report, other documents) (15%)
4. Demonstration (Presentation, User Interface, Usability) (20%)

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5. Contest Participation/ publication (15%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. It will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

Note :

- While planning for the assessment, choose a valid method based on your context. It should be able to understand by both the students as well as the faculty.
- The student group must follow the principles of Software Engineering (Scoping out the problem, the solution implementation and related documentation).
- Researching the problem and outlining various approaches is key here and should be emphasized by the tutor and the mentor.
- Aspects of design thinking (from the point of view of the person facing the problem) are very important. Students should not jump into the technology aspects first.
- The team can follow the principles of Agile Software Development. The weekly meetings could be used as a Scrum meeting.
- The tutor and mentor should actively help the students to scope the work and the approach. They must validate the technology choices.
- If the implementation code is well documented, the project can be continued by subsequent batch – which will help solve a bigger problem.

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2. Problem Based Learning. By Mahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3. Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert Capraro, Mary Margaret Capraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2. Gopalan," Project management core text book", 2 Indian Edition
3. James Shore and Shane Warden, " The Art of Agile Development"

Tutors Role in Project Based Learning

- The fundamentals of problem based learning, lies with the Tutors role.
- Tutors are not the source of solutions rather they act as the facilitator and mentor.
- The facilitator skills of the Tutors / Teacher are central to the success of PBL.

Change of Mindset

- Students are not used to the constructivist approach to learning, it is important that they are carefully told what to expect in PBL.
- Tutors need to explain the differences between PBL and traditional learning.
- Tutors need to explain the principals involved and role of the students in PBL learning.

Designing Problem

- Considering the prior knowledge of the students, their ability and creativity, problem statement should be designed.
- For 2nd year PBL students the tutor should place more emphasis on getting the students to perform higher-level tasks.
- It is important for tutors to design problems that are anchored in authentic contexts only
- Students should take ownership of the problem.
- Problems should not be over simplified or well defiled
- Learning should not be the sequencing of instructional events, but the application of principles for responding to the needs of the situation.
- The problems given to students in PBL should be realistic, complex, and should reflect, as

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much as possible, the actual problems that students would encounter in real life.

Basic function of the tutor

- A good understanding of the overall curriculum the students have to study, the principles of problems solving, critical thinking and meta-cognitive skills.

Grouping

- Study the background and profile of each student.
- Make sure that students of different backgrounds and experience are assigned in a group
- It is useful to group students of different abilities, gender, and nationalities together.
- Tutors must have the commitment to devote the time to the tutorial process.
- A good tutor is always interested in helping students to learn better.
- Sufficient resources should be made available for students to take part the PBL tutorial.
- Time management is important.

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of the groups in PBL
- Assessment of students should not be focused only on the final leaning product.
- PBL tutors need to understand meaningful ways of assessing students' work to motivate learning.
- For assessment to be implemented properly there should be well designed and clearly defined goals and objectives and well thought out strategies, techniques, criteria, and marking schemes.

Student's Role in PBL

- Prepare students for PBL before starting the sessions.
- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PBL must be responsible for their own learning.
- Throughout the PBL process, students have to define and analyze the problem, generate learning issues and apply what they have learned to solve the problem and act for them-selves and be free.
- Students must quickly learn how to manage their own learning, Instead of passively receiving instruction.
- Students in PBL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PBL are expected to work in groups.
- They have to develop interpersonal and group process skills, such as effective listening or coping creatively with conflicts.

Inquiry Skills

- Students in PBL are expected to develop critical thinking abilities by constantly relating:
- What they read to do?
- What they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Formative and summative questions for evaluation:
- How effective is …….?
- How strong is the evidence for ………?
- How clear is ……?
- What are the justifications for thinking?
- Why is the method chosen?
- What is the evidence given to justify the solution?

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Information Literacy

- Information literacy is an integral part of self- directed learning

Information literacy involves the ability to:

- Know when there is a need for information
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
- How to prepare the search , How to carry out the research,
- Sorting and assessing of information in general

Collaborative learning

- It is an educational approach to teaching and learning that involves
- groups of students working together to solve a problem or complete a project
- In collaborative learning, learners have the opportunity to talk with peers, exchange diverse beliefs present and defend ideas, as well as questioning other ideas.

Interpersonal Skills

- Interpersonal skills relating to group process are essential for effective problem solving and learning.
- It is important that students are made aware of these inter personal skills.
- Consensual decision making skills, Dialogue and discussion skills, Team maintenance skills
- Conflict management skills and Team leadership skills.
  Students who have these skills have a better opportunity to learn than students who do not have these skills and Time Management

Resources

- Students need to have the ability to evaluate the resources used

Students have to evaluate the source of the resources used by asking the following questions:

- How current is it?, Is there any reason to suspect bias in the source?
- How credible and accurate is it?

Meta-cognitive Skills

- Students need to reflect on the processes they are using during the learning process,
- Compare one strategy with another, and evaluate the effectiveness of the strategy used

Reflection Skills

- Reflection helps students refine and strengthen their high-level thinking skills and abilities through self-assessment.
- Reflection gives students opportunities to think about how they answered a question, made a decision, or solved a problem.
- What strategies were successful or unsuccessful? ,What issues need to be remembered for next time? , What could or should be done differently in the future?

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	-	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	2

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Savitribai Phule Pune University
Second Year of Computer Engineering (2019 Course)
210259: Code of Conduct

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Tutorial: 01 Hours/Week	01$	Term work$: 25 Marks

Preamble:

Engineering is one of the important and cultured professions. With respect to any engineering profession, engineers are expected to exhibit the reasonable standards of integrity and honesty. Engineering is directly or indirectly responsible to create a vital impact on the quality of life for the society. Acceptably, the services provided by engineers require impartiality, honesty, equity and fairness and must give paramount importance to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the principles of ethical conduct.

Prime aim is to recognize and evaluate ethical challenges that they will face in their professional careers through knowledge and exercises that deeply challenge their decision making processes and ethics.

Course Objectives:

- To promote ethics, honesty and professionalism.
- To set standards that are expected to follow and to be aware that If one acts unethically what are the consequences.
- To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
- To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the basic perception of profession, professional ethics, various moral and social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO2: Aware of professional rights and responsibilities of an engineer, responsibilities of an engineer for safety and risk benefit analysis.

CO3: Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CO4: Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Contents

The following are the certain guidelines as far as ethics and code of conduct are concerned to be clearly and elaborately explained to the students,

Fundamental norms Engineers, in the fulfillment of their professional duties, should include paying utmost attention to the safety, health, and welfare of the society. Along with that engineers should execute the services only in their areas of competence. Whenever there is a need to issue public statements then such statements should be expressed in objective and truthful manner. Engineer should extend high sense of integrity by acting for each employer or client as faithful agents or trustees. Whatever may be the working scope engineer should conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Home

As far as ethical practices are concerned engineers should not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or Code. Engineers should not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise moreover he/she should not aid or abet the unlawful practice of engineering by a person or firm.

Engineers having knowledge of any alleged violation of the Code should report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required. Engineers should disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services. Engineers should not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties. Engineers should not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

Engineers should never falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures, or past accomplishments.

Engineers should not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They should not offer any gift or other valuable consideration in order to secure work. They should not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

There are certain obligations accompanied with engineering profession. Engineers should acknowledge their errors and should not distort or alter the facts. Candid advises in special cases are always welcome. Engineers should not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

Engineers should not promote their own interest at the expense of the dignity and integrity of the profession furthermore they should treat all persons with dignity, respect, fairness, and without discrimination. Engineers should at all times strive to serve the public interest. Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community. Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminar.

Engineers should not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice. They should not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action. "Sustainable development" is the challenge for the engineers meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

Following are contents to be covered in tutorial session-

Home

1. **Introduction to Ethical Reasoning and Engineer Ethics:** Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.
2. **Professional Practice in Engineering :** Global Issues -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct
3. **Ethics as Design** - Doing Justice to Moral Problems : Engineer's Responsibility for Safety - Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk
4. **Workplace Responsibilities and Rights** - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination
5. **Computers, Software, and Digital Information**
6. **Responsibility for the Environment**

#Exemplar/Case Studies :

General Motors ignition switch recalls (2014), Space Shuttle Columbia disaster (2003), Space Shuttle Challenger disaster (1986), Therac-25 accidents (1985 to 1987), Chernobyl disaster (1986), Bhopal disaster (1984), Kansas City Hyatt Regency walkway collapse (1981)

Guidelines for Conduction:

The course will exemplify the budding engineers the Code of Conduct and ethics pertaining to their area and scope of their work. The Instructor/Teacher shall explain the students the importance and impact of the ethics and code of conduct.

Confined to various courses and project/mini-project development the possible vulnerabilities and threats need to be elaborated and the students' participation need to be encouraged in designing such document explicitly mentioning Code of Conduct and Disclaimers.

Suggested set of Activities

1. **Purpose**-Introduce the concept of Professional Code of Conduct
   Method – Using Group Discussion as a platform, ask students to share one practice in their family / home that everyone has to follow. For ex. not wearing footwear in the house, taking a bath first thing in the morning, seeking blessings from elders, etc. Connect this Code of Conduct in their family to one that exists in the professional world
   Outcome – Awareness of profession-specific code of conduct and importance of adherence of that code specified. Ability to express opinions verbally and be empathetic to diverse backgrounds and values
2. **Purpose**-Impress upon the students, the significance of morality
   Method – Role play a professional situation where an engineer is not competent and is trying to copy the work of a colleague and claim credit for that work. Ask observing students to react to that situation. Alternatively, a short video that clearly shows unethical behavior can be played and ask viewers their opinion about the situation. Note to teachers – read about Kohlber's theory and Gilligan's theory to understand levels of moral behavior
   Outcome – Incite students to contemplate their own immoral behavior in public space or academic environment (like copying homework or assignment). Will coax students to introspect their own values and encourage them to choose the right path
3. **Purpose**-Highlight the importance of professional ideals like conflict management, ambition, ethical manners and accountability
   Method – Each student will have to write a 200 word essay on any of above mentioned virtues of being a good professional. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
   Outcome – Learn to express one's ideas and identify and relate to good virtues. Build writing skills, improve language and gain knowledge about how to write an impactful essay

Home

4. **Purpose**-Make students aware of proper and globally accepted ethical way to handle work, colleagues and clients
Method – Teacher can form groups of 6 – 7 students and assign them different cases (these can be accessed online from copyright free websites of B-school content)
Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven analytical arguments making them contributors in any team.

5. **Purpose** – Make students aware that technology can be harmful if not used wisely and ethically
Method – Conduct a quiz on various ethical dilemmas that are relevant in today's world pertaining to privacy right, stalking, plagiarism, hacking, weaponizing technology, AI, electronic garbage creating environmental hazard etc
Outcome – Make students aware of various adverse consequences of technology development and allow them to introspect on how to use technology responsibly.

6. **Purpose** – Expose students to professional situations where engineers must use their skills ethically and for the betterment of society and nation
Method – Students in groups of 4 can be given an assignment in the earlier session to present in front of the class one specific case where they felt unethical treatment has been meted out to a person by an engineer – either as a witness, advisor, dishonesty, improper skills testimony etc. The group has to make a short presentation and also suggested plausible solutions to that situation. Q&A from other students must encouraged to allow healthy discussion
Outcome – Become aware of unethical code of conduct in the professional world and how to follow a moral compass especially when one reaches positions of power.

7. **Purpose** – Provide an insight into rights and ethical behavior.
Method – Movies like The Social Network can be played and students can be asked to discuss their opinion about collegiality, intellectual property, friendship and professional relationships
Outcome – help them look at success stories from an ethical point of view. Develop critical thinking and evaluation of circumstances.

8. **Purpose** – Make students contemplate about ideal and safe professional environment and decide on making right decisions based on codes of conduct
Method – Students can be asked to write down 5 most important codes of conduct that they feel that every computer engineer should follow. After evaluation by teacher / experts, the collection of codes can be converted into a handbook to be given to every student as a memoir to help them in their professional life.
Outcome – Introspection and think about how to shape the professional environment. Also, when they carry back with them their own codes of conduct, they could feel bound to adhere to these ethics.

Term Work Assessment Guidelines

Students must submit the report of all conducted activities. The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations / process (methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity;(optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted.

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Recommended Assessment and Weightage Parameters:
(Attendance 30%, Assignments/Activities- Active participation and proactive learning 50% and report 20%)

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial (Outside Classroom) of at least 04 activities (out of 07 activities) from group (of 02-03) students.
The brief guidelines for report preparations are as follows:
1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (pdf) format only.
3. The report must contain:
- General information about the activity;
- Define the purpose of the activity;
- Detail out the activities carried out during the visit in chronological order;
- Summarize the operations / process (methods) during the activities;
- Describe what you learned (outcomes) during the activities as a student;
- Add photos of the activity;(optional)
- Add a title page to the beginning of your report;
- Write in clear and objective language; and
- Get well presented, timely and complete report submitted.

Recommended Assessment and Weightage Parameters:
(Attendance 30%, Active participation and proactive learning 50% and report 20%)

Web Links:
- https://www.ieee.org/about/compliance.html
- https://www.cs.cmu.edu/~bmclaren/ethics/caseframes/91-7.html
- https://www.nspe.org/
- http://www.ewh.ieee.org/soc/pes/switchgear/presentations/tp_files/2017-1_Thurs_Shiffbauer_Singer_Engineering_Ethics.pdf

MOOC/ Video lectures available at:
- https://swayam.gov.in/nd1_noc20_mg44/preview

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	-	-	-	-
CO2	-	-	-	-	-	-	2	2	-	-	-	-
CO3	-	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	-	2	3	-	-	-	-

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Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210260: Audit Course 4

In addition to credits, it is recommended that there should be audit course in preferably in each semester starting from second year in order to supplement student's knowledge and skills. Student will be awarded the bachelor's degree if he/she earns specified total credits [1] and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. [1]

Guidelines for Conduction and Assessment (Any one or more of following but not limited to):

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini-Project
- Hands on experience on focused topic

Course Guidelines for Assessment (Any one or more of following but not limited to):

- Written Test
- Demonstrations/ Practical Test
- Presentations, IPR/Publication and Report

Audit Course 4 Options

Audit Course Code	Audit Course Title
AC4-I	Water Management
AC4-II	Intellectual Property Rights and Patents
AC4-III	The Science of Happiness
AC4-IV	Stress Relief: Yoga and Meditation
AC4-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier. [1]
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx
http://www.unipune.ac.in/university_files/syllabi.htm

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AC4-I: Water Management

Water is a vital resource for all life on the planet. Only three percent of the water resources on Earth are fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. One fifth of the remaining one percent is in remote, inaccessible areas. As time advances, water is becoming scarcer and having access to clean, safe, drinking water is limited among countries. Pure water supply and disinfected water treatment are prerequisites for the well-being of communities all over the world. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. This course will provide students a unique opportunity to study water management activities like planning, developing, distributing and optimum use of water resources. This course covers the topics that management of water treatment of drinking water, industrial water, sewage or Wastewater, management of water resources, management of flood protection.

Course Objectives

- To develop understanding of water recourses.
- To study global water cycle and factors that affect this cycle.
- To analyze the process for water resources and management.
- To study the research and development areas necessary for efficient utilization and management of water recourses.

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand the global water cycle and its various processes

CO2: Understand climate change and their effects on water systems

CO3: Understand Drinking treatment and quality of groundwater and surface water

CO4: Understand the Physical, chemical, and biological processes involved in water treatment and distribution.

Course Contents

1. Understanding 'water'-Climate change and the global water cycle, understanding global hydrology
2. Water resources planning and management-Water law and the search for sustainability: a comparative analysis, Risk and uncertainty in water resources planning and management
3. Agricultural water use -The role of research and development for agriculture water use
4. Urban water supply and management - The urban water challenge, Water sensitive urban design

References:

1. R. Quentin Graft, Karen Hussey, Quentin Graft, Karen Hussey, Publisher, "Water Resources Planning and Management", Cambridge University Press, ISBN: 9780511974304, 9780521762588.
2. P.C. Basil, "Water Management in India", ISBN: 8180690970, 2004.
3. C.A. Brebbia, "Water Resources Management", ISBN: 978-1-84564-960-9, 978-1-84564-961-6.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	-	2	-	-	-	-	1
CO3	-	-	-	-	-	-	1	-	-	-	-	
CO4	-	-	-	-	-	2	2	-	-	-	-	2

AC4-II: Intellectual Property Rights and Patents

Home

Intellectual property is the area of law that deals with protecting the rights of those who create original works. It covers everything from original plays and novels to inventions and company identification marks. The purpose of intellectual property laws is to encourage new technologies, artistic expressions and inventions while promoting economic growth.

Innovation and originality have great potential value. Whatever line of activity you are engaged in, future success depends on them. The last few years have seen intellectual property rights become an issue of general interest: the smart phone "patent wars", the introduction of Digital Rights management (DRM) and the rise of generic pharmaceuticals and open-source software are just some examples that have been in the public eye. Protecting your intellectual rights appropriately should be at a priority. Yet too many people embark on their chosen professions without even a basic awareness of intellectual property.

Course Objectives:

- To encourage research, scholarship, and a spirit of inquiry
- To encourage students at all levels to develop patentable technologies.
- To provide environment to the students of the Institute for creation, protection, and commercialization of intellectual property and to stimulate innovation.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition

CO2: Identify, apply and **assess** principles of law relating to each of these areas of intellectual property

CO3: Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents

1. **IntroductiontoIntellectualPropertyLaw–**TheEvolutionaryPast-TheIPRToolKit-Para-Legal Tasks in Intellectual Property Law
2. **Introduction to Trade mark –** Trade mark Registration Process – Post registration Procedures -Trade mark maintenance - Transfer of Rights – Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark
3. **Introduction to Copyrights –** Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works
4. **IntroductiontoTradeSecret–**MaintainingTradeSecret–PhysicalSecurity–EmployeeLimitation - Employee confidentiality agreement

Reference:

1. Debirag E. Bouchoux, "Intellectual Property" Cengage learning, New Delhi, ISBN-10:1111648573
2. Ferrera, Reder, Bird, Darrow, "Cyber Law. Texts and Cases", South-Western's Special Topics Collections,ISBN:0-324-39972-3
3. Prabhuddha Ganguli, "Intellectual Property Rights", Tata Mc-Graw–Hill, NewDelhi,ISBN-10:0070077177

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CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	-	-	-	1
CO2	-	-	-	-	-	-	-	2	-	-	-	1
CO3	-	-	-	-	-	-	-	1	-	-	-	1

Home

AC4-III: The Science of Happiness

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That's where this course comes in. The subject "Science of Happiness" aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives

- To understand the feeling of happiness
- To study the sources of positive feelings
- To analyze the anatomy of the happiness system
- To study the effect of thoughts and emotions on the happiness system

Course Outcomes

On completion of the course, learner will be able to–

CO1: Understand what happiness is and why it matters to you

CO2: Learn how to increase your own happiness

CO3: Understand of the power of social connections and the science of empathy

CO4: Understand what is mindfulness and its real world applications

Course Contents

1. Happiness: what is it? , 2. The secret of smiling
3. The autonomy of positive feelings
4. Positive feelings as a compass
5. The happiness system
6. Foundations: Emotions, Motivation and nature of Wellbeing
7. Subjective well being
8. Love and well being
9. Optimal well being
10. Religion, Spirituality and wellbeing

References:

1. Happier, Stefan Klein, "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get", Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing", William, Cengage Learning, 2012, ISBN10: 1111834121.

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CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	1	-	-	-	-	-	-	-	1
CO2	-	-	-	1	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	-	1	-	1	-	-	2
CO4	-	-	-	-	-	-	-	-	-	-	-	2

AC4-IV: Yoga and Meditation

Home

The concepts and practices of Yoga originated in India about several thousand years ago. Its founders were great Saints and Sages. The great Yogis presented rational interpretation of their experiences of Yoga and brought about a practical and scientifically sound method within every one's reach. Yoga today, is no longer restricted to hermits, saints, and sages; it has entered into our everyday lives and has aroused a worldwide awakening and acceptance in the last few decades. The science of Yoga and its techniques have now been reoriented to suit modern sociological needs and lifestyles.

Yoga is one of the six systems of Vedic philosophy. The Yoga advocates certain restraints and observances, physical discipline, breathe regulations, restraining the sense organs, contemplation, meditation and Samadhi. The practice of Yoga prevents psychosomatic disorders and improves an individual's resistance and ability to endure stressful situations.

Course Objectives:

- To impart knowledge about the basic technique and practice of yoga, including instruction in breath control, meditation, and physical postures
- To gain an intellectual and theoretical understanding of the principles embodied in the Yoga Sutras, the Bhagavad-Gita, and other important texts and doctrines
- Relaxation and stress reduction ,Personal insight and self understanding, Personal empowerment, Gaining wisdom and spiritual discernment
- Awakening the abilities or powers of the Super conscious mind

Course Outcomes:

On completion of the course, learner will be able to–

CO1: Understand philosophy and religion as well as daily life issues will be challenged and enhanced.

CO2: Enhances the immune system.

CO3: Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.

CO4: Powers of concentration, focus, and awareness will be heightened.

Course Contents

1. Meaning and definition of yoga – Scope of Yoga - Aims and Objectives of Yoga – Misconception about yoga.
2. Ayurveda: an introduction to this system of health care derived from the Vedic tradition Anatomy and Physiology as they relate to Yoga
3. Yoga Philosophy and Psychology

References:

1. B.K.S. Iyengar, "BKS Iyengar Yoga The Path to Holistic Health" , DK publisher, ISBN-13: 978-1409343479
2. Osho, "The Essence of Yoga", Osho International Foundation, ISBN: 9780918963093

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CO1	1	1	-	-	-	2	-	-	2	-	-	-
CO2	-	-	-	-	-	2	1	-	-	-	-	-
CO3	-	2	-	-	-	2	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	-	-

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AC4-V: Foreign Language (Japanese) Module 2

W ith changing times, the competitiveness has gotten into the nerves and 'Being the Best' at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'! The best can merely be communicated whilst using the best… suited Language!!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course learner will-

1. have ability of basic communication.
2. have the knowledge of Japanese script.
3. get introduced to reading , writing and listening skills
4. develop interest to pursue professional Japanese Language course

Course Contents

1. Katakana basic Script, Denoting things (nominal and pre nominal demonstratives), Purchasing at the Market / in a shop / mall (asking and stating price)
2. Katakana : Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting and finishing time (kara ~ made), Point in time (denoting the time when any action or the movement occurs)
3. Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle.

References:

1. Minna No Nihongo, "Japanese for Everyone", (Indian Edition), Goyal Publishers and Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates- Japan-centric-Delivery-Center-Pune.aspx)

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	3	1	1
CO2	-	-	-	-	1	-	-	-	-	3	1	1
CO3	-	-	-	-	1	-	-	-	-	3	2	2
CO4	-	-	-	-	-	-	-	-	-	1	-	1

Acknowledgement

It is with great pleasure and honor that I share the curriculum for Second Year of Computer Engineering (2019 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the curriculum with the blend of core courses, current developments and courses to understand social and human values. By considering all the aspects with adequate prudence the contents are designed satisfying most of the necessities as per AICTE guidelines and to make the graduate competent enough as far as employability is concerned. I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Success is sweet. But it's sweeter when it's achieved thorough co-ordination, cooperation and collaboration. I am overwhelmed and I feel very fortunate to be working with such a fabulous team- the Members of Board of Studies, Computer Engineering!

Even in these anxious situation, during the time of this unfortunate pandemic, each and every person, including the course coordinators and their team members, have worked seamlessly to come up with this all inclusive curriculum for Second Year of Computer Engineering.

Thank you to all of you for delivering such great teamwork. I don't think it would have been possible to achieve the goal without each and every one of your efforts! I would like to express my deep gratitude to Dr. Rajesh Prasad (SITS), member BoS, Computer Engineering, for coordinating the complete activity and getting it to completion in a smooth manner.

I deeply appreciate and thank the managements of various colleges affiliated to SPPU for helping us in this work. These colleges have helped us by arranging sessions for preliminary discussion in the initial stage and at the same time in conducting Faculty Development Programs for various courses of the revised curriculum. All your support is warmly appreciated.

I sincerely appreciate, the hard work put in by the course coordinators and their team members, without your intellectual work and creative mind, and it would have not been possible to complete this draft. You have been a valuable member of our team!

Special thanks are due to Dr. Parikshit Mahalle, Dr. Swati Bhavsar and Dr. Jayashri Prasad for helping with the formatting and crisp presentation of this draft. I would like to thank you from the core of my heart. Thank you for always being your best selves and contributing to the work.

I am thankful to Dr. Nuzhat Shaikh, for the time she has spent in critically reading the draft and giving the final touches. I appreciate her initiative and thank her for her time, patience and hard work!

Thank you all, for not only your good work but also for all the support you have given each other throughout the drafting process, that's what makes the team stronger! You took the meaning of teamwork to a whole new level.

Thank you for all your efforts!

Professor (Mrs) Varsha H. Patil

Chairman, Board of Studies (BoS), Computer Engineering, Faculty of Science and Technology, Savitribai Phule Pune University.

BoS Members- Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

Task Force at Curriculum Design

Home

1. Advisors, the Team of Board of Studies-

Dr. Varsha Patil (Chairman), Dr. Shirish Sane, Dr. Sunil Bhirud, Dr. Manik Dhore, Dr. Rajesh Prasad, Dr. Girish Khilari, Dr. Sachin Lodha, Dr. Parikshit Mahalle, Dr. Pramod Patil, Dr. Venkatesharan, Dr. Geetanjali Kale, Dr. Suhasini Itkar, Dr. R. V. Patil and Dr. P. M. Yawalkar.

2. Team Leader- **Dr. Rajesh Prasad**

3. Teams, Course Design-

Name of Course	Team Leaders	Team Members	
Discrete Mathematics	Dr. Nihar Ranjan Dr. Mrs. Archana Chaugule	Dr. S. K. Pathan Dr. Mrs. Snehal Kamlapur Dr. Mrs. Shital Sonawane	Dr. V. S. Pawar Dr. Kailash Shaw Prof. Ravindra Rathore
Fundamental of Data Structure & Lab	Dr. S R Dhore Dr. Prashant Dhotre	Dr. Mrs. Gitanjali Shinde Dr. Mrs. A. P. Kale Prof. Anupama Phakatkar	Dr. Vinayak Kottawar Prof. Ajitkumar Shitole Prof. Ms. Snehal Kulkarni
Object Oriented Programming	Dr. Amol Dhumane Dr. Mrs. S. K. Wagh	Prof. D. D. Sapkal Prof. Ms. Poojashree Vidap Prof. K. M. Sanghavi	Dr. Mrs. R. A. Satao Dr. Mrs. Swati Bhavsar Dr. Mrs. Chiwhane
Computer Graphics & Lab	Dr. Mrs. N. F. Shaikh	Prof. P. P. Vaidya Prof. Dr. Aparna Junnarkar	Dr. Shabnam Farook Sayyad Prof. Mrs. Laxmi Sisode
Digital Electronics and Logic Design & Lab	Dr. Mrs. C. R. Jadhav Dr. V. V. Kimbahune	Prof. M. B. Lonare Prof. Mrs. M.S. Pokale Dr A. R. Buchade	Dr. Nilesh Sabale Prof. Ms. Ila Sawant
Humanities and Social Studies & Code of Conduct	Dr. Mrs. R. A. Khan	Prof. Mrs. Vaidehi Banerjee Prof. N. L. Bhale	Prof. S. P. Pingat Mr. Ranjeet Gawande
Data Structures and Algorithms & Lab	Dr. Mrs. G. S Navale Dr. S. D. Babar	Dr. K. C. Nalavade Dr Mrs. A. R. Deshpande Prof. Ms. Pallavi Baviskar	Prof. Mrs. S. M. Bhadkumbhe Prof. Ms. Neha Patil
Software Engineering	Dr. Mrs. J. R. Prasad	Dr. Mrs. Manjusha Joshi Prof. Ms. Deipali Gore	Dr. Hanchate D.B. Prof. Sachin Shinde Ms. Poonam Dholi
Microprocessor & Lab	Dr. Sunil M. Sangve Dr. Sable Nilesh P.	Prof. Mrs. S.A. Joshi Dr. K. N. Honwadkar Prof. Mahendra Salunke	Prof. Nitin M. Shahane Prof. N. L. Bhale Prof. Uday C. Patkar
Principles of Programming Languages	Dr. Mrs. Jyoti Rao	Dr. J. R. Pansare Prof. Mrs. P. P. Joshi Prof. Mrs. Sonali Lunavat Prof. Ms. Geeta R Gupta Prof. Mrs. Snehal Patil	Prof. Mrs. Vaishali Latke Prof. Santosh Nagargoje Prof. Vaibhav Muddebihalkar Prof. Phadtare Tushar T
Project Based Learning	Dr. Mrs. Manisha Bhende Dr. Chaudhari Manohar	Dr. Saumitra Das Dr. D. T. Mane Dr. Swati Bhavsar	Prof. Subhash Rathod Prof. Mrs. Swati Shinde Prof. Kushal P. Birla Mr. Pravin Andhale

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Savitribai Phule Pune University, Pune

Faculty of Science and Technology

Board of Studies

Electrical Engineering

Syllabus

Second Year Electrical Engineering

(2019 Course)

(w.e.f. AY: 2020-21)

Savitribai Phule Pune University

Syllabus: Second Year (SE) Electrical Engineering (2019 Course)
w.e.f. AY:2020-2021

SEMESTER-I

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
207006	Engineering Mathematics-III	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203141	Power Generation Technologies	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203142	Material Science	03	04#	--	30	70	25	--	25	**150**	03	02	--	**05**
203143	Analog and Digital Electronics	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203144	Electrical Measurement & Instrumentation	03	04#	--	30	70	25	25	--	**150**	03	02	--	**05**
203150	Applications of Mathematics in Electrical Engineering	--	02*	--	--	--	25	--	--	**25**	--	01	--	**01**
203151	Soft Skill	--	02	--	--	--	25	--	--	**25**	--	01	--	**01**
203152	Audit Course-III	--	--	--	--	--	--	--	--	**--**	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

SEMESTER-II

Course Code	Courses Name	Teaching Scheme			Examination Scheme and Marks						Credits			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
203145	Power System-I	03	--	--	30	70	--	--	--	**100**	03	--	--	**03**
203146	Electrical Machines-I	03	02	--	30	70	--	50	--	**150**	03	01	--	**04**
203147	Network Analysis	03	02	--	30	70	25	--	--	**125**	03	01	--	**04**
203148	Numerical Methods & Computer Programming	03	02	--	30	70	--	25	--	**125**	03	01	--	**04**
203149	Fundamental of Microcontroller and Applications	03	04$	--	30	70	25	--	25	**150**	03	02	--	**05**
203152	Project Based Learning	--	04	--	--	--	50	--	--	**--**	--	02	--	**--**
203153	Audit Course-IV	--	--	--	--	--	--	--	--	**--**	**Grade: PP/NP**			
Total		**15**	**14**	**--**	**150**	**350**	**100**	**75**	**25**	**700**	**15**	**07**	**--**	**22**

* - Lab sessions on application of Mathematics in Electrical Engineering using professional software.

\# - Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week :Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field .

$ - Practical section will comprises of two Part : a) PART A : 2 hours per week : Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory b) PART B : 2 Hours a week : IOT application in Electrical Engineering using microcontroller and GSM module to bridge gap between curriculum and enhance application knowledge.

Abbreviation: TH: Theory, PR: Practical, TUT:Tutorial, ISE: Insem Exam, ESE: End Sem Exam, TW: Term Work, OR: Oral

207006: Engineering Mathematics-III

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisites: - Differential & Integral calculus, Taylor series, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Vector algebra and Algebra of complex numbers.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary differential equations, Laplace transform, Fourier transform & Z-transform, Statistics & Probability, Vector Calculus and functions of a Complex Variable. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes: At the end of this course, students will be able to:

CO1:Solve higher order linear differential equation using appropriate techniques to model and analyze electrical circuits.

CO2: Apply Integral transforms such as Laplace transform, Fourier transform and Z-Transform to solve problems related to signal processing and control systems.

CO3: Apply Statistical methods like correlation, regression and Probability theory as applicable to analyze and interpret experimental data related to energy management, power systems, testing and quality control.

CO4: Perform Vector differentiation and integration, analyze the vector fields and apply to wave theory and electro-magnetic fields.

CO5: Analyze Complex functions, conformal mappings, and perform contour integration in the study of electrostatics, signal and image processing.

Unit I: Linear Differential Equations (**LDE**) and Applications (08Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral,General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II: Laplace Transform (**LT**) (07Hours)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear differential equations.

Unit III: Fourier and Z - transforms (08 Hours)

Fourier Transform (**FT**): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine & Cosine transforms and their inverses.

Z - Transform **(ZT):** Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit IV: Statistics and Probability (07 Hours)

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.

Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test.

Unit V: Vector Calculus (08 Hours)

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal and Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI: Complex Variables (08 Hours)

Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Differential Equations, 3e by S. L. Ross (Wiley India).
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press).
6. Complex Variables and Applications, 8e, by J. W. Brown and R. V. Churchill (McGraw-Hill Inc.).

203141: Power Generation Technologies

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite:

- Fuel calorific value.
- Semiconductor materials for PV cells.
- Work, power and energy calculation.

Course Objective:

- To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.
- To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.
- To commence interconnection of energy source to gird, stand alone and hybrid system.

Course Outcome: Upon successful completion of this course, the students will be able to:

CO1: Identify components and elaborate working principle of conventional power plants.
CO2: Recognize the importance and opportunities of renewable energies.
CO3: Calculate and control power output of wind solar, and hydro power plant.
CO4: Describe process of grid interconnection of distributed generation and requirements.
CO5: Interpret the environmental and social impact of various generation technologies.

Unit 01: Thermal Power Plant **(06 hrs)**

Basic thermodynamic cycles: Carnot cycle, Rankine cycle; Actual Rankine cycle; Reheat cycle (theoretical only); heat rate (Numerical on Heat rate).

Thermal Power Plants: Site selection, Main parts and its working. Types of boilers (FBC, Fire tube, and Water tube). Assessment of heat recovery systems Steam turbines Fuel Handling, Ash disposal and dust collection, Draught systems, electrostatic precipitator.

Unit 02: Nuclear, Diesel, Gas Power Plant **(6 Hrs)**

A. Nuclear Power Plant: Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal.

B. Diesel Power Plants: Main components and its working, Diesel plant efficiency and heat balance (Numerical), Site selection of diesel power plant.

C. Gas Power Plant: Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants, concept of heat to power ratio.

Unit 03: Hydro Power Plant **(6 Hrs)**

Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydro graphs and number of turbine required. Small, mini and micro hydro power plant (Introduction only).

Unit 04: Wind Energy Systems **(6 Hrs)**

Historical Development of Wind Power, Types of wind turbine, Impact of Tower Height, Power in the Wind. Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind (Numerical). Wind Turbine Generators (WTG) - Synchronous and Asynchronous (block diagrams only), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.

Unit 05: Solar Energy **(6 Hrs)**

Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. Over view of recent development of PV technologies. A Generic

Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, Numerical on number of solar panel selection. The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I–V curves, System: Introduction to the Major Photovoltaic System Types.

Unit 06: Other Sources and Grid Connection (6 Hrs)

Biomass energy, conversion to electricity, municipal solid waste to energy conversion, geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection criteria, stand alone, hybrid stand alone and grid connected renewable systems and their requirements.

Industrial Visit: One industrial visit to conventional /non-conventional power plant is necessary. A separate report file should be maintained in the department.

Text Books:

[T1] P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Publications.
[T2] Dr. P. C. Sharma, "Power Plant Engineering", S.K. Kataria Publications.
[T3] R. K. Rajput, "A text book on Power System Engineering", Laxmi Publications (P) Ltd.
[T4] Chakrabarti, Soni, Gupta, Bhatnagar, "A text book on Power System Engineering", DhanpatRai publication.
[T5] R.K. Rajput, "Non-Conventional Energy Sources and Utilization", S. Chand Publications.
[T6] M.M. Wakil, "Power Plant Engineering", McGraw Hill, Indian Edition.
[T7] G. D. Rai, "Renewable Energy Sources", Khanna Publications.
[T8] Chetan singh solanki " Solar Photovotaics: Fundamentals, Technology and Application" PHI Publications.

Reference Books:

[R1] Arora and Domkundwar, "A Course in Power Plant Engineering", DhapatRai Publication.
[R2] Dr. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publication.
[R3] Mukund Patel, "Wind and Solar Power Plants", CRC Press.
[R4] Gilbert Masters John, "Renewable Energy", Wiley and sons' publications.
[R5] Robert Foster, Majid Ghassemi, Alma Cota "Solar Energy" CRC Press

Unit	Text Books	Reference Books
1	T1, T2, T3	R1
2	T1, T2, T3	R1
3	T1, T2, T3	R1
4	T6, T7	R3, R4
5	T5, T6, T8	R2, R3, R4, R5
6	T5, T7	R4

203142: Material Science

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating, magnetic and resistive along with their basic characteristics.

Course Objectives: The course aims to :

1. Explain classification,properties and characteristics of electrical engineering materials.
2. Describe applications and measuring methods for parameters of dielectric, insulating, magnetic, conducting and resistive materials.
3. Illustrate solving of simple problems based on dielectric, magnetic and conducting materials.
4. Impart knowledge of Nano-technology to electrical engineering.5. Demonstrate testing methods of dielectric, insulating, magnetic, conducting and resistive materials as per IS.
5. Enable students to create self learning resource material through active learning based on practical /case study/assignments.

Course Outcomes:

Upon successful completion of this course, the students will be able to :

CO1: Discuss classification,properties and characteristics of different electrical engineering materials.

CO2: State various applicationsmeasuring methods for parameters of different classes of electrical engineering materials.

CO3: Solve simple problems based on dielectric, magnetic and conducting materials.

CO4: Apply knowledge of Nano-technology to electrical engineering.

CO5: Execute tests ondielectric, insulating, magnetic, conducting, resistive materials as per IS to decide the quality of thematerials.

CO6: Create learning resource material ethically to demonstrate **self learning leading to** lifelong learning skills and usage of ICT/ online technology through collaborative/active learning activities.

Unit 01: Dielectric Properties of Insulating Materials: (6 Hrs)

Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations-Electronic, Ionic and Orientation Polarization (descriptive treatment only), Clausius Mossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta.

Unit 02: A) Dielectric Breakdown: (2 Hrs) Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.

Unit 02: B) Testing of Materials: (4Hrs) Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.

1. Measurement of dielectric loss tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of dielectric strength of solid insulating material-IS 2584.
3. Measurement of dielectric strength of liquid insulating material -IS 6798.
4. Measurement of dielectric strength of gaseous insulating material as per IS.

Unit 03 : Insulating Materials, Properties & Applications: (6 Hrs)

Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF_6.

Insulating Materials for Power and Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

Unit 04 : Magnetic Materials: (6 Hrs)

Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Anti-ferromagnetism, Ferrites, Applications of Ferro magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core, Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials.

Unit 05 : Conducting Materials: (6 Hrs)

General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High and Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Kanthal, Silver and Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Electrical Carbon Materials. Materials used for Lamp Filaments, Solders, Metals and Alloys for different types of Thermal Bimetal and Thermocouples.

Unit 06 : Nanotechnology: (6 Hrs)

Introduction, Concepts of Energy bands and various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires. Nano materials used in Batteries, Photovoltaic Cells and in Supercapacitors.

Industrial Visit:

Minimum one visit should be arranged to an industry related to manufacturing of batteries, capacitors, cables, transformers, motors (Any one industry). A hand written report should be submitted by every student as a part of term work

***Guidelines for TW Assessment will be given later.**

There is **Term Work of 25 marks**for the subject.

Practical section will comprise of two parts: (Refer SE Structure 2019 Pattern)

PART A: 2 Hours per week:

Regular curriculum listed practical total 12 numbers out of which conduction of 8 numbers will be mandatory. Out of 25 marks of Term Work, **15 Marks** will be based on continuous assessment that should be carried out such as checking of previous experiment along with its mock oral session (minimum 4-5 questions to each student), while conducting new experiment.

PART B: 2 Hours a week:

Practical/case studies/assignments to enable active learning based on advances related to subject to bridge gap between curriculum and enhance practical knowledge required in field. **10 Marks**

<u>List of Experiments:</u>

Part A: Term Work **(TW): 15 Marks**

List of total 12 numbers of experiments out of which conduction of 8 numbers of experiments will be mandatory.

1. To measure dielectric strength of solid insulating material-IS 2584.
2. To measure dielectric strength of liquid insulating material-IS 6789.
3. To measure dielectric strength of gaseous insulating material as per IS using Sphere Gap-Unit.
4. To obtain hysteresis loop of the ferromagnetic material.
5. To understand the principle of thermocouple and to obtain characteristics of different thermocouples.
6. To measure insulation resistance and kVAr capacity of power capacitor.
7. To measure resistivity of high resistive alloys.
8. To observe development of tracks due to ageing on different insulating materials e.g. Bakelite, Perspex, polyesters, Mica, Fiberglass etc.
9. Testing of resins and polymers.
10. Measurement of Tangent of Dielectric Loss Angle (tan δ) of solid/liquid dielectric materials.
11. Measurement of Flux Density by Gauss-meter.
12. Write report on visit to an industry related to manufacturing of batteries, capacitors, cables,

transformers (Any one industry).

List of Experiments: Part B:Part B :2 Hours per week (**Term Work(TW) : 10 Marks) (Total 6 activities from the list below are mandatory for evaluation of Term Work for Part B. Activity numbers 1, 4 and 6 are compulsory)**

Practical/case studies/assignments to enable self,active, collaborative **learning leading to** lifelong learning, based on advances related to subject to bridge gap between curriculum and enhance application knowledge of the subject.

Guidance/monitoring/assessment/presentation/field visits /expert sessions related activity can be carried out in **'Part B'** practical schedules .

1) Review of research/on line literature from latest journal papers /transactions related to different insulating, magnetic, semiconducting and conducting materials, advanced material developments and their applications. Draft of paper, presentation among students, in conference /publishing it.
2) Detailed case study of complete insulation system in transformer, comparison of various types of solid, liquid materials and study of recent advances related with major and minor insulating materials.
3) Detailed study of patents on caster oil used in transformer, its properties and comparison with other liquid insulating material.
4) Mini project on development of prototype of various electrical gadgets right from draft of specifications,design, selection of conducting, magnetic and insulating material.
5) Testing and diagnosis of induction motor, cable, transformer insulation by measurement of Polarization index, Dielectric Absorption Ratio, Step Voltage, dielectric discharge and ramp testing using 5/10KV IR Tester.
6) Laboratory visits/survey/role play/games/debates/any activity focusing collaborative, student centrist, active learning on Industrial/ Social/ Sustainability/ Public Health/ Safety/Ethical/Cultural/ Societal and Environmental aspects related to advanced materials Presentations of industrial case studies related with material science.
7) Two - Three household appliances like mixer -motor, ceiling fan- motor etc can be opened up by students either individually or by group of students and analyzed w.r.t. the materials found in it. Name each material used and to which category of materials does it belong, other applications of the same materials can be listed.
8) Detailed study of insulation system of resin casted transformer, comparison of various resins, study of testing of insulation system with applicable IS/IEC /IEEE standards
9) Visit to NABL accredited Laboratory to study testing of oil for DGA, furan analysis, study of equipment's used, test procedure and applicable IS/IEEE/IEC standard and recommended limits.
10) Discussions/Presentations/any activity using or related to IS/ IEC /IEEE standards/Recent Patents related with insulating, conducting and magnetic materials .
11) Case study on failure modes of various insulating materials and measures to reduce failure. Recent advancement in testing and diagnostic of solid and liquid insulating materials.
12) Case study on recent advancement of magnetic materials, high temperature superconductors and its applications.
13) Any activity using advanced ICT tool like Virtual Labs/animations/simulations/advanced software/on line certificate course like NPTEL/on line quiz etc related to curriculum.

Guidelines for Instructor's Manual - Practical Sessions

Instructor's Manual should contain following things related to every experiment-

1. The circuit diagram of the experiment should be drawn at the start.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Five - six questions based on that experiment should be written at the end.

Guidelines for Student's Lab Journal

Student's Lab Journal should be **Hand Written/ Drawn** containing, following things related to every experiment-

1. The circuit diagram of the experiment should be drawn on the graph paper at the start of the experiment.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Students should write answers to five - six questions based on that experiment at the end.

Guidelines for Laboratory Conduction

1. The circuit diagram should be explained to students in such a way that they should be able to develop it at their own.
2. Detail explanation of the experiment along with its circuit diagram, observation table, calculations, result table and plotting of graphs (if any).
3. While conducting new experiment, assessment of previous experiment should be carried out by its checking along with its mock oral session (minimum 4 -5 questions to each student).

Text Books:

[T1] "A Course in Electrical Engineering Materials", by S.P. Seth, Dhanpat Rai and Sons publication.

[T2] A Textbook of "Electrical Engineering Materials" by R.K.Rajput, Laxmi Publications (P) Ltd.

[T3] "Electrical Engineering Materials", by T.T.T.I, Madras.

[T4] "Electrical Engineering Materials", by K. B. Raina and S. K. Bhattacharya, S. K. Kataria Sons.

[T5] "Material Science for Electrical Engineering", by P.K. Palanisamy, Scitech Pub. Pvt. Ltd., Chennai (India).

[T6] "Introduction to Nanotechnology" by Charles P. Poole, Jr. Frank & J. Ownes (Wiley Student Edition)

Reference Books:

[R1] "Electrical Power Capacitors-Design & Manufacture", by D. M. Tagare, Tata McGraw Hill Publication.

[R2] "Electrical Engineering Materials", by S. P. Chalotra and B. K. Bhattacharya, Khanna Publishers, Nath Market.

[R3] "Electrical Engineering Materials", by C. S. Indulkar and S. Thiruvengadam, S. Chand and Company Ltd.

[R4] "High Voltage Engineering" by Kamraju and Naidu, Tata McGraw Hill Publication.

[R5] "Introduction to Material Science for Engineering", Sixth Edition by James F. Shackelford & M. K. Muralidhara, Pearson Education.

[R6] "Insulation Technology Course Material" of IEEMA Ratner, Pearson Education.

[R7] "Materials Science for Engineering Students", by Traugott Fischer, Elsevier Publications.

[R8]"Energy Conversion Systems", by Rakosh Das Begamudre, New Age International Publishers.

[R9] "Advanced Nanomaterials and Their Applications in Renewable Energy", by Jingbo Louise Liu, Sajid Bashir, ELSEVIER Publications.

Unit No.	Text Book	Reference Book
1	T1, T2	R1, R3, R8
2	T1, T2, T3	R1, R2, R4
3	T1, T2, T3, T4	R1, R3, R4, R6
4	T1, T2, T3, T4	R3, R5
5	T1, T2, T4	R7, R8
6	T6	R9

203143: Analog And Digital Electronics

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite: Basic Electronics Engineering, Numbering system, Logic Gates and flip flops,Diode and BJT

Course Objectives:

1) To use K map for Boolean algebra reduction and design digital circuit
2) To introduce digital memories and logical families.
3) To construct sequential and combinational circuits using flip flops and K map
4) To develop the concept of basics of operational Amplifier and its applications.
5) To design uncontrolled rectifier

Course Outcomes: Upon successful completion of this course, the students will be able to :-

CO1: Design logical, sequential and combinational digital circuit using K-Map.
CO2: Demonstrate different digital memories and programmable logic families.
CO3: Apply and analyze applications of OPAMP in open and closed loop condition.
CO4: Design uncontrolled rectifier with given specifications

Unit 01 : Design of combinational circuit:(6 hrs)

Booleans algebra, De-Morgan theory etc, Karnaugh map: structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map. Design of combinational circuits using Boolean expression and K-map, encoder, decoder, half and full adder.

Unit 02: Design of sequential circuit:(6 hrs)

Introduction to sequential circuit. Design of synchronous (K-map) and asynchronous counters. Up down counters, N modulo counters, Shift registers, ring and twisted ring counters

Unit 03: Digital memories and logic families:(6 hrs)

A) Digital memories: SRAM, DRAM, ROM, EPROM
B) **Digital logic families:** PAL,PLA, CPLD, FPGA

Unit 04: Operational Amplifier Applications: (6 hrs)

Open loop and close loop configuration of Op-Amp. Applications of Op- Amp- zero crossing detectors, Comparator, Schmitt trigger, V-I and I-V converters, Instrumentation amplifier, peak detector, Waveform generation using Op-amp - sine, square, saw tooth and triangular generator,

Unit 05: Other Analog circuits:(6 hrs)

Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters using OPAMP, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using IC78xx, 79xx, LM 317

Unit 06: Diode rectifier:(6 hrs)

Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load.

List of Experiments:

Perform any **eight (three experiment should be on bread board/trainer kit)** experiment from following list:

1. Design of logical circuit for display of decimal number on seven segment display. **(Hardware)**
2. Deign 3:8 decoder for binary to octal decoding.**(Hardware)**
3. Design three bit full adder using any open source software. **(Software)**
4. Design logical circuit to convert binary to EXCESS 3/Gray number system. **(Hardware)**
5. Design digital clock or stop watch using decade counter.(IC74192) **(Hardware)**
6. Find phase angle difference between same frequency signal using ZCD and AND gate. **(Hardware)**
7. Design of comparator and schmitt trigger. **(Hardware)**
8. Study of Instrumentation amplifier using three Op-amp, CMRR measurement **(Hardware)**

9. Design sine, and triangular wave generator. **(Hardware)**
10. Design first order high pass and low pass filter using OPAMP in any open source software. (For this provide one statement to each of four students to perform with desired cut-off frequency. Each group will demonstrate their result and prepare documentation) **(Software)**
11. Design of monostable mutivibrator using IC555 and digital circuit to count number of pulses. **(Hardware)**
12. Design astable multivibrator using IC-555. **(Hardware)**
13. Design of single phase bridge rectifier with output voltage and specified ripple.(this practical should be design by each students, perform in simulation and demonstrate with hardware in laboratory with design documents) **(Software and Hardware)**

Guidelines for Instructor's Manual Practical Sessions

The Instructor's Manual should contain following related to every experiment: Brief theory related to the experiment,Connection diagram /circuit diagram, Observation table,,Sample calculations for one reading,Result table, Graph and Conclusions,,Data sheets of the ICs used. Few questions related to the experiment (10 marks) List of components required with their specifications .

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment: Theory related to the experiment, Connection diagram /circuit diagram , Observation table, Sample calculations for one reading, Result table, Graph and Conclusions, Data sheets of the ICs used, List of components required with their specifications,

Guidelines for Lab Assessment

- There should be continuous assessment.
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do connections on bread board and get the results.
- Timely submission of journal.

Guidelines for Laboratory Conduction

- First half an hour should be utilized for explaining the circuit diagram and theory related to the experiment.
- Next one hour for connection and conduction of the experiment.
- Remaining half an hour for continuous assessment and timely checking of the experiment (This time slot can be adjusted as per convenience)
- Separate breadboard should be provided for every student for those experiments which are compulsory to be performed on breadboard or trainer kit (**ready made set up is not allow**)

Books & Other Resources:

Text Books:

[T1] Floyd and Jain, "Digital Fundamentals", Pearson Education.
[T2] R. P. Jain, "Digital Electronics", Tata McGraw Hill, New Delhi.
[T3] Malvino, "Digital Computer Electronics- An Introduction to Microcomputers," Tata McGraw Hill.
[T4] Gaikwad R., "Operational Amplifier", PHI New Delhi.
[T5] Floyd, "Electronics Devices", Pearson Education.
[T6] Mottershed, "Electronics Devices & Circuits", PHI New Delhi
[T7] Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd edition, Pearsons Education.
[T8] Fundamental of digital circuits, 4th Edition, by A Anand Kumar, PHI learning private limited publication

Reference Books:

[R1] Tokheim, "Digital Electronics-Principles and Application", 6th edition, Tata McGraw Hill, New Delhi.
[R2] A Jaico and Charles H. Roth, "Fundamentals of Logic Design" Jr. Forth Edition.
[R3] K. R. Botkar, "Integrated Circuits", Khanna Publication, New Delhi.
[R4] James, "Operational Amplifier and Linear Integrated Circuits Theory and Application."
[R5] P John Paul, "Electronics Devices and circuits", New Age international Publications.

[R6] P. S. Bimbhra, “Power Electronics”, Khanna Publications.
[R7] NPTEL course on Digital Electronics Circuit, IIT, Kharagpur. https://nptel.ac.in/courses/108105132/
[R8] NPTEL course on Integrated circuit, MOSFET, OPAMP and there applications IISC Banglore. https://nptel.ac.in/courses/108/108/108108111/
[R9] NPTEL course on power electronics by IIT Kharagpur. https://nptel.ac.in/courses/108/105/108105066/

Unit 01	Test Books	References
1	T1, T2, T8	R1, R7
2	T1, T2, T3, T8	R2, R7
3	T8	R7
4	T4, T5	R3, R4, R8
5	T4, T5	R3, R4, R8
6	T7	R6, R9

203144: Electrical Measurements and Instrumentation

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Practical** : 25 Marks

Course Objectives:

1. To understand the necessity and importance of measurement and instrumentation.
2. To know about various types of measurement techniques, instruments and sensors.
3. To learn to apply proper methods of measurement and use of sensors in instrumentation.

Course Outcomes:

After completion of this course, the students will be able to:

CO1: Define various characteristic and classify measuring instruments along with range extension techniques.

CO3: Apply measurement techniques for measurement of resistance, inductance and capacitance.

CO4: Demonstrate construction, working principle of electrodynamo type and induction type instruments for measurement of power and energy.

CO5: Make use of CRO for measurement of voltage, current and frequency.

CO6: Classify transducer and apply it for measurement of physical parameters in real time.

Unit 01: (7 Hrs)

A. Classification of Measuring Instruments: Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital. Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) instruments (attraction and repulsion). block diagram and operation of digital ammeter & voltmeter.

B. Range Extension: Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02: (6 Hrs)

A. Measurement of Resistance: Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger. Earth tester for earth resistance measurement.

B. Measurement of Inductance: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Maxwell's inductance, Maxwell's inductance – Capacitance Bridge, Anderson's bridge.

Unit 03: (6 Hrs)

Measurement of Power: Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method.

Unit 04: (5 Hrs)

Measurement of Energy: Construction, working principle, torque equation of single phase conventional (induction type) energy meter. Block diagram and operation of single phase and three phase static energy meter. Calibration of static energy meter. TOD meter.

Unit 05: (6 Hrs)
A. Oscilloscope: Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by Lissajous pattern. Introduction to DSO.
B. Transducers: Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers.
C. Pressure Measurement: Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.

Unit 06: (6 Hrs)
A. Level Measurement: Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic.
B. Displacement Measurement: LVDT & RVDT – construction, working, applications, specifications, advantages & disadvantages, effect of frequency on performance.
C. Strain Gauge: Introduction, definition of strain, types of strain gauge: wire strain gauge, foil strain gauge, semiconductor strain gauge; their construction, working, advantages and disadvantages.

Industrial Visit(s)

Minimum one visit should be arranged to electrical instrument manufacturing company or where electrical instruments are calibrated or where various measuring instruments (Electrical/Mechanical) can be seen or observed.

List of Experiments

Practical section will comprise of two part; part A and part B.
Practical examination will be conducted on Part A.
Distribution of term works marks; Part A : 10 Marks, Part B : 15 Marks.
Part A: Minimum eight experiments are to be conducted from the following experiments:
1. Extension of ammeter range using CT, voltmeter range using PT and watt meter range using CT / PT.
2. i) Measurement of medium resistance by Ammeter- Voltmeter method.
   ii) Measurement of low resistance using Kelvin's Double Bridge.
3. Measurement of inductance using Anderson's bridge / Maxwell's bridge.
4. Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two way switch.
5. Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.
6. Measurement of three phase active & reactive power by two wattmeter method procedure.
7. Measurement of active power in three phase, four wire system using three CTs & two wattmeter.
8. Calibration of single phase wattmeter at different power factors.
9. Calibration of single phase static energy meter at different power factors.
10. Measurement of voltage, current, time period, frequency & phase angle using CRO.
11. To study and plot the characteristics of LVDT.
12. Electrical methods for measurement of liquid level.

Part B: Minimum eight experiments / case studies are to be conducted from the following:
1. Study of various standards (IS/IEC) related to calibration process of various instruments and NABL accredited Test Laboratory visit.
2. Measurement of soil resistivity using four pin wenner method.
3. Study of programmable LCR meter; Measure L, C, R, Q, dissipation factor and power factor of given component.
4. Demonstration of Power analyser and multifunction meter for measurement of various

electrical quantities.

5. Study of Digital Storage Oscilloscope:
   a) Different modes in DSO such as Roll, Average, Peak detection.
   b) Capture transients
   c) FFT analysis
   d) Various MATH operations
6. Study and demonstration of net meter and four quadrant TOD Meter.
7. Detailed study of various temperature transducers, their selection procedure, specifications, characteristics and comparison, calibration process of temperature transducer.
8. Determination of polarities and ratio, phase angle and ratio error of various CTs and PTs.
9. Study and demonstration of DIAF / Woodward alternator synchronization relay used in industrial power system for synchronization of DG sets and Alternators.
10. Detailed study of on line Energy Monitoring System, various parameters, EMS software capabilities, trending with IOT applications. Demonstration of EMS system by inviting Expert.
11. Virtual instrument modeling using software like LABVIEW.
12. Study of advanced metering infrastructure in smart grid.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- The instructor's manual need to include prologue (about University / program / institute / department / foreword / preface etc), University syllabus, conduction and assessment guidelines, topics under consideration - concept, objectives, outcomes, list of experiments, references etc.
- The feedback seeking sheet for enhancement of instructor's manual may be added as annexure.

Guidelines for Student's Lab Journal

- The laboratory experiments are to be submitted by student in the form of journal.
- Journal consists of prologue, Certificate, table of contents, and write-up of each experiment (Title, Objectives, Outcomes, List of apparatus, Circuit diagram, Theory, Observation Table, Sample Calculation, Result Table, Conclusion / Analysis, exercises - MCQs, assignments, Date of Completion, Assessment grade and assessor's sign with date).

Guidelines for Lab /TW Assessment

- Each experiment will be assigned grade based on parameters with appropriate weightage.
- Suggested parameters include - timely completion, performance, innovation, punctuality and neatness.

Guidelines for Laboratory Conduction

- The instructor is expected to shortlist necessary experiments from the suggested list of experiments. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
- Proper safety instructions and demonstration of the experiment is to be given before asking the students to perform the experiment. The experiment is carried out by the students under the supervision of the instructor.
- The instructor should take utmost care towards safety of the students, self and other hazards that may be caused by improper operation of the equipment.
- The instructor may also design an experiment which is relevant to the subject and beyond the scope of syllabus.

Text Books

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation", Dhanpat Rai & Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation", S. K. Kataria & Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers.

[T4] B. C. Nakra & K. K. Chaudhari, "Instrumentation Measurement and Analysis", Tata

McGraw Hill.

Reference Books

[R1] E. W. Golding & F. C. Widdies, “Electrical Measurements & Measuring Instruments”, Reem Publications.
[R2] Dr. Rajendra Prasad, “Electronic Measurements & Instrumentation”, Khanna Publishers.
[R3] Arun K. Ghosh, “Introduction to Measurements and Instrumentation”, PHI Publication.
[R4] M. M. S. Anand, “Electronics Instruments and Instrumentation Technology”, PHI Publication.

Unit	Text Books	Reference Books
I	T1,T2,T3,T4	R1,R2,R3,R4
II	T1,T2	R1,R4
III	T1,T2	R1,R2
IV	T1,T2	R1,R2
V	T1,T2,T3,T4	R2,R3,R4
VI	T1,T2,T3	R2,R3

203150: Applications of Mathematics in Electrical Engineering

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Prerequisite: Basic mathematics, Engineering Mathematics-I, II

Course Objective: Course Objectives are:

- To relate mathematics and electrical problems.
- To introduce software solution
- To develop mathematical and complex problem solving skill.

Course Outcome: At the end of this course, learner will be able to

CO1: Apply fundamentals of mathematics in solving electrical engineering problem

CO2: Analyze complex electrical engineering problem using mathematical techniques.

CO3: Implement program and simulation for problems in electrical engineering.

CO4: Demonstrate self lifelong learning skills with applications of mathematics in electrical engineering through software.

Perform any **Eight** experiments from following list using any professional software:

1. To solve ordinary differential equations in electrical circuits or DC motors:
2. To apply Laplace Transform for solving ordinary differential equations in electrical circuits or DC motors:
3. To analyze the waveform generated using Fourier series.
4. To solve difference equations using z-Transform:
5. To Perform convolution of two discrete signal using software programming:
6. To solve linear simultaneous equations from electrical network (KVL/KCL) using software programming:
7. To determine a phasor of AC signal using Discrete Fourier Transform.
8. To perform mathematical addition, subtraction, multiplication and division of electrical signals.
9. To calculate rms and average values of given waveform using software programming.
10. To calculate electrical power under sinusoidal and non sinusoidal voltage and current

Perform any **Two** experiments from following list using any professional software:.

1. To determine maxima and minima of single/two variable problem.
2. To convert three phase electrical signal quantities dq0 transformation.
3. To apply partial difference equation in Electromagnetic (Maxwell equation)
4. To apply graph theory in network analysis
5. To calculate poles and zeros in complex electrical network.

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm
- Three to four different sets of problem statement
- Solve numerical using appropriate method
- Ten questions based on experiment
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm
- Problem statement
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on experiment

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

203151: Soft Skill

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 02 Hrs/ Week	**Pr**:01	**Term Work**: 25 Marks

Course Objective: The course aims to:- □

- To possess knowledge of the concept of Self-awareness and Self Development. □
- To understand the importance of Speaking Skills, listening skills, Presentation Skills and leadership skills. □
- To gain the knowledge of corporate grooming & dressing, Email & telephone etiquettes, etiquette in social & office setting. □
- To get conversant with Team work, Team effectiveness, Group discussion, Decision making.
- To recognize the importance of time management and stress management.

Course Outcome: Students will be able to :- □

CO1: DoSWOC analysis. □

CO2: Develop presentation and take part in group discussion. □

CO3: Understand and implement etiquette in workplace and in society at large. □

CO4: Work in team with team spirit. □

CO5: Utilize the techniques for time management and stress management.

Unit 01 : Self-Awareness & self-Development: (4Hrs)

A) Self-Assessment , Self-Appraisal, SWOT, Goal setting - Personal & career - Self Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self-appraisal, Personal Goal setting,

B) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting and prioritization.

Unit 02 : Communication Skill: (6 Hrs)

A) Importance of communication, types, barriers of communication, effective communication.

B) Speaking Skills: Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self-expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

C) Listening Skills:Law of nature- you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, Avoid selective listening

D) Group Discussion:Characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

E) Presentation skills:Planning, preparation, organization, delivery.

F) Written Skills: Formal & Informal letter writing, Report writing, Resume writing - Sentence structure, sentence coherence, emphasis. Paragraph writing. Letter writing skills – form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

Unit 03 : Corporate / Business Etiquette: (2 Hrs)

Corporate grooming & dressing, Email & telephone etiquette, etiquette in social & office setting: Understand the importance of professional behavior at the work place, Understand and Implement etiquette in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquette (targeted at young professionals who are just entering business environment), Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

Unit 04 : Interpersonal relationship: (4 Hrs)

A) Team work, Team effectiveness, Group discussion, Decision making – Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.

B) Group Discussion- Preparation for a GD, Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD, Conflict management, Do's and Don'ts in GD

Unit 05 : Leadership skills: (2 Hrs)

Leaders' role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example,effective feedback.
Unit 06 : Other skills: (2 Hrs) A) Time management- The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to priorities using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions , to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individualized plan of action. B) Stress management- understanding the stress & its impact, techniques of handling stress. C) Problem solving skill, Confidence building Problem solving skill, Confidence building
Term Work/Assignments: Term work will consist the record of any 8 assignments of following exercises 1. SWOT analysis 2. Personal & Career Goal setting – Short term & Long term 3. Presentation Skill 4. Letter/Application writing 5. Report writing 6. Listening skills 7. Group discussion 8. Resume writing 9. Public Speaking 10. Stress management 11. Team Activity-- Use of Language laboratory
Teaching Methodology: Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below. Practical Assignments (Term work) Minimum 8 assignments are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should explain the topics mentioned in the syllabus during the practical sessions followed by the actual demonstration of the exercises. Students will submit report of their exercise (minimum 8) assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed. 1. **SWOT analysis**: The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects. 2. **Personal & Career Goal setting** – Short term & Long term 3. **Presentation Skills**: Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes. 4. **Letter/Application writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts. 5. **Report writing**: The teacher should teach the students how to write report. The teacher should give proper format and layouts. Each student will write one report based on visit / project /

business proposal etc.
6. **Listening skills**: The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.
7. **Group discussion**: Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.
8. **Resume writing**: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
9. **Public Speaking**: Any one of the following activities may be conducted : A) Prepared speech(topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver. B) Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic) C) Story telling (Each student narrates a fictional or real life story for 5 minute search) D) Oral review(Each student orally presents a review on a story or a book read by them)
10. **Team Activity**-- Use of Language laboratory

Text Books:

[T1] Sanjay Kumar and PushpaLata, “Communication Skills”, Oxford University Press.
[T2] Krishna Mohan, MeeraBanerji, “Developing Communication Skill”, McMillan India Ltd.
[T3] Simon Sweeney, “English for Business Communication”, Cambridge University Press

Reference Books:

[R1] Accenture, Convergys, Dell et.al, “NASSCOM-Global Business Foundation Skills, Foundation Books, Cambridge University Press.
[R2] E. H. McGraw, “Basic Managerial Skills for all”, Eastern Economy Edition, Prentice hall
[R3] Barun K. Mitra, “Personality Development and Group Discussions”, Oxford University Press.
[R4] PriyadarshiPatnaik, “Group Discussions and Interview Skills: Foundation Books”, Cambridge University Press.
[R5] Napoleon Hill, “Thinks and Grow Rich”, Ebury Publishing, ISBN 9781407029252.
[R6] Tony Robbins, “Awaken the Giant Within”, Harper Collins Publishers, ISBN139780743409384. S.E. Electrical Engineering (2015 course) – Savitribai Phule Pune University 25
[R7] Wayne Dyer, “Change Your Thoughts, Change Your Life”, Hay House India, ISBN-139788189988050.
[R8] Stephen Covey, “Habits of Highly Effective People”, Pocket Books, ISBN139781416502494.
[R9] Dr. Joseph Murphy, “The Power of Your Subconscious Mind”, MaanuGraphics, ISBN-13 9789381529560.
[R10] Daniel Coleman, “The new Leaders”, Sphere Books Ltd, ISBN-139780751533811.
[R11] Richard Koch, “The 80/20 Principal”, Nicholas Brealey Publishing , ISBN-13 9781857883992.
[R12] Julie Morgenstern, “Time management from inside out”, Owl Books (NY),ISBN-13 9780805075908.
[R13] Shiv Khera, “You can win”, Macmillan, ISBN-139789350591932.
[R14] Gopalaswamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”

203152 : Audit Course-III

List of three audit course is provided. Students can choose any one from 203152(A) 203152(B) and 203152(C)

203152 (A) : Solar Thermal System

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Description: The course will introduce the basics of: solar energy, availability, applications, heat transfer as applied to solar thermal systems, various types of solar thermal systems, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The field visits will be designed for first-hand experience and basic understanding of the system elements.

Course Objective:

- To understand basics and types of solar thermal systems.
- To get knowledge of various types of concentrators.
- To make students aware of different Standards and certification for Concentrator Solar Power.

Course Outcome: Student will be able to

CO1: Differentiate between types of solar Concentrators

CO2: Apply software tool for solar concentrators

CO3: Design different types of Solar collectors and balance of plant

Course Contents:

- Sun, Earth and seasons
- Solar Radiation
- Basics of heat transfer
- Absorption, reflection and transmission of radiation
- Types of Solar thermal systems
- Basic design of different types of systems
- Applications of solar thermal systems and their economics
- Need for solar concentration
- Various types of solar concentrators
- Movement of Sun and tracking
- Control systems for solar tracking
- Concentrating solar thermal (CSP)
- Concentrating solar PV (CPV)
- Balance of plant for CSP
- Critical points in concentrating solar system installation
- Operation and maintenance of CSP
- Typical financial analysis of CSP
- Software tools for concentrating solar power
- Environmental impact assessment
- Standards and certification for CSP
- Basics of solar thermal (STH) systems
- Elements of various STH systems
- Design, materials and manufacturing of
  - Flat plate solar collector
  - Evacuated tube solar collector
  - Parabolic trough collector
  - Dish type solar concentrators
  - Concentrating PV systems
  - Balance of plant
- Manufacturing standards

- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Assignment

- Design of solar thermal system for residential/ commercial building.

References:

1. Trainers Textbook Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India
2. Students Workbook for Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India

203152 (B) : C Language Programming

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Course Objective:

- To give basic idea about C programming language
- To prepare students for writing algorithm, draw flow chart and program in C language
- To learn data types and syntax in C language.

Course Outcome: Student will be able to

CO1: Elaborate data types, arithmetic, logical and conditional operators
CO2: Apply control and looping statements in C programming
CO3: Write programming using C language with functions, arrays and pointers.

Course Contents:

Unit 01: The language of C : Phases of developing a running computer program in C, Data concepts in C :Constants, Variables, Expressions, Operators, and operator precedence in C., Statements : Declarations, Input-Output Statements, Compound statements, Selection Statements. Conditions, Logical operators, Precedence. Repetitive statements, While construct, Do-while Construct, For construct., Data types, size and values. Char, Unsigned and Signed data types. Number systems and representations. Constants, Overflow., Arrays. Strings. Multidimensional arrays and matrices.

Unit 02: Functions :The prototype declaration, Function definition.Function call : Passing arguments to a function, by value, by reference. Pointers : Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Examples. Accessing arrays through pointers. Pointer

Assignment

- Write C program for arithmetic operations such as +,-,*,/,%.
- Write C program for decision making statements such as if, else-if etc.
- Write C program for Representative statements such as for, while, do-while.
- Write C program to determine roots of an quadratic equation using functions.
- Write C program to enter matrix data and printing its inverse.
- Write C program to demonstrate use of pointers.

References:

1. A.R. Bradley, "Programming for Engineers", Ringer, 2011
2. Hankering and Chitchat, "The C Programming Language", (2nd ed.) Prentice Hall, 1988

203152(C) Japanese Language-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Course Objective:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome: On completion of the course student

- Will have ability of basic communication.
- Will have the knowledge of Japanese script.
- Will get introduced to reading , writing and listening skills
- Will develop interest to pursue professional Japanese Language course.

Course Contents:

Unit 1: Introduction to Japanese Language. Hiragana basic script, colors, Days of the week

Unit 2: Hiragana: modified Kana, double consonant, Letters combined with ya, yu, yo Long vowels, Greetings and expressions

Unit 3: Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one's age.

References:

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Text book 1-1 (IndianEdition), Goyal Publishers & Distributors Pvt. Ltd.

Guidelines for Conduction

(Any one or more of following but not limited to)

- Guest Lectures
- Visiting lectures
- Language Lab

Guidelines for Assessment (Any one of following but not limited to)

- Written Test
- Practical Test
- Presentation
- Paper
- Report

203145: Power System-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week	**Th**: 03	**In Sem** : 30 Marks **End Sem** : 70 Marks

Prerequisite courses if any: Power Generation, Various insulating materials and properties, Knowledge of fundamentals of electrical circuit components and engineering mathematics.

Course Objectives:

1. To learn the basic structure of electrical power systems, various electrical terms related with power system and understand various types of tariff.
2. To understand the specifications and applications of various major electrical equipment present in power plant.
3. To get the knowledge of mechanical and electrical design of overhead and underground transmission system.
4. To learn representation of transmission lines for performance evaluation.

Course Outcomes:

Upon successful completion of this course, the students will be able to:

CO1: Recognize different patterns of load curve and calculate associated different factors with it and tariff.

CO2: Draft specifications of electrical equipment in power station.

CO3: Design electrical and mechanical aspects in overhead transmission and underground cables.

CO4: Evaluate the inductance and capacitance of different transmission line configurations.

CO5: Analyse the performance of short and medium transmission lines

Unit 01: Structure of Electrical Power Systems and Tariff [6Hrs]

A) Structure of Electrical Power Systems: Structure of electrical power system, Different factors associated with generating stations such as Connected load, Maximum demand, Demand factor, Average load, Load factor, Diversity factor, Plant capacity factor, Reserve capacity, Plant use factor, Load curve, Load duration curve, Concept of base load and peak load stations, Advantages of interconnected grid system, Fitting of available generating station into the area load duration curve. **[4 Hrs]**

B) Tariff: Introduction of Tariff, Tariff setting principles, desirable characteristics of tariff, various consumer categories and implemented tariff such as two part tariff, three part tariff(Numerical on two part and three part tariff), Time of day tariff for H.T and L.T industrial and commercial consumers, Introduction to Availability based tariff (ABT), kVAh tariff(Descriptive treatment only).[**2 Hrs**]

Unit 02 Major Electrical Equipment's in Power Station & Underground Cables [6Hrs]

A) Major Electrical Equipment's in Power Station: Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, Power transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays. Current transformers, potential transformers, Lightning arresters, Earthing switches, isolators, Carrier current equipment’s (P.L.C.C), Control panels, battery rooms, metering and other control room equipment in generating station**. [3Hrs]**

B)Underground Cables: Construction of Cables, Classification of cables, XLPE cables, Capacitance of single core and three core cable, Dielectric stresses in single core cable, Grading of cables, inter sheath grading, capacitance grading. **[3Hrs]**

Unit 03: Mechanical Design of Overhead lines and Insulators: [6Hrs]

A) Mechanical Design of Overhead lines: Main components of overhead lines, Various types of line supports, Conductor spacing, Length of span, Calculation of sag for equal and unequal supports and effect of ice and wind loading. **[3Hrs]**

B) Overhead Line Insulators: Types of insulators, its construction and their applications such as Pin type, Suspension type, Strain type, Shackle type, Post insulators, bushing. Potential distribution over suspension insulators, String efficiency, (Numerical on string efficiency and up to four discs only), Methods of improving string efficiency (Descriptive treatment only). **[3Hrs]**

Unit 04:Resistance and Inductance of Transmission Line: [6Hrs]

Resistance of transmission line, Skin effect and proximity effect, Factors responsible for production of these effects, Internal and external flux linkages of single conductor, Inductance of single phase two wire line, Necessity of transposition, Inductance of three phase line with symmetrical and unsymmetrical spacing with transposition, Concept of G.M.R and G.M.D, Inductance of bundled conductors.

Unit 05: Capacitance of Transmission Line: [6Hrs]

Electric potential at single charged conductor, Potential at conductor in a group of charged conductors, Capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R and G.M.D for capacitance calculations, need of transposition for capacitance calculations, Capacitance of three phase line with symmetrical and unsymmetrical spacing with transposition. Capacitance of single circuit and double circuit three phase line with symmetrical and unsymmetrical spacing considering transposition (without considering earth effect).

Unit 06: Performance of Transmission Line [6Hrs]

Classification of lines based on length and voltage levels such as short, medium and long lines, Performance of short transmission lines with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Π' and 'Nominal T' circuits using R,L and C parameters, Ferranti effect, Representation of 'T' and 'Π' models of lines as two port networks, Evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of efficiency and regulation of short and medium lines.

Industrial Visit: Compulsory one visit to EHV substation is recommended

Text Books:

[T1] V.K.Meheta, Rohit Mehta, "Principles of Power System", S. Chand Publication.
[T2] J.B.Gupta, "Transmission and Distribution", S.K.Kataria and Sons, New Delhi.
[T3] J.B.Gupata,"Generation and Economic Considerations",S.K.Kataria & Sons, New Delhi.
[T4] Dr.B.R.Gupta, "Generation of Electrical Energy", S. Chand Publication.
[T5] A Chakraborty, M.L.Soni, P.V. Gupta, U.S.Bhatnagar,"A text book on Power System Engineering", Dhanpatrai & Co, Delhi.
[T6] S.N.Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

[R1] Nagrath & Kothari, "Power System Engineering", Tata McGraw Hill Publications
[R2] D. Das," Electrical Power System", New Age Publication
[R3] W.D.Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] M.V.Deshpande," Elements of Power Station Design", Wheeler Publishing.
[R5] I.J. Nagrath and D.P.Kothari," Modern Power System Analysis", Tata McGraw Hill
[R6] NPTEL course on Power System Engineering, IIT Kharagpur https://nptel.ac.in/courses/108/105/108105104/
[R7] NPTEL course on Power System Analysis, IIT Kharagpur https://nptel.ac.in/courses/108/105/108105067/
[R8] NPTEL Power System Analysis, IIT Kharagpur https://www.youtube.com/playlist?list=PLRWKj4sFG7-6gWwDMLI0Wy5DDRqyKP1uQ
[R9] MAHADISCOM Website for tariff: https://wss.mahadiscom.in/wss/wss?uiActionName=getEnergyBillCalculator
[R10] Maharashtra Electricity Regulatory Commission www.merc.gov.in

Units	Text Books	Reference Books
1	T1,T3,T6	R1,R3,R4,R8,R9,R10
2	T1,T4	R4,R6
3	T1,T5	R4,R6
4	T1,T2,T5,T6	R1,R7,R8
5	T1,T2,T5,T6	R1,R7,R8
6	T1,T2,T5	R3,R5,R7,R8

203146: Electrical Machines-I

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 50 Marks

Prerequisite:

- Magnetic circuit, mutual induced EMF, dynamically induced EMF, Direction of magnetic field in current carrying conductor, Flemings LHR & RHR, Electromechanical energy conversion.

Course Objective:

- To understand energy conversion process.
- To understand selection of machines for specific applications.
- To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.
- To test & analyse the performance of machine.

Course Outcome: Upon successful completion of this course, the students will be able to:

CO1: Evaluate performance parameters of transformer with experimentation and demonstrate construction along with specifications as per standards.

CO2: Distinguish between various types of transformer connections as per vector groups with application and to perform parallel operation of single/three phase transformers.

CO3: Select and draft specifications of DC machines and Induction motors for various applications along with speed control methods.

CO4: Justify the need of starters in electrical machines with merits and demerits.

CO5: Test and evaluate performance of DC machines and Induction motors as per IS standard.

Unit 01: Transformers: (6 Hrs)

Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer, Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Auto transformers, their ratings and applications. Comparison with two winding transformers with respect to saving of copper and size.

Unit 02: (6 Hrs)

Transformers:

Polarity test. Parallel operation of single-phase transformers, conditions to be satisfied, loadsharing under various conditions. & Welding Transformer

Three Phase Transformers:

Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V connections. Three winding (tertiary windings) transformers

Unit 03: D.C. Machines (Part-1): (6 Hrs)

Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F, torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.

Unit 04: D.C. Machines (Part-2): (6 Hrs)

Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors.

Commutation: Process of commutation, time of commutation, reactance voltage, different form of commutations, causes of bad commutation and its remedies (Descriptive treatment only)

Unit 05: Three Phase Induction Motor: (6 Hrs)

Construction: Stator, Squirrel cage & wound rotors. Production of rotating mmf. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram, Relation between rotor input power, rotor copper loss & gross mechanical power developed, efficiency.

Unit 06: Three Phase Induction Motor: (6 Hrs)

Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors, comparison of various starters. Testing of three phase induction motor as per IS 325 & IS 4029.

Industrial Visit:

Minimum One visit to above machines manufacturing industry (mentioned in syllabus) is recommended.

List of Experiments:

Compulsory Experiments:

1. O.C. and S.C. test on single phase Transformer
a. Determination of equivalent circuit parameters from the test data
b. Determination of voltage regulation and efficiency
2. Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedance.
3. Speed control of D.C. Shunt motor and study of starters.
4. Load test on 3-phase induction motor.

Any four experiments are to be conducted of following experiments:

1. Polarity test on single phase and three phase transformer.
2. Brake test on D.C. Shunt motor
3. Load characteristics of D.C. series motor.
4. Hopkinson's test on D.C. shunts machines.
5. No load & blocked-rotor test on 3-phase induction motor:
a) Determination of parameters of equivalent circuit.
b) Plotting of circle diagram.
6. Calculation of motor performance from (a) & (b) above.
7. Determination of sequence impedance of the transformer
8. To study Sumpner's test.
9. Measurements of non-sinusoidal current waveform of transformer at no load
10. Swinburne Test on DC shunt Motor.

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", Dhanpat Rai& Sons.
[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
[T4] Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, Third Edition.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", TataMcGraw

Hill Publication Ltd., Fifth Edition.
[R3] A.S. Langsdorf, “Theory and performance of DC machines”, Tata McGraw Hill.
[R4] M.G. Say, “Performance and Design of AC. Machines”, CBS Publishers and Distributors.
[R5] Smarajit Ghosh, “Electrical Machines”, Pearson Education, New Delhi.
[R6] Charles I Hubert, “Electrical Machines Theory, Application, & Control”, Pearson Education, New Delhi, Second Edition.

Unit No.	Text Book	Book Reference
I	T1, T2, T3, T4	R2, R4, R5
II	T1, T2, T3, T4	R2, R4, R5
III	T2, T3, T4	R1, R3, R5
IV	T2, T3, T4	R1, R3, R5
V	T1, T3, T4, T5, T6	R4, R5, R6
VI	T1, T3, T4, T5, T6	R4, R5, R6

203147: Network Analysis

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks

Prerequisite:
Terminology of electrical networks, series and parallel combinations of resistance, Laplace transforms , linear differential equations.

Course Objective:
1. To develop the strong foundation for Electrical Networks.
2. To develop analytical qualities in Electrical circuits by application of various theorems.
3. To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach.
4. To apply knowledge of laws and Network theory for analysis of 2-port networks and design of other circuits like filters.

Course Outcome:
Upon successful completion of this course, the students will be able to :-
CO1: Calculate current/voltage in electrical circuits using simplification techniques, Mesh, Nodal analysis and network theorems.
CO2: Analyze the response of RLC circuit with electrical supply in transient and stead state.
CO3: Apply Laplace transform to analyze behaviour of an electrical circuit.
CO4: Derive formula and solve numerical of two port network and Design of filters
CO5: Applyknowledge of network theory to find transfer function, poles and zeroes location to perform stability analysis and parallel resonance

Unit 1 Types of Network, Mesh and Nodal analysis [6 Hrs]
Lumped and Distributed, Linear and Nonlinear, Bilateral and Unilateral, Time-variant and Time-invariant. Independent and Dependent (controlled) voltage and current sources. Concept of voltage and current divider, Source transformation and shifting. Network Equations: Network equations on Loop basis and Node basis, choice between Loop analysis and Nodal analysis. Concept of super node and super mesh, mutual inductance, Dot convention for coupled circuits, Concept of duality and dual networks.

Unit 2: Network Theorem:[6 Hrs]
Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity, Millman theorems applied to electrical networks with all types of sources.
Graph Theory : Tree ,Co-tree, Incidence matrix ,F-cutest Matrix, Tie set B Matrix

Unit 3: Transients in RLC circuit[6 Hrs]
Solutions of differential equations and network equations using classical method for R-L, R-C and R-L-C circuits, Initial and Final Condition (series and parallel).

Unit 4: Laplace Transform[6 Hrs]
Basic Properties of Laplace Transform, Laplace Transform of Basic R, L and C components, Solutions of differential equations and network equations using Laplace transform method for RL, R-C and R-L-C circuits (series and parallel), Inverse Laplace transforms, transformed networks with initial conditions. Analysis of electrical circuits with applications of step, pulse, impulse & ramp functions, shifted & singular functions the convolution integral,application of initial and final value theorem.

Unit 5 Two port network and Filters [6 Hrs]
Two Port Network: Z, Y, H and transmission parameters, Interrelations between parameters. Introduction to passive filters, low pass filters, high pass filters and m-derived LPF and HPF filters and design.

Unit 6 Network Functions: [6 Hrs]
Poles and Zeros: Terminal pairs or ports, network functions for the one port and two ports, the calculation of network functions, general networks. Poles and zeros of network functions, Restrictions on poles and zeros locations for transfer functions and driving point function, Time –

domain behavior from the pole and zero plot. Stability of active networks. Parallel Resonance, Resonance frequency, Quality factor, Current and resonance.

List of Experiments: Any four experiments from the first five of the following and any four experiments from rest of the list. (Minimum four experiments should be based on simulation software along with hardware verification)

1. Verification of Superposition theorem in A.C. circuits.
2. Verification of Thevenin's theorem in A.C. circuits.
3. Verification of Reciprocity theorem in A.C. circuits.
4. Verification of Millmans' theorem.
5. Verification of Maximum Power Transfer theorem in A.C. circuits.
6. Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor)
7. Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit)
8. Determination of time response of R-L-C series circuit to a step D.C. voltage input.
9. Determination of parameter of Two Port Network.
10. Determination of current under parallel Resonance condition .
11. Determination of Resonance, Bandwidth and Q factor of R-L-C series circuit.

Guidelines for Instructor's Manual□

- Specify objective(s) of the experiment. □
- List out equipment required to perform the experiment with their ratings. □
- Include circuit diagram with specifications. □
- Related theory of the experiment must be included. □
- Include step by step procedure to perform the experiment. □
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable. □
- It should include the formula required to calculate desired results. □ Instructions for plotting the graphs must be included wherever required. □
- Provide space to write conclusion on their own. □
- For simulation experiments using MATLAB, the Simulink diagram with proper details must be included.

Guidelines for Student's Lab Journal □

- Students are expected to write the journal in the following sequence: □
  - Aim □
  - Equipment □
  - Circuit diagram □
  - Theory
  - Procedure
  - Observation table□
  - Calculations □
  - Graphs□
  - Conclusion. □
- Students are expected to draw the circuit diagrams on 1mm graph paper. □
- For plotting the characteristics they must use 1mm graph papers. □
- Students should write conclusion. □
- Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Lab

- TW Assessment should be on the basis of: □
- Neatness of circuit diagram. □
- Completed write up including theory, procedure. □
- The detail calculations to obtain results. □
- Graph with title, scale, labeling of axes etc. □
- Conclusion. □

- Punctuality, discipline, attendance, understanding and neatness of the journal. Few questions on the basis of the experiment can be asked to verify the understanding of the students about that experiment.

Guidelines for Laboratory Conduction □

- Give the safety instructions to students. □
- Allow 4-5 students per group for performing the experiment. □
- Explain theory related to the experiment to be conducted. □
- Introduce the equipment required to students. □
- Explain students the calibration process of equipment. □
- Explain the circuit diagram of the experiment. □
- Connections should be completed by the students according to circuit diagram. □ Perform the experiment in the presence of instructor. □
- Verify the results obtained.

Text Book:

[T1] Network Analysis Third Edition by M. E. Van Valkenburg, Prentice Hall of India Private Limited.
[T2] Network Analysis & Synthesis by G. K. Mittal, Khanna Publication.
[T3] Network Analysis and Synthesis by Ravish R Singh, McGraw Hill.
[T4] Introduction to Electric Circuits by Alexander & Sadiku, McGraw Hill.
[T5] Introduction to Electric Circuits by S. Charkarboorty, Dhanpat Rai & Co.
[T6] Fundamentals of Electrical Networks by B.R.Gupta & Vandana Singhal- S.Chand Publications 8. Electrical Circuit Analysis 2nd Edition by P. Ramesh babu, Scitech Publication India Pvt Ltd.

Reference Books:

[R1] Network Analysis by Cramer , McGraw Hill Publication.
[R2] Engineering Circuit Analysis by William H. Hayt, Jr. Jack E. Kemmerly, McGraw Hill Publication.
[R3] Schaum's Outline of Electric Circuits, McGraw-Hill Education; 7 edition

Unit	Text book	Reference
1	T1,T2, T3 T5	R1,R3
2	T1,T2, T3, T4	R1,R3
3	T2, T3,T5	R2,R3
4	T2, T3,T5	R2,R3
5	T2, T3, T4	R3
6	T5,T6	R3

203148: Numerical Methods and Computer Programming

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 02 Hrs/ Week	**Th**: 03 **PR**:01	**In Sem** : 30 Marks **End Sem** : 70 Marks **Practical** : 25 Marks

Prerequisite:

1. Differentiation and integration of a single real variable, ordinary differential equations.
2. Programming and Problem solving.
3. Linear Algebra.

Course Objectives:

1. To emphasize the need of computational techniques and analyze errors involved in the computation.
2. To provide sound knowledge of various numerical methods.
3. To apply various numerical methods to obtain solution of different types of equations such as transcendental, simultaneous, ODE etc. and also for interpolation, integration and differentiation.
4. To impart skills to develop algorithms and programs for various numerical methods.

Course Outcomes:

On completion of the course, student will be able to

CO1: Demonstrate types of errors in computation and their causes of occurrence.

CO2: Calculate root of algebraic and transcendental equations using various methods.

CO3: Apply numerical methods for various mathematical problems such as interpolation, numerical differentiation, integration and ordinary differential equation.

CO4: Solve linear simultaneous equation using direct and indirect method.

CO5: Develop algorithms and write computer programs for various numerical methods.

Unit 01 : Numerical Computations, Errors and Concept of root of equation (6hrs)

A) Basic principle of numerical computation. Floating point algebra with normalized floating point technique, Significant digits. **Errors**: Different types of errors, causes of occurrence and remedies to minimize them, Generalized error formula (Derivation and Numerical)

B) **Concept of roots** of an equation. Descartes' rule of signs, Intermediate value theorem, Roots of Polynomial Equations using Birge-Vieta method.

Unit 02: Solution of Transcendental and polynomial equation and Curve Fitting: (6hrs)

A) Solution of Transcendental and polynomial equation using Bisection, Regula- Falsi, Newton-Raphson method for single variable and two variables.

B) Curve fitting using least square approximation – First order and second order

Unit 03: Interpolation (6hrs)

Forward, Backward, Central and Divided Difference operators, Introduction to interpolation.

A)Interpolation with equal Intervals - Newton's forward, backward interpolation formula (Derivations and numerical), Stirling's and Bessel's central difference formula (Only numericals)

B) Interpolation with unequal Intervals- Newton's divided difference formula and Lagrange's interpolation (Derivations and numerical).

Unit 04: Numerical Differentiation and Integration (6hrs)

A) **Numerical Differentiation** using Newton's forward and backward interpolation formula (Derivation and numerical).

B) Numerical Integration: Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single integral. Numerical on double integrals using Trapezoidal and Simpson's 1/3 rd rule.

Unit 05:Solution of linear simultaneous equation (6hrs)

A) Solution of linear simultaneous equation: Direct methods - Gauss elimination method, concept of pivoting – partial and complete. Gauss Jordan method, Iterative methods – Jacobi method and Gauss Seidel method.

B)Matrix Inversion using Gauss Jordan method

Unit 06: Solution of Ordinary Differential Equation(ODE) (6hrs)

A) Solution of First order Ordinary Differential Equation (ODE) using Taylor's series method, Euler's method, Modified Euler's method (Derivation and numerical). Runge-Kutta fourth order method (Numerical).

B)Solution of Second order ODE using 4th order Runge-Kutta method (Numerical)

List of Experiments:
Develop computer program using **Python language**
Compulsory Experiments-1,2,3,4,7,10
Any one from 5 or 6 and any one from 8 or 9

1. Develop algorithm, draw flow chart and write a program to implement following:
   (a) for loop and while loop-- application in Descarte's rule of sign.
   (b) if-else and functions-- application in Intermediate value theorem.
   (c) 2DArray formation-- application in matrix data entry, transposition and printing matrix.
2. Develop algorithm, draw flow chart and write a program to implement Birge-Vieta method.
3. Develop algorithm, draw flow chart and write a program to implement Bisection/Regula falsi /Newton-Raphson method (single variable) in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Finding critical clearing angle in power system stability (give equation directly)
   (b) Relation between voltage and current in solar PV.
4. Develop algorithm, draw flow chart and write a program to implement curve fitting using least square approximation in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging.
   (b) Relate temperature and resistance in thermocouple.
   (c) Current through inductor during excitation.
5. Develop algorithm, draw flow chart and write a program to apply Newton's forward/backward interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Voltage across capacitor during charging
   (b) Relation of speed and armature voltage in DC motor.
   (c) Relation of breakdown voltage and thickness of insulation
6. Develop algorithm, draw flow chart and write a program to apply Newton's divided difference/Lagrange's interpolation method in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Power transfer equation to find power at particular angle
   (b) Transformer efficiency at particular loading (data of % loading and efficiency in known at a particular power factor)
   (c) Growth of electricity consumption in India (year Vs. Per capita electrical consumption).
7. Develop algorithm, draw flow chart and write a program to implement trapezoidal/ Simpson (1/3)rd rule in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) RMS/Average value of given waveform.
   (b) Finding current through first order circuit (RL series)
   (c) kWh consumption from load curve
   (d) Magnetic field intensity in overhead transmission line
8. Develop algorithm, draw flow chart and write a program to implement Gauss elimination/Jordan in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
9. Develop algorithm, draw flow chart and write a program to implement Gauss Jacobi/Seidel in following applications (formulate problem statement in any one of following area(but not limited to))
   (a) Electrical network using KVL
   (b) Electrical Network using KCL
10. Develop algorithm, draw flow chart and write a program to implement Modified Euler's/4th order RK method in following applications (formulate problem statement in any one of following area(but not limited to)
   (a) Response of RC series circuit with DC
   (b) Response of RL circuit with DC
   (c) Deflection angle in MI type instrument

Guidelines for Instructor's Manual Practical Sessions

The Instructor Manual should contain following related to every program

- Theory related to the method
- Algorithm and Flowchart of the method
- Three to four different sets of problem statement for numerical method

- Solve numerical using appropriate method
- Ten questions based on method and related Python commands
- Expected Output

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment:

- Theory related to the method
- Algorithm and Flowchart of the method
- Problem statement for numerical method
- Solve numerical using appropriate method
- Program printout with output
- Conclusion
- Ten questions based on method and related Python commands

Guidelines for Lab Assessment

- There should be continuous assessment
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do programming
- Timely submission of journal

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken in the lecture prior to the lab session
- Algorithm should be discussed in detail in the lab session
- Students are expected to do the program based on the discussed algorithm individually
- Printout of the program and output should be taken on the day when the program is performed

Books & Other Resources:

Text Books:

[T1] M. K. Jain, S.R.K. Iyangar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Publications.

[T2] Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences", Khanna Publishers.

[T3] P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis", Krishna Prakashan Media Ltd, Meerut.

[T4] T. Veerarajan and T. Ramchandran, "Numerical Methods with Programs in C and C++", Tata McGraw Hill Publication.

[T5] S Arumugam, "Numerical Methods" Scitech Publication

Reference Books:

[R1] J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH, New Delhi.

[R2] Steven Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publication.

[R3] S.S. Sastry, "Introductory methods of Numerical Analysis", PHI Learning Private Ltd.

[R4] P. Thangaraj, "Computer oriented Numerical Methods", PHI Learning Private Ltd.

[R5] Yashwant Kanitkar, "Let us Python", pbp publications

[R6] NPTEL course on Numerical Analysis, IIT, Roorkee.
https://nptel.ac.in/courses/111107062/

[R7] NPTEL course on MATLAB Programming on Numerical Computation, IIT Madras
https://nptel.ac.in/courses/103106118/

[R8] NPTEL course on Python for Data Science, IIT Madras
https://nptel.ac.in/courses/106106212/

[R9]Jaan Kiusalaas, "Numerical methods in Engineering with Python", Cambridge University Press

Unit No	Text Books	References
1	T5, T4	R2, R3, R6
2	T1, T5	R2, R3, R6
3	T3, T4, T5	R4, R2, R1, R6, R7
4	T2, T3,T5	R2, R3, R7
5	T2, T3,T5	R2, R3, R7
6	T2, T3,T5	R2, R3, R6, R7
Python	--	R5, R8,R9

203149: Fundamental of Microcontroller and Applications

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 03 Hrs/ Week **Practical** : 04 Hrs/ Week	**Th**: 03 **PR**:02	**In Sem** : 30 Marks **End Sem** : 70 Marks **Term Work**: 25 Marks **Oral** : 25 Marks

Prerequisite:

- Knowledge of numbering systems and Boolean algebra.
- Knowledge of combinational and sequential logic circuits.

Course Objective: Objectives of the course are to

- Explain the microcontroller architecture & describe the features of a typical microcontroller.
- To use the 8051 addressing modes and instruction set and apply this knowledge to develop programs in assembly language and C language.
- To define the protocol for serial communication and understand the microcontroller development systems.
- Explain the interrupt structure of the microcontroller and to develop programs related to interrupt handling
- To introduce students to Global System for Mobile Communication (GSM)
- To provide students with interfacing concepts and develop interfacing circuits for simple devices.

Course Outcome: Upon successful completion of this course, the students will be able to:-

CO1: Describe the architecture and features of various types of the microcontroller.

CO2: Illustrate addressing modes and execute programs in assembly language for the microcontroller.

CO3: Write programs in C language for microcontroller 8051.

CO4: Elaborate interrupt structure of 8051 and program to handle interrupt and ADC809

CO5: Define the protocol for serial communication and understand the microcontroller development systems.

CO6: Interface input output devices and measure electrical parameters with 8051 in real time.

Unit 01 : (6 Hrs)

Introduction to concept of microcontroller, Intel 8051 Functional block diagram, Functions of pins of 8051, Memory organization of 8051, PSW and Flag Bits, Stack and Stack pointer. Overview of special function registers,Data transfer instructions and programs in assembly language.

Unit 02 : (6 Hrs)

Arithmetic and logical instructions and programs in assembly language.Boolean and Program Branching instructions and programs in assembly language.Addressing modes of 8051.

Unit 03 : (6 Hrs)

8051 Programming in C , Data types in C . Ports of 8051, their use, and programming in C (Byte Level and Bit-level). Time delay programming in C.

Timers and counters in 8051, Timer modes 0,1,2 and its programming in C and counter-programming.

Unit 04 : (6 Hrs)

Interrupt structure of 8051 and SFR associated with interruptsProgramming of External hardware interrupts in C.Interfacing of ADC 0809 with 8051.

Unit 05 : (6 Hrs)

Serial port Structure in 8051. Programming of Serial port for transferring and receiving data in C in mode 1.

Introduction to GSM module, AT commands, Programming to send and read SMS.

Unit 06 : (6 Hrs)

Measurement of electrical parameters such as voltage, current (Theoretical Treatment only).

Interfacing of Stepper motor with 8051 and its programming in C.Interfacing and programming of single Key, LED, and Relay with 8051 in C.

Guidelines for Instructor's Manual

1. Commands to be followed to operate the 8051 microcontroller kit.
2. The architecture of the 8051 microcontroller kit-Functional block diagram & its explanation.
3. Pin Diagram of 8051 microcontrollers with a description of all the 40 pins.
4. Addressing modes-Explanation with an example.
5. Instruction set for Data transfer, Arithmetic, Logical, Branching & Bit manipulation along with an explanation.
6. User manuals of all the interfacing kits such as stepper motor, DC motor, DAC, ADC &LED.

Guidelines for Student's Lab Journal

1. Title of the program.
2. The program has to be written in the following format. Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on a separate page.

Guidelines for Laboratory Conduction

1. Each group in the lab should have not more than three students.
2. Each student within the group has to enter and execute the program turn wise.
3. A faculty member has to check the result of all the groups after the execution of the program.

List of Experiments:

PART A: [TW: 15 Marks]

Compulsory Experiments:

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for the arithmetic operation of 8-bit numbers.
3. Assembly Language Program for finding the largest number and smallest number from a given an array of 8-bit numbers.
4. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order and descending order.

Any four experiments are to be conducted of the following experiments using embedded C :

1. Implementation of Serial Communication by using 8051 serial ports.
2. Programming using a cross-assembler.
3. The blinking display of LED's interfaced with 8051.
4. Interfacing of 8 bit DAC 0808 with 8051 to generate various waveforms.
5. Interfacing of 8 bit ADC 0809 with 8051 Microcontroller.
6. Interfacing of the relay with 8051.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of matrix keyboard/ 7 segment display with 8051.
9. Interfacing of LCD with 8051.

PART B: [TW: 10 Marks]

Prerequisite: Programming exercises of C language.

Compulsory Experiments:

1. Study of GSM Module SIM800/SIM900/QUECTEL M95 and AT Commands
2. Study of IoT system
3. Interfacing of GSM with a computer through COM port to Send and Receive SMS.
4. Interfacing GSM with 8051 trainer kit and develop a program to send AT commands.

Any two experiments are to be conducted of the following experiments:

1. Develop a program in C to read and send SMS from the GSM module.
2. Measurement of physical parameters (Temperature/Pressure/Humidity) using 8051 and send value to GSM after an interval of the specified interval.
3. Measurement of electrical parameters (Voltage/Current) using 8051 and send value to the GSM module after an interval of 10min.
4. Develop a program to turn on and turn off induction Motor using 8051 and GSM module.
5. Development of mobile app for various applications in electrical engineering.

Text Books:

[T1] Muhammad Ali Mazidi, J.G. Mazidi, “The 8051 Microcontroller and Embedded Systems”, Pearsons Publishers.

[T2] V Udayashankara and M S MallikarjunaSwamy, “8051 Microcontroller, Hardware, software and applications”, TATA McGraw Hill.

[T3] Ajay Deshmukh, “Microcontroller 8051” –TATA McGraw Hill.

[T4] Theagrajan,” Microprocessor and Microcontroller”, BS Publication.

[T5] K. J. Ayala, “The 8051 Microcontrollers- Architecture, Programming and Applications”, Peram International Publications.

[T6] SubrataGhoshal, “8051 microcontroller”, Pearsons Publishers.

[T7] Han-Way Huang,” Embedded System Design with C8051”, Cengage Learning

Reference Books:

[R1] Scott Mackenzie, “8051 Microcontroller”, Pearson Education.

[R2] Intel Microcontroller data book.

[R3] Intel Corporation 1990- 8 bit embedded controller handbook.

203152: Project Based Learning

Teaching Scheme	Credits	Examination Scheme [Marks]
Practical : 04 Hrs/ Week	**PR**:02	**Term Work**: 50 Marks

Preamble: For better learning experience, along with traditional classroom teaching and laboratory learning, project-based learning has been introduced to motivate students to learn by working in a group cooperatively to solve a problem. Project-Based Learning (PBL) is a student-centered and experimental approach to education promoting 'deeper learning' through active exploration of real-world problems and challenges. A central goal of PBL is to facilitate the deeper learning process and support students' acquisition of complex cognitive competencies, e.g., rigorous content knowledge and critical thinking skills. The PBL engages students in the problem definition, design process, contextual understanding, and systems thinking approaches. In the PBL approach, learning based on memorization is de-emphasized and more emphasis is given on understanding and application of engineering design principles. Because of frequent assessments throughout the course, plagiarism can be more easily controlled.

Course Objectives: Objectives of this course are to

1. Impart technical knowledge and skills, and develop deeper understanding to integrate knowledge and skills from various areas.
2. Build critical thinking, problem-solving, communication, collaboration and creativity, and innovation amongst students
3. Make students aware of their own academic, personal, and social developments.
4. Develop habits of self-evaluation and self-criticism, against self-competency and trying to see beyond own ideas and knowledge

Course Outcomes: At the end of this project-based learning, students will be able to

CO1: Identify, formulate, and analyze the simple project problem.

CO2: Apply knowledge of mathematics, basic sciences, and electrical engineering fundamentals to develop solutions for the project.

CO3: Learn to work in teams, and to plan and carry out different tasks that are required during a project.

CO4: Understand their own and their team-mate's strengths and skills.

CO5: Draw information from a variety of sources and be able to filter and summarize the relevant points.

CO6: Communicate to different audiences in oral, visual, and written forms.

Procedure: A group of 4-5 students will be assigned to a faculty member called a mentor. Based on the engineering knowledge of a group and societal and industry problems, the mentor has to guide a group to identify project problems and plan the work schedule. Here, the expected outcomes of the project must be noted. The complete work-plan should be divided in the form of the individual tasks to be accomplished with targets. Weekly review of the completed task should be taken and further guidelines are to be given to a group. The final activity will be presenting the work completed and submitting the report. A group should be promoted to participate in a competition or write a paper.

A problem needs to refer back to a particularly practical, scientific, social, and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and the structure of the activity. It may have

- ✓ A few hands-on activities that may or may not be multidisciplinary.
- ✓ Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize, and present their learning.
- ✓ Activities on solving real-life problems, investigation /study, and writing reports of in-depth study, fieldwork.

Assessment:

The department/mentor is committed to assess and evaluate both students' performance and course effectiveness. The progress of PBL is monitored regularly every week. During the process of monitoring, continuous assessment and evaluation the individual and team performances are to be measured by supervisor /mentor and authorities.

Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning, and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and students must actively participate in the assessment and evaluation processes. Groups may demonstrate their knowledge and skills by developing a solution to the problem, public product, and/or report and/or presentation.

- ✓ Individual assessment for each student (Understanding individual capacity, role, and involvement in the project)
- ✓ Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- ✓ Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities are to be recorded in a PBL workbook regularly, regular assessment of work to be done and proper documents are to be maintained at the department level by both students as well as a mentor. Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department. Recommended parameters for assessment, evaluation, and weightage are as follows.

- ✓ Idea Inception **(5%)**
- ✓ Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product **(50%)** (Individual assessment and team assessment)
- ✓ Documentation (Gathering requirements, design and modeling, implementation/execution, use of technology and final report, other documents) **(25%)**
- ✓ Demonstration (Presentation, User Interface, Usability, etc.) **(10%)**
- ✓ Contest Participation/ publication **(5%)**
- ✓ Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects **(5%)**
- ✓ PBL workbook will serve the purpose and facilitate the job of students, mentors, and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken

203153: Audit Course-IV

List of three audit course is provided. Students can choose any one from 203153(A) 203153(B) and 203153(C)

203153(A): Solar Photovoltaic Systems

Teaching Scheme	Credits	Examination Scheme [Marks]
Lectures: 2hrs/week	**No credit**	**Grade: PP/NP** **Quiz and term paper**

Prerequisite: Completion of FE or equivalent

Description: The course will introduce the basics of: solar energy, availability, semiconductors as photovoltaic convertors and solar cells, applications of photovoltaic, various types of solar photovoltaic systems, and introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The practical will be designed for basic understanding of the system elements.

Course Objective:

- To learn Solar PV system and its appliances
- To get knowledge of balance of PV system, batteries, inverters etc.
- To understand grid tied SPV solar plants

Course Outcome: Students will be able to

CO1: design of Solar PV system for small and large installations

CO2: handle software tools for Solar PV systems

Course Contents:

- Physics of photovoltaic (PV) electricity
- Photodiode and solar cell
- Solar radiation spectrum for PV •
- Types of solar cell and comparison
- Introduction to various types of solar module manufacturing
- Basic system design and economics
- Types of systems
- Common applications of solar PV
- Introduction to solar PV (SPV) systems
- SPV appliances
- Small capacity SPV power plants
- Grid tied SPV power plants
- Large scale SPV power plants
- Balance of system
- Solar inverters
- Batteries
- Financial modelling of SPV
- Operation and maintenance of SPV
- Software tools for SPV
- Environmental impact assessment
- Standards and certification for SPV
- Basics of SPV systems
- Elements of SPV appliances and power plants Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly
- Manufacturing standards
- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication

- Typical shop layouts
- Inventory management
- Economics of manufacturing

Practical:

- PV characterization
- Batteries and energy storage
- PV system design

Assignment

- Design of solar PV system for department / college.

References:

[1] A.S.Kapur -A Practical Guide for Total Engineering of MW capacity Solar PV Power Project
[2] Solanki C.S- Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers- PHI
[3] Solanki C.S- SolarPhotovoltaics - Fundamentals, Technologies and Applications- PHI
[4] S. Sukhatme -Solar Energy : Principles of Thermal Collection and Storage- McGraw Hill

203153(B) Installation & Maintenance of Electrical appliances

Teaching Scheme Lectures: 2hrs/week	Credits No credit	Examination Scheme [Marks] Grade: PP/NP Quiz and term paper

Prerequisite: Completion of FE/DEE or equivalent

Course Objective: This course has been designed to provide the knowledge of Repairing and Maintenance of home appliances. Students will be familiar with maintenance of everyday household necessities.

Course Outcome: At the end of the course the students will be having knowledge of: -

- Observing the safety precautions while working,
- Test line cord for continuity with test lamp/ multimeter
- Dismantle and reassemble an electric iron
- Heater, kettle, room heater, toaster, hair dryer, mixer grinder etc.
- Install a ceiling fan and the regulator
- Check a fluorescent lamp chock, starter and install it
- Domestic installation testing before energizing a domestic installation

Course Contents:

- General safety & electrical safety
  - ➢ What is safety, Why safety is needed
  - ➢ Tools for electrical safety
  - ➢ Safety rules
  - ➢ Precaution during electrical maintenance
- Crimping & crimping tool, soldering
  - ➢ What is crimping, crimping tool, How to use RJ-11 connector, telephone wire, UTP Cable
  - ➢ crimping technique, precaution during crimping
  - ➢ Soldering Iron, Soldering wire, Soldering Flux,
  - ➢ Soldering method, Zero defect soldering
- Earthing& types of Earthing
  - ➢ Introduction of Earthing
  - ➢ Need of Earthing, Hazard
  - ➢ Types of Earthing
  - ➢ Advantage of Earthing, working of Earthing
- Simple house wiring circuit
  - ➢ Introduction of Wiring ,types of wiring
  - ➢ need of wiring, advantage of wiring
  - ➢ wiring methods
  - ➢ electrical panel
  - ➢ cable type
- Install, service and repair of automatic electric iron, mixer grinder, ceiling and table fan, heater, iron, kettle, washing machine etc
  - ➢ Installation procedure of electric iron,
  - ➢ Installation procedure mixer grinder
  - ➢ Installation procedure of ceiling and table fan,
  - ➢ Installation procedure heater, iron, kettle
  - ➢ Installation procedure washing machine
  - ➢ fault finding & removal of faulty component in electric iron, mixer grinder, ceiling and table fan
  - ➢ fault finding & removal of faulty component in heater, iron, kettle, washing machine
- Assemble and install of a fluorescent lamp
  - ➢ Parts of fluorescent lamp,
  - ➢ Working principle of fluorescent lamp

- Assembling procedure of lamp
- Thermostat heat controls of Automatic electric iron, steam iron, spray irons.
  - Thermostat, Bimetal, Wax Pallet , Gas Expansion, Pneumatic,
  - Bimetallic Switching thermostat, Simple two wire thermostats
  - Combination heating/Cooling regulation, Heat Control of Steam Iron, Electric Iron
- Maintenance of decorative serial lamp for a required supply voltage
  - What is decorative lamp, Working of decorative lamp
  - Description of decorative serial lamp,
  - Maintenance of decorative serial lamp
- Introduction to re- winding Insulating material used
  - Material, Types of Material
  - Insulating Material, Types of Insulating Material
  - Need of insulating material, winding, re-winding

References:

[1] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House
[2] B. K. N. Rao -Hand book of condition monitoring- Elsevier Advance Tech., Oxford (UK).
[3] Eric Kleinert-Troubleshooting and Repairing Major Appliances / Edition 3- McGraw Hill
[4] Service Manual of Electrical Home Appliances

<table>
<tr><td colspan="3">203153(C) Japanese Language-II</td></tr>
<tr><td>Teaching Scheme
Lectures: 2hrs/week</td><td>Credits
No credit</td><td>Examination Scheme [Marks]
Grade: PP/NP
Quiz and term paper</td></tr>
<tr><td colspan="3">Course Objective:
• To meet the needs of ever growing industry with respect to language support.
• To get introduced to Japanese society and culture through language.
Course Outcome:On completion of the course student
• Will have ability of basic communication.
• Will have the knowledge of Japanese script.
• Will get introduced to reading , writing and listening skills
• Will develop interest to pursue professional Japanese Language course.</td></tr>
<tr><td colspan="3">Course Contents:
Unit 1:Katakana basic Script, Denoting things (nominal & prenominal demonstratives)Purchasing at the Market / in a shop / mall (asking & stating price)
Unit 2:Katakana: Modified kana, double consonant, letters with ya, yu, yo, Long vowelsDescribing time, describing starting & finishing time (kara ~ made) Point in time (denoting the time when any action or the movement occurs)
Unit 3: Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle
References:
1. Minna No Nihongo, “Japanese for Everyone”, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.</td></tr>
<tr><td colspan="3">Guidelines for Conduction
(Any one or more of following but not limited to)
• Guest Lectures
• Visiting lectures
• Language Lab</td></tr>
<tr><td colspan="3">Guidelines for Assessment (Any one of following but not limited to)
• Written Test
• Practical Test
• Presentation
• Paper
• Report</td></tr>
</table>

Savitribai Phule Pune University
Faculty of Science & Technology

Curriculum/Syllabus
for

Second Year
Bachelor of Engineering
(Choice Based Credit System)
Mechanical Engineering and Automobile Engineering
(2019 Course)

Board of Studies - Automobile and Mechanical Engineering
(With Effect from Academic Year 2020-21)

Savitribai Phule Pune University

Board of Studies - Automobile and Mechanical Engineering

Undergraduate Program - Automobile Engineering & Mechanical Engineering (2019 pattern)

Course Code	Course Name	Teaching Scheme (Hours/ Week)			Examination Scheme and Marks						Credit			
		TH	PR	TUT	ISE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-III														
202041	Solid Mechanics	4	2	-	30	70	-	50	-	150	4	1	-	5
202042	Solid Modeling and Drafting	3	2	-	30	70	-	50	-	150	3	1	-	4
202043	Engineering Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202044	Engineering Materials and Metallurgy	3	2	-	30	70	25	-	-	125	3	1	-	4
203156	Electrical and Electronics Engineering	3	2	-	30	70	25	-	-	125	3	1	-	4
202045	Geometric Dimensioning and Tolerancing Lab	-	2	-	-	-	25	-	-	25	-	1	-	1
202046	Audit Course - III	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**16**	**12**	**-**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**6**	**-**	**22**
Semester-IV														
207002	Engineering Mathematics - III	3	-	1	30	70	25	-	-	125	3	-	1	4
202047	Kinematics of Machinery	3	2	-	30	70	-	-	25	125	3	1	-	4
202048	Applied Thermodynamics	3	2	-	30	70	-	-	25	125	3	1	-	4
202049	Fluid Mechanics	3	2	-	30	70	-	-	25	125	3	1	-	4
202050	Manufacturing Processes	3	-	-	30	70	-	-	-	100	3	-	-	3
202051	Machine Shop	-	2	-	-	-	50	-	-	50	-	1	-	1
202052	Project Based Learning - II	-	4	-	-	-	50	-	-	50	-	2		2
202053	Audit Course - IV	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**12**	**1**	**150**	**350**	**125**	**-**	**75**	**700**	**15**	**6**	**1**	**22**

Abbreviations: TH: Theory, **PR**: Practical, **TUT**: Tutorial, **ISE**: In-Semester Exam, **ESE**: End-Semester Exam,**TW**: Term Work, OR: Oral

Note: Interested students of SE (Automobile Engineering and Mechanical Engineering) can opt for any one of the audit course from the list of audit courses prescribed by BoS (Automobile and Mechanical Engineering)

Instructions

- Practical/Tutorial must be conducted in three batches per division only.
- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Assessment of tutorial work has to be carried out as a term-work examination. Term-work Examination at second year of engineering course shall be internal continuous assessment only.
- Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.
- Audit course is mandatory but non-credit course. Examination has to be conducted at the end of Semesters for award of grade at institute level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

202041 - Solid Mechanics

Teaching Scheme	Credits	Examination Scheme
Theory : 04 Hr./Week Practical : 02 Hr./Week	**05** Theory : 04 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Engineering Mathematics- I and II, Systems in Mechanical Engineering, Engineering Mechanics

Course Objectives

1. To acquire basic knowledge of stress, strain due to various types of loading.
2. To draw Shear Force and Bending Moment Diagram for transverse loading.
3. To determine Bending, Shear stress, Slope and Deflection on Beam.
4. To solve problems of Torsional shear stress for shaft and Buckling for the column.
5. To apply the concept of Principal Stresses and Theories of Failure.
6. To utilize the concepts of Solid Mechanics on application based combined mode of loading.

Course Outcomes

On completion of the course, learner will be able to

CO1. DEFINE various types of stresses and strain developed on determinate and indeterminate members.

CO2. DRAW Shear force and bending moment diagram for various types of transverse loading and support.

CO3. COMPUTE the slope & deflection, bending stresses and shear stresses on a beam.

CO4. CALCULATE torsional shear stress in shaft and buckling on the column.

CO5. APPLY the concept of principal stresses and theories of failure to determine stresses on a 2-D element.

CO6. UTILIZE the concepts of SFD & BMD, torsion and principal stresses to solve combined loading application based problems.

Course Contents

Unit I — Simple stresses & strains — [10 Hr.]

Simple Stress & Strain: Introduction to types of loads (Static, Dynamic & Impact Loading) and various types of stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Stress-strain diagram for ductile and brittle materials, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads and self-weight, Thermal stresses in plain and composite members

Unit II — Shear Force & Bending Moment Diagrams — [08 Hr.]

SFD & BMD: Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure

Unit III — Stresses, Slope & Deflection on Beams — [12 Hr.]

Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section

Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section

Slope & Deflection on a Beam: Introduction to slope & deflection on a beam with application, slope, deflection and Radius of Curvature, Macaulay's Method, Slope and Deflection for all standard beams

Unit IV	**Torsion, Buckling**	**[08 Hr.]**

Torsion of circular shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience
Torsion on Thin-Walled Tubes: Introduction of Torsion on Thin-Walled Tubes Shaft and its application
Buckling of columns: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory

Unit V	**Principal Stresses, Theories of Failure**	**[08 Hr.]**

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses
Theories of Elastic failure: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory

Unit VI	**Application based combined loading & stresses**	**[08 Hr.]**

(Based on load and stress condition studied in Unit I to Unit V)

Introduction to the Combined Loading and various stresses with application, Free Body Diagram and condition of Equilibrium for determining internal reaction forces, couples for 2-D system, Combined stresses at any cross-section or at any particular point for Industrial and Real life example for the following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined problem of Normal and Shear type of Stresses

Books & Other Resources

Text Books

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication
3. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
4. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
5. Singer and Pytel, "Strength of materials", Harper and row Publication
6. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication

Reference Books

1. Egor. P. Popov, "Introduction to Mechanics of Solids",Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore
6. Prof. S.K. Bhattacharyya, IIT Kharagpur , "NPTEL Web course material"
   https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

The Termwork shall consist of completion of Practicals, Self-learning Study Assignments and Presentations. Practical examination shall be based on the Termwork undertaken during the semester.

Practical (*Any 6 experiments out of experiment no 1 to 8 from the following list whereas experiment no. 9 and 10 are mandatory. Minimum One experiment must be performed on IoT platform- Virtual Lab*):

1. Tension test for Ductile material using extensometer on Universal Testing Machine.
2. Compression test for Brittle material on Universal Testing Machine.
3. Shear test of ductile material on Universal Testing Machine.
4. Tension test of Plastic/Composite material on low load capacity Tensile Testing Machine.
5. Measurement of stresses and strains using strain gauges.

6. Experimental verification of flexural formula in bending for cantilever, Simple supported beam.
7. Study and interpretations of stress distribution pattern using Polariscope for Plastic/Acrylic.
8. Experimental verification of torsion formula for circular bar.
9. Verification of results of any two from experiments no 1-8 using any FEA software tools.
10. **Self-learning study practical**: *Following topics are distributed among the group of 3-5 Students and groups need to present and also submit the slides/poster on TW file*.
    a. Experimental stress analysis, Strain Gauges rosette with case study.
    b. Residual stresses and Fatigue life with case study.
    c. Effect of heat treatment on the mechanical properties of a metal with case study.
    d. Mechanical properties of materials, Stresses and Design of components with case study.
    e. Failure Mode Analysis and Stresses with case study.

202042 - Solid Modeling and Drafting		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Practical : 50 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Graphics, Engineering Mathematics - I and II

Course Objectives

1. To understand basic structure of CAD systems and their use to create geometric models of simple engineering parts
2. To introduce the curves and surfaces and their implement in geometric modeling
3. To apply basic concepts of 3D modeling, viewing and evaluate mass properties of components and assemblies
4. To apply geometrical transformations in CAD models
5. To understand data exchange standards and translators for various applications
6. To create engineering drawings, design documentation and use in manufacturing activities

Course Outcomes

On completion of the course, learner will be able to

CO1. UNDERSTAND basic concepts of CAD system, need and scope in Product Lifecycle Management

CO2. UTILIZE knowledge of curves and surfacing features and methods to create complex solid geometry

CO3. CONSTRUCT solid models, assemblies using various modeling techniques & PERFORM mass property analysis, including creating and using a coordinate system

CO4. APPLY geometric transformations to simple 2D geometries

CO5. USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.

CO6. USE PMI & MBD approach for communication

Course Contents

Unit I — Fundamentals of 3D Modeling — [08 Hr.]

Introduction, Product Life Cycle, CAD tools in the design process of Product Cycle, Scope of CAD, Software Modules - Operating System (OS) module, Geometric module, application module, programming module, communication module, Computer Aided Design - Features, requirements and applications

3D Modeling approach - Primitive, Features and Sketching, Types of Geometric models - 2½ extrusions, axisymmetric, composite, 3D objects, difference between wireframe, surface & solid modeling, Modeling strategies

Model viewing: VRML web-based viewing

Unit II — Curves & Surfaces — [08 Hr.]

Curves: Methods of defining Point, Line and Circle, Curve representation - Cartesian and Parametric space, Analytical and Synthetic curves, Parametric equation of line, circle, ellipse, Continuity (C^0, C^1 & C^2), Synthetic Curves - Hermit Cubic Spline, Bezier, B-Spline Curve, Non-Uniform Rational B-Spline curves (NURBS)

Surfaces: Surface representation, Types of Surfaces, Bezier, B-Spline, NURBS Surface, Coons patch surface, Surface Modeling

Reverse Engineering: Introduction, Point Cloud Data (PCD), PCD file formats, Quality issues in PCD, Requirements for conversion of surface models into solid models, Applications of PCD

Unit III — Solid Modeling — [08 Hr.]

Introduction, Geometry and Topology, Solid entities, Solid representation, Fundamentals of Solid modeling, Half spaces, Boundary representation (B-Rep), Constructive Solid Geometry (CSG), Sweep representation, Analytical solid modeling, Parametric solid modeling, feature based modeling, etc., Euler Equation (Validity of 3D solids), Mass Property Calculations

Introduction to Assembly Modeling, Assemblies (Top-down and Bottom-up approach), Design for Manufacturing [DFM], Design for Easy Assembly & Disassembly [DFA], Design for Safety

Unit IV **Geometric Transformation** **[08 Hr.]**

Introduction, Geometric Transformations, Translation, Scaling, Rotation, Reflection/Mirror, Shear, Homogeneous Transformation, Inverse Transformation, Concatenated Transformation (limited to 2D objects with maximum 3 points only), Coordinate systems - Model (MCS), Working (WCS), Screen (SCS) coordinate system, Mapping of coordinate systems

Projections of geometric models - Orthographic and Perspective projections, Design and Engineering applications

Unit V **CAD Data Exchange** **[08 Hr.]**

Introduction, CAD Kernels, CAD Data File, Data interoperability, CAD Data Conversions, challenges in CAD data conversions/remedies, Direct Data Translators, Neutral 3D CAD file formats (DXF, IGES, PDES, STEP, ACIS, Parasolid, STL, etc.), Data Quality

Requirements of CAD file format for 3D Printing (Additive Manufacturing), CAE, FEA, CFD, CAM (Subtractive Manufacturing), Multi-Body Dynamics (Motion Simulations), Computer Aided Inspection (CAI), Computer Aided Technologies (CAx), AR/VR applications, etc., Introduction to CAD Geometry Clean-up for different applications

Unit VI **CAD Customization & Automation** **[08 Hr.]**

Introduction, Limitations of 2D drawings, Introduction to Product and Manufacturing Information (PMI), Model Based Definitions (MBD), Applications of PMI & MBD

CAD Customization: Introduction, advantages and disadvantages, Applications of Customization Interfaces, Product Customization Approaches - Part Modeling Customization, Assembly Modeling Customization, Drawing sheets & PMI Customization, CAD Automation

Introduction to Application Programming Interface (API), Structures of APIs, Coding/Scripting for customization, Introduction to CAD API Development, CAD Files & application handling

Books & Other Resources

Text Books

1. Zeid, I and Sivasubramania, R., (2009), “CAD/CAM : Theory and Practice”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070151345
2. Rao, P. N., (2017), “CAD/CAM: Principles and Applications”, 3rd edition, McGraw Hill Education, ISBN-13: 978-0070681934
3. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design", Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Lee, Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley, ISBN-13: 978-0201380361
2. Bordegoni, Monica and Rizzi, Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer, ISBN-13: 978-1447161875
3. Vukašinovic, Nikola and Duhovnik, Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer, ISBN-13: 978-3030023980
4. Um, Dugan, (2018), "Solid Modeling and Applications: Rapid Prototyping, CAD and CAE Theory", 2nd edition, Springer, ISBN-13: 978-3319745930
5. Rogers, D. and Adams, J. A., (2017), “Mathematical Elements for Computer Graphics”, 2nd edition, McGraw Hill Education, ISBN-13: 978-0070486775
6. Hearn, D. D. and Baker, M. P., (2013), "Computer Graphics with OpenGL", 4th edition, Pearson Education India, ISBN-13: 978-9332518711
7. Gokhale, N. S., Deshpande, S. S., Bedekar, S. V. and Thite, A. N., (2008), “Practical Finite Element Analysis”, Finite to Infinite, Pune, India, ISBN-13: 978-8190619509
8. Lee Ambrosius, (2015), “AutoCAD® Platform Customization: User Interface, AutoLISP®, VBA, and Beyond”, John Wiley & Sons, Inc., IN, ISBN-13: 978-1118798904

9. Bucalo, Joe and Bucalo, Neil, (2007), “Customizing SolidWorks for Greater Productivity”, Sheet Metal Guy, LLC, ISBN-13: 978-0979566608
10. Ziethen, Dieter R. (2012), “CATIA V5: Macro Programming with Visual Basic Script”, McGraw-Hill Companies, Inc./Carl Hanser Verlag München, ISBN-13: 978-0071800020, ISBN: 978-007180003-7
11. Programming Manuals of Softwares

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Practical

The student shall complete the following Practical in laboratory using suitable CAD modeling software. Learner will demonstrate skills to communicate drawings as per industry standards.

1. 2-D sketching with geometrical and dimensional constraints
2. Solid & Surface modeling for simple mechanical components (Output file as Production drawing and Model Based Definition (MBD)
   - (a) Sheet-Metal
   - (b) Machining
   - (c) Fabrication
   - (d) Casting
   - (e) Forgings
   - (f) Plastic Molding
3. Assembly modeling (Output file as Assembly drawing and detailing) of the parts modeled in Practical assignment-2 using proper assembly constraint conditions and generation of exploded view for assemblies like Couplings, Clutches, Gear Assemblies, Engine/Pump/Turbine Components, Valves, Machine Tools, Automobile Components, Gear-Box, Pressure Vessels, etc.
4. Reverse Engineering of surface/solid modeling using Point Cloud Data.
5. Assembly Modeling by importing parts/components from free online resources like CAD and Product development software websites, forums, blogs, etc.
6. Demonstration on CAD Customization (with introduction to programming languages, interfacing)

202043 - Engineering Thermodynamics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry

Course Objectives

1. To introduce the fundamentals of thermodynamics.
2. To understand the concepts of laws of thermodynamics.
3. To apply the concepts of thermodynamics towards open and closed systems.
4. To be acquainted with Entropy generation and Exergy Analysis.
5. To understand the behaviour of a Pure substance and to analyze Vapour power cycles.
6. To undertake the performance analysis of a steam generator.

Course Outcomes

On completion of the course, learner will be able to

CO1. DESCRIBE the basics of thermodynamics with heat and work interactions.

CO2. APPLY laws of thermodynamics to steady flow and non-flow processes.

CO3. APPLY entropy, available and non available energy for an Open and Closed System,

CO4. DETERMINE the properties of steam and their effect on performance of vapour power cycle.

CO5. ANALYSE the fuel combustion process and products of combustion.

CO6. SELECT various instrumentations required for safe and efficient operation of steam generator.

Course Contents

Unit I — Fundamentals of Thermodynamics — [07 Hr.]

Introduction, Review of basic definitions, Zeroth law of Thermodynamics, Macro and Microscopic Approach, State Postulate, State, Path, Process and Cycles, Point function and Path function, quasi static process, Equilibrium, **Temperature** (concepts, scales, international fixed points and measurement of temperature), Constant volume gas thermometer and constant pressure gas thermometer, mercury in glass thermometer.

First Law of Thermodynamics: Concept of heat and work, Sign convention and its conversion. First law of thermodynamics, Joules experiments, Equivalence of heat and work. Application of first law to flow and non-flow Processes and Cycles. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Compressors, Boilers etc. PMM-I kind.

Unit II — Ideal Gas and Second law of Thermodynamics — [08 Hr.]

Properties and Processes of Ideal Gas: Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes (Open and Closed systems), Calculations of Heat transfer, Work done, Internal Energy.

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Thermal reservoir, Heat Engine, Refrigerator and Heat pump: Schematic representation, Efficiency and Coefficient of Performance (COP), Kelvin-Planck & Clausius Statement of the Second law of Thermodynamics; PMM-II kind, Equivalence of the two statements; Clausius Inequality, Concept of Reversibility and Irreversibility, Carnot Theorem/Principles, Carnot Cycle.

Unit III — Entropy and Availability — [08 Hr.]

Entropy: Entropy as a property, Clausius Inequality, Principle of increase of Entropy Principle, Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas and Pure Substance, Concept of Entropy generation. Entropy - a measure of Disorder.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems.

Unit IV Properties of Pure substances & Thermodynamics of Vapour Cycle [07 Hr.]

Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow Vapour Processes, Change of Properties, Work and Heat transfer.

Thermodynamics of Vapour Cycle: Rankine Cycle, Comparison of Carnot cycle and Rankine cycle, Introduction to Steam power Plant, Efficiency of Rankine Cycle, Relative Efficiency, Effect of Varying operating parameters like Superheat, Boiler and Condenser Pressure on performance of Rankine cycle, Modified Rankine Cycle.

Unit V Fuels and Combustion [07 Hr.]

Types of fuels, Proximate and ultimate analysis of fuel, Combustion theory, Combustion Equations, Theoretical and Excess air requirements, Equivalence ratio, Analysis of products of combustion, Calorific value - HCV & LCV. Bomb and Boys gas Calorimeters. Flue Gas Analysis using Orsat Apparatus, Exhaust Gas analyser, Enthalpy of formation, Adiabatic flame temperature.

Unit VI Steam Generators & Boiler Draught [08 Hr.]

Steam Generators: Classification, Constructional details of low pressure boilers, Primary Features of high pressure (Power) boilers, Location, Construction and working principle of boiler, Boiler mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to IBR Act, Boiler performance Calculations-Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.

Boiler Draught: Classification, Necessity of Draught, Natural draught, Determination of Height of chimney, Diameter of chimney, condition for maximum discharge, Forced draught, Induced draught, Balanced draught, Draught losses.

Books & Other Resources

Text Books

1. P. K. Nag, “Engineering Thermodynamics”, Tata McGraw Hill Publications
2. R. K. Rajput, “Engineering Thermodynamics”, EVSS Thermo, Laxmi Publications
3. P. L Ballaney, “Thermal Engineering”, Khanna Publishers
4. C.P. Arora, “Thermodynamics”, Tata McGraw Hill
5. Domkundwar, Kothandaraman and Domkundwar,“Thermal Engineering”,Dhanpat Rai Publishers
6. M M Rathore, “Thermal Engineering”, Tata McGraw-Hill

Reference Books

1. Rayner Joel, “Basic Engineering Thermodynamics”, AWL-Addison Wesley
2. Cengel and Boles, “Thermodynamics an Engineering Approach”, McGraw Hill
3. G.VanWylen, R.Sonntag and C.Borgnakke, “Fundamentals of Classical Thermodynamics”, John Wiley & Sons
4. Holman J.P, “Thermodynamics”, McGraw Hill
5. M Achuthan, “Engineering Thermodynamics”, PHI
6. Steam Tables/Data book

Guidelines for Laboratory Conduction

The student shall complete the following activity as Term Work

The Term work shall consist of successful completion of Practicals, and Industrial Visits. Oral Examination shall be based on the term work.

Practical

1. Joule’s experiment to validate, first law of thermodynamics.
2. Survey of temperature sensors used in various thermal systems.
3. Determination of dryness fraction of steam using combined separating and throttling calorimeter.
4. Determination of HCV of solid or gaseous fuel using Bomb or Junker’s calorimeter respectively.

5. Demonstration on Orsat Apparatus.
6. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
7. Thermodynamic Analysis of any System / Model by using any Computer Software.
8. Energy and Exergy analysis of contemporary steam generator.

Industrial Visits

Visit to any Process Industry/Plant having Boiler equipped with Accessories.

The visit report consists of

- Details about the Industry/Process Plant.
- Operational description of the Equipment with specification, its use, capacity, application etc.

202044 - Engineering Materials and Metallurgy

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Higher Secondary Science courses, Engineering Physics, Engineering Chemistry, Systems in Mechanical Engineering

Course Objectives

1. To impart fundamental knowledge of material science and engineering.
2. To establish significance of structure property relationship.
3. To explain various characterization techniques.
4. To indicate the importance of heat treatment on structure and properties of materials.
5. To explain the material selection process.

Course Outcomes

On completion of the course, learner will be able to

CO1. COMPARE crystal structures and ASSESS different lattice parameters.

CO2. CORRELATE crystal structures and imperfections in crystals with mechanical behaviour of materials.

CO3. DIFFERENTIATE and DETERMINE mechanical properties using destructive and non-destructive testing of materials.

CO4. IDENTIFY & ESTIMATE different parameters of the system viz., phases, variables, component, grains, grain boundary, and degree of freedom. etc.

CO5. ANALYSE effect of alloying element & heat treatment on properties of ferrous & nonferrous alloy.

CO6. SELECT appropriate materials for various applications.

Course Contents

Unit I — Crystal Structures and Deformation of Materials — [08 Hr.]

Crystal Structures: Study of Crystal structures BCC, FCC, HCP and lattice parameters & properties, Miller indices, Crystal imperfections, and Diffusion Mechanisms

Material Properties: Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic properties

Deformation of Materials: Elastic deformation, Plastic deformation: slip, twinning, work hardening, baushinger effect, recovery, re-crystallization and grain growth, Fracture: Types of fractures (brittle, ductile), Creep & Fatigue failures

Unit II — Material Testing and Characterization Techniques — [06 Hr.]

Destructive Testing: Impact test, Cupping test and Hardness test

Non-Destructive Testing: Eddy current test, Sonic & Ultrasonic testing, X-ray Radiography testing (Principle and Applications only)

Microscopic Techniques: Sample Preparation and etching procedure, optical microscopy, Electronic microscopy - only SEM, TEM and X-ray diffraction (Principle and Applications only)

Macroscopy: Sulphur printing, flow line observation, spark test

Unit III — Phase Diagrams and Iron-Carbon Diagram — [09 Hr.]

Solid solutions: Introduction, Types, Humerothery rule for substitutional solid solutions

Solidification: Nucleation & crystal growth, solidification of pure metals, solidification of alloys.

Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules

Iron-Carbon Diagram: Iron-carbon equilibrium diagrams in detail with emphasis in the invariant reactions

Unit IV	Heat Treatments	[08 Hr.]

Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling transformation diagrams. Retained austenite and its effect

Steps in Heat treatment and Cooling Medium

Heat Treatment Processes: Introduction, Annealing (Full annealing, Process annealing, Spheroidise annealing, isothermal annealing, stress relief annealing), Normalising, Hardening, Tempering, Austempering, Martempering, Sub-Zero Treatment, Hardenability

Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding, Carbonitriding

Unit V	Ferrous Materials	[07 Hr.]

Carbon Steel: Classification, types & their composition, properties and Industrial application

Alloy Steels: Classification of alloy steels & Effect of alloying elements, examples of alloy steels, (Stainless steel, Tool steel) sensitization of stainless steel

Designation of carbon steel and alloy steels as per IS, AISI, SAE Standards

Cast Iron: Classification, types & their composition, properties and Industrial application of (White CI, Gray CI, SG CI, Malleable Cast and alloy Cast Iron)

Microstructure and property relationship of various ferrous Materials

Unit VI	Non-Ferrous Materials	[07 Hr.]

Classification of Non-Ferrous Metals: Study of Non-ferrous alloys with Designation, Composition, Microstructure

Mechanical & other properties for Industrial Applications: Copper and its Alloys (Gilding Metal, Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze), Aluminium and its Alloy (LM5, Duralumin, Y-Alloy, Hinduminum), Nickel and its Alloys (Invar, Inconel), Titanium and its Alloys (α Alloys, α-β Alloys), Cobalt and its Alloys (Stellite Alloys, Alnico), Bearing Alloys (Classification, lead based alloys, tin based alloys), Age Hardening

Microstructure and Property relationship of various Non-ferrous Materials

Recent Material used in Additive Manufacturing: Properties, Composition and Application only

Books & Other Resources

Text Books

1. Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication.
2. William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley & Sons, Inc.

Reference Books

1. A. K. Bhargava, C.P. Sharma, "Mechanical Behaviour & Testing of Materials", P H I Learning Private Ltd.
2. Raghvan V., "Material Science & Engineering",Prentice Hall of India, New Delhi. 2003
3. Avner, S.H., "Introduction to Physical Metallurgy", Tata McGraw-Hill, 1997.
4. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd.
5. George Ellwood Dieter, "Mechanical Metallurgy", McGraw-Hill 1988
6. Smith, W.F, Hashemi, J., and Prakash, R., "Materials Science and Engineering in SI Units", Tata McGraw Hill Education Pvt. Ltd.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments, and Industrial Visits.

Practical *(Any Seven)*

1. Destructive testing - Hardness testing (Rockwell/Vickers) Hardness conversion number
2. Brinell and Poldi hardness Test

3. Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)
4. Non Destructive testing - Dye Penetrant Test/ Magnetic Particle test/ Ultrasonic Test
5. Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope
6. Observation and Drawing of Microstructure of Steels, Cast Iron of various compositions
7. Observation and Drawing of Microstructure of Non Ferrous Metals of various compositions
8. Heat Treatment of steels based on relative hardness
9. Jominy End Quench Test for hardenability

Miniature commitment or Assignments *(Any Two)*

1. Exploration of engineering Alloy (Name, composition, properties, microstructure, Heat treatment, Designation & specific applications)- One student one Alloy or material
2. Examine aspects of component form material and manufacturing process point of view (Name, Material, Drawing, Manufacturing Process, properties, microstructure, Heat treatment, & specific applications) - For example spur gear, Needle etc. One student one component
3. Creep and Fatigue Test (Virtual Lab IIT Bombay)
4. Fluorescence Microscope (Virtual Lab IIT Bombay)

Industrial Visits

To provide awareness and understanding of the course, Compulsory Industrial Visit must be arranged for the students.

The Industrial Visit must be preferably to

- Material & Metallurgy related like Engineering Cluster, NDT Lab, and Nearby NABL lab or
- Any manufacturing unit with material orientation

Student must submit a properly documented Industrial Visit Report.

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment
2. Apparatus with their detailed specifications
3. Standard ASME/ IS numbers of test procedure
4. Schematic, Layout/diagram
5. Observation table/graphs.
6. Sample calculations for one/two reading
7. Result table, Graph and Conclusions.
8. 3/4 questions related to the experiment
9. Relevance of practical in industry with recent software of image analysis

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment:

1. Theory related to the experiment
2. Apparatus with their detailed specifications
3. Schematic, Layout/diagram
4. Observation table/simulation plots/graphs
5. Sample calculations for one/two reading
6. Result table. Graph and Conclusions
7. 3/4 questions related to the experiment
8. Attach Photo of experiment or image related to Experiment

Guidelines for Lab/TW Assessment

1. There should be continuous assessment for the TW
2. Assessment must be based on understanding of theory, attentiveness during practical, and understanding
3. Session, how efficiently the student is able to do connections and get the results
4. Online evolutions of practical with objective type of Questions
5. Timely submission of journal

203156 - Electrical and Electronics Engineering		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Basic Electrical Engineering, Basic Electronics Engineering, Systems in Mechanical Engineering

Course Objectives

1. To understand Arduino IDE; an open source platform and its basic programming features
2. To interface Atmega328 based Arduino board with different devices and sensors
3. To study principle of operation of DC machines and speed control of DC motors
4. To know about three phase induction motor working and its applications
5. To get acquainted with Electric Vehicle (EV) technology and subsystems
6. To get familiar with various energy storage devices and electrical drives

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY programming concepts to UNDERSTAND role of Microprocessor and Microcontroller in embedded systems

CO2. DEVELOP interfacing of different types of sensors and other hardware devices with Atmega328 based Arduino Board

CO3. UNDERSTAND the operation of DC motor, its speed control methods and braking

CO4. DISTINGUISH between types of three phase induction motor and its characteristic features

CO5. EXPLAIN about emerging technology of Electric Vehicle (EV) and its modular subsystems

CO6. CHOOSE energy storage devices and electrical drives for EVs

Course Contents

Unit I — Introduction to Arduino — [08 Hr.]

Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Introduction to Arduino IDE- features, IDE overview, Programming concepts: variables, functions, conditional statements, Concept of GPIO in Atmega328 based Arduino board, digital input and output

Unit II — Peripheral Interface — [07 Hr.]

Interfacing of Atmega328 based Arduino board with LED and LCD/serial monitor, serial communication using Arduino IDE, Concept of ADC in Atmega328 based Arduino board, interfacing of Atmega328 based Arduino board with temperature sensor (LM35), LVDT, strain gauge

Unit III — DC Machines — [08 Hr.]

Generating and motoring action, Constructional features of a DC machine, EMF equation of DC machine and its significance in motor

Concept of torque developed by motor and it's equation, Concept of load torque, Types of loads and dynamics of motor and load combination, Characteristics of DC shunt motor, Speed control methods of DC shunt motor, Reversal of direction of rotation of DC motor, Braking in DC motor and its types, Regenerative braking in DC shunt motor

Unit IV — Three Phase Induction Motors — [07 Hr.]

Constructional features, working principle of three phase induction motor, types, torque equation, torque-slip characteristics, effect of rotor resistance on characteristics, modification in squirrel cage motor with deep bar rotor construction

Power stages, efficiency, starters (DOL starter and Star Delta starter), Methods of speed control- voltage and frequency control, variable frequency drive, applications

Unit V	Electric Vehicle (EV) Technology	[08 Hr.]

Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV

Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison, Challenges faced by EV technology

Subsystems and configurations of EV, Subsystems of Hybrid EV, Configurations of series, parallel and series-parallel Hybrid EV

Impact of EV on grid, Vehicle to grid technology- block diagram

Unit VI	Energy Storage Devices and Electric Drives	[07 Hr.]

Storage Devices: Cell construction and working of batteries like Lithium- Iron Phosphate (LFP), Lithium Nickel-Manganese-Cobalt (NMC) and Lithium- Manganese Oxide (LMO), Voltage, Impedance, Ah and Wh Capacity, Cycle Life, Energy density, Power, C-rate and safety aspects

Use of supercapacitor and hydrogen fuel cell in EVs- necessity, advantages and specifications

Factors used in selection of energy storage device in case of EVs, Vehicle Battery Management System - block diagram

Electric Drives: Factors used for selection of the electric motor in EVs

BLDC hub motor drive for EVs, characteristics and speed control of BLDC motor, three phase induction motor drive for EVs

Books & Other Resources

Text Books

1. Barret Steven F, “Arduino Microcontroller Processing for Everyone!”, 3rd Ed, Morgan and Claypool Publishers
2. Michael Margolis, “Arduino Cookbook”, 2nd Ed, O'Reilly Media
3. Hughes Edward, “Electrical and Electronic Technology”, Pearson Education
4. Ashfaq Husain, “Electric Machines”, 3rd Ed, Dhanpat Rai & Sons
5. Bhattacharya S. K., “Electrical Machine”, 3rd Ed, Tata McGraw Hill
6. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill
7. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press
8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, 2nd Ed, CRC Press

Reference Books

1. Deshmukh Ajay, “Microcontrollers Theory and Applications”, Tata McGraw Hill
2. Massimo Banzi, “Getting Started with Arduino”, 2nd Ed, Maker Media, Inc.
3. Brad Kendall, “Getting Started With Arduino: A Beginner's Guide”, Justin Pot and Angela Alcorn (Editors)
4. Lowe, “Electrical Machines”, Nelson Publications
5. [A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, “Electrical Machines”, 5th Ed, Tata McGraw Hill
6. Pillai S. K., “A First Course on Electrical Drives”, New Age International (P) Ltd.
7. James Larminie, John Lowry, , “Electric Vehicle Technology Explained”, Wiley
8. Dhameja Sandeep, “Electric Vehicle Battery Systems”, Newnes
9. R. Krishnan,“Permanent Magnet Synchronous and Brushless DC Motor Drives”, CRC Press

Web References

1. www.arduino.cc *(for downloading Arduino IDE and information)*
2. www.alldatasheet.com *(for datasheets of components)*
3. https://spoken-tutorial.org/tutorial-search/ *(for video tutorials on Arduino)*
4. https://swayam.gov.in/NPTEL *(for e-learning courses and video lectures)*

Guidelines for Laboratory Conduction
The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Virtual Laboratory & Detailed Industrial Visit Report and Group Assignment using Case Study/Product Survey.

Practical - Electronics Engineering Laboratory *(Any four experiments to be performed)*

Atmega328 based Arduino board can be used for following interfaces:

1. Interfacing of LED to blink after every 1 sec
2. Display data using serial communication with PC
3. Interfacing of LCD to display given message
4. Interfacing of temperature sensor (LM35) and display output on LCD/serial monitor
5. Interfacing of strain gauge sensor to measure parameters like pressure, weight, etc., and display the measured value
6. Interfacing of LVDT sensor to measure the displacement and display the measured value

Practical - Electrical Engineering Laboratory *(Any four experiments to be performed)*

7. Demonstration of use of starters for DC motor and three phase induction motor along with understanding of specifications on name plates of these machines
8. Brake test on DC shunt motor
9. Study of power electronic converter based DC motor drive
10. Study of electrical braking of DC shunt motor (Rheostatic/ Plugging/regenerative)
11. Load test on three phase induction motor
12. Torque- speed characteristics of three phase induction motor

Assignments using Virtual Laboratory

Virtual Labs project is an initiative of the Ministry of Human Resource Development (MHRD), Government of India under the aegis of National Mission on Education through Information and Communication Technology (NMEICT). Please visit the following link for exploring experiments on Electrical Machines: http://www.vlab.co.in/broad-area-electrical-engineering

Assign following experiments by applying Virtual Labs:

1. Speed control of DC shunt motor by armature and field resistance control
2. Speed control of slip ring induction motor by rotor resistance control

Please refer http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html

Assignments using Case Study/Product Survey

Each group consisting of maximum five number of students should carry out a case study/product survey focused on various EVs available in Indian market. *Forming groups and allotment of specific task to the students group should be done at the beginning of semester so that students get sufficient time to carry out the survey and prepare a presentation.*

Students must

- Compare various models in each class.
- Study various main components of EVs
- A formal presentation on case study/product survey must be arranged before class/batch.

Industrial Visits

An industrial visit must be arranged to one of the following establishments during the semester.

The Industrial Visit must be preferably to

- Automation/Manufacturing industries
- Battery/EV Charging Stations
- Retro-fitting Workshops of ICE vehicle to EVs
- EV Service Stations

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Instructions for Laboratory Conduction

Electronics Engineering Laboratory

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.

2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them different experiments.
3. Each student in the group is supposed to execute the program.
4. The faculty should check the result of all the groups.

Electrical Engineering Laboratory

1. Check whether the MCB / ELCB / main switch is off while preparing the set-up.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For the rest of the connections, use thick wires. Do not keep the connections loose. Get it checked by the faculty / Lab Assistant.
3. Perform the experiment only in presence of faculty or Lab Assistant.
4. Do the calculations and get these checked from the faculty.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked regularly after conducting

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment:

1. Brief theory related to the experiment.
2. Connection diagram /circuit diagram
3. Observation table
4. Sample calculations for one reading
5. Result table
6. Graph and Conclusions.
7. Data sheets of the ICs used(if any)

Guidelines for Student's Lab Journal

Electronics Engineering Laboratory

1. Title of the program should be mentioned
2. The algorithm of the program must be written
3. Flow Chart for each program has to be drawn on separate page
4. Input data has to be specified
5. Result of the program should be highlighted

Electrical Engineering Laboratory

1. Lab journal should be hand written
2. Circuit diagrams can be drawn on graph paper
3. Specifications of the instruments/machines used for conduction of practical should be mentioned in respective write-up
4. Conclusion of each experiment should be written by student at the end

Guidelines for Lab/TW/PR Assessment

1. Continuous assessment should be carried out time to time.
2. During assessment, faculty should put the remark by writing the word "Complete" and not simply "C". Put the signature along with the date at the end of experiment and also in the index.
3. Assess each laboratory experiment/virtual lab assignment/report of industrial visit/case study for 10 marks each as per following details:
   Attendance in practical - 02 marks
   Timely completion of journal -03 marks
   Presentation of write-up and results - 02 marks
   Depth of understanding - 03 marks
4. Maintain a continuous assessment sheet on the basis of which final TW marks can be offered.

202045 - Geometric Dimensioning and Tolerancing Lab

Teaching Scheme	Credits	Examination Scheme
Practical : 02 Hr./Week	**01** Practical : 01	Term Work : 25 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Project Based Learning - I, Workshop Practise, Engineering Graphics

Course Objectives

1. To understand requirements of industrial drawings
2. To read, understand and explain basic Geometric Dimensioning & Tolerancing concepts
3. To apply various geometric and dimension tolerances based on type of fit
4. To include surface roughness symbols based on manufacturing process
5. To measure and verify position tolerances with applied material conditions
6. To understand requirements for manufacturing and assembly

Course Outcomes

On completion of the course, learner will be able to

CO1. SELECT appropriate IS and ASME standards for drawing

CO2. READ & ANALYSE variety of industrial drawings

CO3. APPLY geometric and dimensional tolerance, surface finish symbols in drawing

CO4. EVALUATE dimensional tolerance based on type of fit, etc.

CO5. SELECT an appropriate manufacturing process using DFM, DFA, etc.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work Journal

Total 9 Practical Assignments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Industrial Visit Report and Group Assignment.

Practical *(Assignment # 1 to 6 & 10 are compulsory; Select any Two from Assignment # 7 to 9)*
The student shall complete the following Practical in laboratory. Learner will demonstrate skills to communicate drawings as per industry standards:

1. Study of drawing sheet layout, Principles of Drawing and various IS Standards & Conventions in Machine Drawing, Dimensioning practices - Terminology & Basic Rules, Styles, Conventions [02 Hr.]
2. GD&T -
   (a) Terminology, Maximum and Minimum Material conditions, Features, Rules for GD&T, Datum Control [02 Hr.]
   (b) Adding GD&T to a Design, Form Tolerances [02 Hr.]
   (c) Orientation Tolerances, Profile Tolerances [02 Hr.]
   (d) Location Tolerances, Run out Tolerances [02 Hr.]
3. Surface finish, Welding symbols [02 Hr.]
4. Study and reading of Industrial Drawings to understand standard industrial practices viz. Dimensioning, GD&T, Surface finish, welding symbols, etc. [04 Hr.]
   (a) Machine Drawing, (b) Production Drawing, (c) Part Drawing,
   (d) Assembly Drawing - (i) Assembly Drawing for Design, (ii) Assembly Drawing for Instruction Manuals, (iii) Exploded Assembly Drawing, (iv) Schematic Assembly Drawing, (v) Patent Drawing, etc.
5. Calculation of Tolerances based on Type of Fits in Assembly [02 Hr.]
6. Tolerance Stacks-Up with suitable examples [02 Hr.]
7. Design for Manufacturing (DFM) with suitable examples [02 Hr.]
8. Design for Assembly and Dis-assembly with suitable examples [02 Hr.]
9. Design for Safety with suitable examples [02 Hr.]
10. Industrial visit / Case study

Books & Other Resources
Text Books 1. Standards: ASME Y14.5 – 2018 2. Narayana, K. L., Kannaiah, P., Venkata Reddy, K., (2016), "Machine Drawing", 2nd edition, New Age International Publishers, New Delhi, India, ISBN-13: 978-8122440546 3. Bhatt, N. D. and Panchal, V. M., (2014), "Machine Drawing", Charotar Publishing House Pvt. Ltd, Anand, India, ISBN-13: 978-9385039232
Reference Books 1. Cogorno, G. R., (2020), "Geometric Dimensioning and Tolerancing for Mechanical Design", 3rd edition, McGraw-Hill Education 2. Blokdyk, Gerardus, (2019), "Geometric Dimensioning and Tolerancing: A Complete Guide - 2020 Edition", 5STARCooks 3. Standards: ISO/TR 23605:2018, ISO 1101:2017, SP 46, IS 15054(2001)

202046 - Audit Course - III

Teaching Scheme	Credits	Examination Scheme
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GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course III

- Technical English For Engineers
- Entrepreneurship Development
- Developing soft skills and personality
- Design Thinking
- Foreign Language (preferably German/ Japanese)
- Science, Technology and Society

\# The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

207002 - Engineering Mathematics - III

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Tutorial : 01Hr/Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 25 Marks

Prerequisite Courses

Differential & Integral calculus, Differential equations of first order & first degree, Fourier series, Collection, classification and representation of data and Vector algebra.

Course Objectives

1. To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Laplace transform & Fourier transform, Statistical methods, Probability theory and Vector calculus.
2. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes

On completion of the course, learner will be able to

CO1. SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.

CO2. APPLY Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.

CO3. APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.

CO4. PERFORM Vector differentiation & integration, analyze the vector fields and APPLY to fluid flow problems.

CO5. SOLVE Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents

Unit I — Linear Differential Equations (LDE) and Applications — [08 Hr.]

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modelling of Mass-spring systems, Free &Forced damped and undamped systems.

Unit II — Transforms — [08 Hr.]

Laplace Transform **(LT):** LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform **(FT):** Fourier integral theorem, Fourier transform, Fourier sine & cosine transforms, Inverse Fourier Transforms.

Unit III — Statistics — [07 Hr.]

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.

Unit IV — Probability and Probability Distributions — [07 Hr.]

Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis: Chi-Square test, t-test.

UnitV — Vector Calculus — [08 Hr.]

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoidal & Irrotational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.

Unit VI	**Applications of Partial Differential Equations (PDE)**	**[08 Hr.]**

Basic concepts, modelling of Vibrating String, Solution of Wave equation, One and two dimensional Heat flow equations, Method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier transforms.

Books & Other Resources

Text Books

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics', 10e, by Wiley India.
2. M. D. Greenberg, "Advanced Engineering Mathematics", 2e, by Pearson Education.
3. Peter V. O'Neil , "Advanced Engineering Mathematics", 7e, by Cengage Learning
4. S. L. Ross, "Differential Equations", 3e by Wiley India.
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, by Elsevier Academic Press

Guidelines for Tutorial and term Work

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.The student shall complete the following activity as a Term Work Journal.

202047 - Kinematics of Machinery

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Systems in Mechanical Engineering, Engineering Mathematics - I and II, Engineering Physics, Engineering Mechanics, Geometric Modeling & Drafting

Course Objectives

1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
2. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
3. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
4. To develop the competency to understand & apply the principles of gear theory to design various applications.
5. To develop the competency to design a cam profile for various follower motions.

Course Outcomes

On completion of the course, learner will be able to

CO1. APPLY kinematic analysis to simple mechanisms

CO2. ANALYZE velocity and acceleration in mechanisms by vector and graphical method

CO3. SYNTHESIZE a four bar mechanism with analytical and graphical methods

CO4. APPLY fundamentals of gear theory as a prerequisite for gear design

CO5. CONSTRUCT cam profile for given follower motion

Course Contents

Unit I — Fundamentals of Mechanism — [07 Hr.]

Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom, Mobility of Mechanism, Inversion, Grashoff's law, Four-Bar Chain and its Inversions, Slider crank Chain and its Inversions, Double slider crank Chain and its Conversions, Mechanisms with Higher pairs, Equivalent Linkages and its Cases - Sliding Pairs in Place of Turning Pairs, Spring in Place of Turning Pairs, Cam Pair in Place of Turning Pairs

Unit II — Kinematic Analysis of Mechanisms: Analytical Method — [07 Hr.]

Analytical methods for displacement, velocity and acceleration analysis of slider crank Mechanism, Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Vector and Complex Algebra Methods. Computer-aided Kinematic Analysis of Mechanism like Slider crank and Four-Bar mechanism, Analysis of Single and Double Hook's joint

Unit III — Kinematic Analysis of Mechanisms: Graphical Method — [08 Hr.]

Displacement, velocity and acceleration analysis mechanisms by Relative Velocity Method (Mechanisms up to 6 Links), Instantaneous Centre of Velocity, Kennedy's Theorem, Angular Velocity ratio Theorem, Analysis of mechanism by ICR method (Mechanisms up to 6 Links), Coriolis component of Acceleration (Theoretical treatment only)

Unit IV — Synthesis of Mechanisms — [07 Hr.]

Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors

Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar and Single Slider Crank Mechanisms

Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's equation, Blotch synthesis

Unit V	Kinematics of Gears	[08 Hr.]

Gear: Classification

Spur Gear: Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis (theoretical treatment only)

Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears

Bevel Gear & Worm and Worm Wheel: Terminology, Geometrical Relationships

Gear Train: Types, Analysis of Epicyclic gear Trains, Holding torque - simple, compound and Epicyclic gear Trains, Torque on Sun and Planetary gear Train, compound Epicyclic gear Train

Unit VI	Mechanisms in Automation Systems	[08 Hr.]

Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon

Automation: Introductions, Types of Automation

Method of Work Part Transport: Continuous transfer, Intermittent or Synchronous Transfer, Asynchronous transfer, Different type of transfer mechanisms - Linear transfer mechanisms and Rotary transfer mechanisms

Automated Assembly-Line: Types, Assembly line balancing Buffer Storages, Automated assembly line for car manufacturing, Artificial intelligence in automation

Books & Other Resources

Text Books

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
3. G. Ambekar, "Mechanism and Machine Theory", PHI
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford

Reference Books

1. Paul E. Sandin, "Robot Mechanisms and Mechanical Devices Illustrated", Tata McGraw Hill Publication
2. Stephen J. Derby, "Design of Automatic Machinery", 2005, Marcel Dekker, New York
3. Neil Sclater, "Mechanisms and Mechanical Devices Sourcebook", Fifth Edition, Tata McGraw Hill Publication
4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
5. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication
6. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
7. Sadhu Singh, "Theory of Machines", Pearson
8. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
9. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI
10. M.P. Groover, "Automation, production systems and computer-integrated manufacturing", Prentice-Hall of India Pvt. Ltd, New Delhi

Web References

1. https://nptel.ac.in/courses/112104121/ (NPTEL1, Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur)
2. https://nptel.ac.in/courses/112/106/112106270/ (NPTEL2, Theory of Mechanism, Prof. Sujatha Srinivasan, IIT Madras)
3. https://nptel.ac.in/courses/112/105/112105268/ (NPTEL3, Kinematics of Mechanisms and Machines, Prof. Anirvan DasGupta, IIT Kharagpur)

4. https://nptel.ac.in/courses/112/105/112105236/ (NPTEL4, Mechanism and Robot Kinematics, Prof.Anirvan DasGupta, IIT Kharagpur)
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Mechanical/Robotics Course/Course_home_lect1.html (NPTEL5, Introduction to Robotics and Automation, IIT Bombay)

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. Term Work of the Student is evaluated based on the completion of Practical, Assignments using Drawing Aids, Assignments using Software & Programming Languages, Assignments using Virtual Laboratory and Detailed Industrial Visit Report.

Practical *(Experiment # 1 is compulsory and Select any Two from Experiment # 2 to 4)*

1. To make a model of any mechanism by using waste material by the group of 4 to 6 students and to give a presentation using PPTs.
2. Speed and torque analysis of epicyclic gear train to determine holding torque.
3. To study and verify cam jump phenomenon.
4. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.

Assignments using Drawing Aids *(Experiment #1 to 3 and 6 are compulsory and Select any One from Experiment #4-5)*

Do following graphical assignments on Half Imperial drawing sheet:

1. Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom. Submit the sheet and working video of the mechanism.
2. To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.
3. To solve two problems on velocity analysis using the ICR method.
4. To draw conjugate profile for any general type of gear tooth.
5. To study various types of gearboxes.
6. To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam.

Assignments using Software *(Any Three Assignments - Minimum one computer programming based and Minimum one based on use of software)*

Do following assignments by using Software or by using Coding/Programming Languages:

1. To design a simple Planer Mechanism by using any software (Geogebra, SAM, Working Model, any 3D Modelling Software, etc.)
2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Slider Crank Mechanism using Analytical Method
3. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke's joint Mechanism using Analytical Method
4. To generate a Cam Profile using any Modelling Software (Mech Analyser, any 3D Modelling Software)
5. To synthesize the Four-Bar and Slider Crank Mechanism (Geogebra, SAM, any 2D/3D Modelling Software)
6. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for the Synthesis of Mechanism using Chebychevs spacing, Freudensteins equation and function generation

Assignments using Virtual Laboratory *(minimum Two experiments)*

Please visit the links given below for exploring experiments on Kinematics of Machinery using Virtual Laboratory. Write a Brief Reports of using Virtual Laboratory to perform following assignment:

1. Mechanics-of-Machines Lab (All Experiments), http://mm-nitk.vlabs.ac.in/index.html
2. Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
3. Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

4. Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

Industrial Visits

A Compulsory industrial visit must be arranged to industries/ establishments consisting automation and mechanization during semester to provide awareness and understanding of the course.

The Industrial Visit must be preferably to

- Manufacturing industries with Assembly-line Automation
- Sugar factory
- Bottle filling plants

Student must submit properly documented Detailed Industrial Visit Report in his/her own words.

Assignments on Content beyond syllabus

Following assignments can be attempted:

1. Forward and Inverse Kinematics of 2R/2P/RP/PR Manipulators using Software (Geogebra, RoboAnalyser, Vlab, etc.)
2. Kinematic Analysis of 6 DOF Industrial Robot using Software (RoboAnalyzer, Vlab, etc.)

202048 - Applied Thermodynamics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Thermodynamics, Systems in Mechanical Engineering, Engineering Mathematics - I, Engineering Mathematics - II

Course Objectives

1. To determine COP of refrigeration cycle and study Psychrometric properties and processes.
2. To study working of engine, Actual, Fuel-Air and Air standard cycle and its Performance.
3. To understand Combustion in SI and CI engines and factors affecting performance parameters
4. To study emission from IC Engines and its controlling method, various emission norms.
5. To estimate performance parameters by conducting a test on I. C. Engines.
6. To determine performance parameters of Positive displacement compressor.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE COP of refrigeration system and ANALYZE psychrometric processes.
CO2. DISCUSS basics of engine terminology,air standard, fuel air and actual cycles.
CO3. IDENTIFY factors affecting the combustion performance of SI and CI engines.
CO4. DETERMINE performance parameters of IC Engines and emission control.
CO5. EXPLAIN working of various IC Engine systems and use of alternative fuels.
CO6. CALCULATE performance of single and multi stage reciprocating compressors and DISCUSS rotary positive displacement compressors

Course Contents

Unit I — Basics of Refrigeration and Psychrometry — [07 Hr.]

Refrigeration: Reversed Carnot Cycle, unit of refrigeration, Simple Vapour Compression Cycle (VCC), Refrigerating Effect, Compressor Power & COP. Simple Vapor Absorption Cycle (VAC), Comparison between VCC & VAC.

Psychrometry: Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.

Unit II — Introduction to Internal Combustion (IC) Engine — [06 Hr.]

IC Engine: Components and Construction details, Terminology, Classification, Applications, Intake and exhaust system, Valves actuating mechanisms, Valve timing diagram.

Fuel, Air and Actual Cycle: Air-standard cycles, fuel air cycles, and actual cycles, Effects of variables on performance, various losses, and Comparison of Air standard with Fuel and Actual cycle.

Unit III — SI and CI Engines — [09 Hr.]

SI Engines: Theory of Carburetion and Types of Carburetor, Working of Simple Carburetor, Electronic Fuel Injection System, Combustion stages in SI engines, Abnormal Combustion, Theory of Detonation and Parameters affecting detonations, Rating of fuels in SI engines, Combustion Chambers used in SI Engine.

CI Engines: Fuel Injection system, Construction and Working of Fuel Pump, Fuel Injector and Various types of Nozzle, Combustion stages in CI engines, Theory of knocking and Parameters affecting knocking, Rating of fuels in CI engines, Combustion Chambers used in CI Engines.

Unit IV — IC Engine Testing and Emission — [09 Hr.]

Engine Testing: Engine Testing Procedure, Measurement of indicated power, Brake power, fuel consumption, Air Consumption, Measurement of friction power by Willan's Line Method and Morse Test, calculation of mean effective pressure, various efficiencies, specific fuel consumption, heat balance sheet of IC Engines and performance Characteristic curves.

Emission & Control: Introduction to Indian Driving Cycle (IDC), European Driving Cycle (EDC), SI and CI Engines Emission and controlling methods, Methods to measure emission such as (Non Dispersive Infrared Red (NDIR), Flame Ionization Detector (FID), Chemiluminescent Analyzer, Smoke meter), Euro Norms and Bharat Stage Norms.

Unit V **Engine Systems and Alternative Fuels** **[07 Hr.]**

Cooling system: Air Cooling, Liquid cooling, **Lubrication system**: Objectives of lubrication system, properties of lubricant, Methods of lubrication system, **Ignition system**: battery coil ignition system, magneto ignition system, Electronics Ignition (CDI, TCI), Maximum Brake Torque (MBT) & spark advance. Supercharging and Turbo-charging.

Alternative Fuels: Bio-diesel, Ethanol, LPG, CNG and Hydrogen.

Unit VI **Compressor** **[07 Hr.]**

Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors.

Rotary Compressors: Roots blower, Vane type, Screw compressor and Scroll compressor.

Books & Other Resources

Text Books

1. Arora C. P., "Refrigeration and Air Conditioning", Tata McGraw-Hill
2. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill
3. M. L. Mathur and R.P. Sharma, "A course in Internal combustion engines", Dhanpat Rai & Co.
4. H.N. Gupta, "Fundamentals of Internal Combustion Engines", PHI Learning Pvt. Ltd.

Reference Books

1. Dossat Ray J, "Principles of refrigeration, S.I. version", Willey Eastern Ltd, 2000
2. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill
3. Domkundwar & Domkundwar, "Internal Combustion Engine", Dhanpat Rai & Co.
4. R. Yadav, "Internal Combustion Engine", Central Book Depot, Ahmedabad.
5. S.Domkundwar,C.P. Kothandaraman,A.Domkundwar,"Thermal Engineering",DhanpatRai & Co.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 of the following list must be performed. During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations and Detailed Industrial Visit Report.

Practical *(Minimum 6 Practical must be performed)*

1. Trial on Vapour Compression System
2. Trial on Vapour Absorption System
3. Trial on Air-Conditioning Test Rig.
4. Morse Test on Petrol engine.
5. Trial on Diesel engine.
6. Trial on Petrol engine.
7. Trial on variable compression ratio engine.
8. Trial on Positive Displacement Air Compressor.
9. Demonstration on Exhaust Gas Analyser and Smoke meter.

Survey *(Minimum one)*

1. Practical Survey of various fuel supply systems.
2. Practical Survey of supercharged and turbocharged engines.

Activity: *Presentation based*

Compulsory study of following topics must be done by students during semester to gain awareness and further understanding of the course and a presentation of the same should be included in the TW:

1. **Engines**:(any one) Homogeneous charge compression ignition (HCCI)/ Stratified charge

engine/Variable valve timing (VVT)/Variable geometry turbocharger (VGT), etc.

2. **Automotive Field**: (any one) Hydrogen CNG vehicles/Adaptive cruise control system/On-board diagnostic system (OBD) / Electric Battery classification/Fuel Cell vehicle/Rear driving emission (RDE) system

Industrial Visit

A Compulsory industrial visit must be arranged to automobile manufacturing or servicing.

Students must submit properly documented Detailed Industrial Visit Report in his/her own words.

202049 - Fluid Mechanics

Teaching Scheme	Credits	Examination Scheme
Theory : 03 Hr./Week Practical : 02 Hr./Week	**04** Theory : 03 Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Oral : 25 Marks

Prerequisite Courses

Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mechanics, Engineering Physics

Course Objectives

1. To understand basic properties of fluids.
2. To learn fluid statics and dynamics
3. To study basics of flow visualization
4. To understand Bernoulli's theorem and its applications.
5. To understand losses in flow, drag and lift forces
6. To learn to establish relation between flow parameters.

Course Outcomes

On completion of the course, learner will be able to

CO1. DETERMINE various properties of fluid

CO2. APPLY the laws of fluid statics and concepts of buoyancy

CO3. IDENTIFY types of fluid flow and terms associated in fluid kinematics

CO4. APPLY principles of fluid dynamics to laminar flow

CO5. ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface

CO6. CONSTRUCT mathematical correlation considering dimensionless parameters, also ABLE to predict the performance of prototype using model laws

Course Contents

Unit I — Properties of Fluid — [06 Hr.]

Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, measurement of viscosity, application based numerical on viscosity-flow through pipe, lubrication, bearing, brake fluids, parallel plates, rotating shafts etc., vapor pressure surface tension, capillarity, compressibility

Unit II — Fluid Statics — [07 Hr.]

Laws of fluid statics: forces acting on fluid element, pascal’s law, hydrostatics law, hydraulic ram Pressure measurement: pressure scale, piezometer, barometer, manometer - simple, inclined, differential, micro manometer, inverted

Forces acting on surfaces immersed in fluid: total pressure and center of pressure on submerged plane surfaces, curved surface submerged in liquid including numerical on dam gate

Buoyancy: flotation, stability of bodies

Unit III — Fluid Kinematics — [08 Hr.]

Flow description methods, types of flows, velocity and acceleration fields, continuity equation in 1D & 3D flow, flow visualization (path line, stream line and streak line), stream tube, angularity, vorticity, stream function and velocity potential function, flow net

Unit IV — Fluid Dynamics — [10 Hr.]

Euler’s equation of motion differential form and Navier Stokes equation, Euler’s equation of motion along streamline, Bernoulli’s theorem and modified Bernoulli’s theorem, stagnation pressure, HGL, TEL

Flow measurement: venturimeter, orifice meter, pitot tubes, static pitot tube, introduction to coriolis flow meter, introduction to orifices, notches & weirs

Laminar flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, fixed parallel plates and Couette flow, velocity profile of turbulent flow

Unit V	Internal & External Flow	[09 Hr.]

Internal Flow: Losses - major & minor losses, hydro dynamically smooth and rough boundaries, Moody's chart, compounding of pipes & equivalent pipe, siphons, transmission of power

External Flow: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation, drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body

Unit VI	Dimensional Analysis & Similitude	[08 Hr.]

Dimensional Analysis: Introduction, system of dimensions, Dimensional homogeneity, Buckingham-Pi Theorem, repeating variables, dimensionless numbers and their physical significance

Similitude & Model Testing: Model & prototype, similarity, scaling parameters , model laws, objectives , importance and application of model studies.

Books & Other Resources

Text Books

1. Sukumar Pati, "Fluid Mechanics and Hydraulics Machines", TATA McGraw Hill.
2. Munson, Young and Okiishi, "Fundamentals of Fluid Mechanics", Wiley India
3. Potter Wiggert, "Fluid Mechanics", Cengage Learning
4. Fox, Pichard, "Introduction to Fluid Mechanics", McDonald- Wiley
5. Modi P. N. and Seth S. M, "Hydraulics and Fluid Mechanics",Standard Book House.
6. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
7. F. M. White, "Fluid Mechanics", TATA McGraw-Hill
8. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publication

Reference Books

1. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India
2. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press.
3. Edward Shaughnessy, Ira Katz James Schaffer, "Introduction to Fluid Mechanics",Oxford University Press

Web References

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/104/112104118/
3. https://nptel.ac.in/courses/112/105/112105269/
4. http://www.efluids.com/efluids/books/efluids_books.htm
5. http://web.mit.edu/hml/ncfmf.html
6. http://www.efluids.com/efluids/pages/edu_tools.htm
7. https://spoken-tutorial.org/tutorial-search/?search_foss=OpenFOAM&search_language=

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 10 experiments from the following list must be performed. During Oral, the Student is evaluated based on the completion of Practical, Assignments using Virtual Lab and Detailed Mini project / Industrial Visit Report/ Simulation of fluid flow / Programming using any suitable software.

Practical *(Experiment # 3 & 9 are compulsory; Select any One Simulation of Experiments from Experiment # 4 & 6; Perform any Eight experiments)*

1. Determination of pressure using manometers (minimum two)
2. Determination of fluid viscosity and its variation with temperature.
3. Determination of Metacentric height of floating object.
4. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
5. Draw flow net using electrical analogy apparatus to calculate discharge for rectangular / enlargement / contraction channel.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter/Notch.
8. Determination of minor/major losses through metal/non-metal pipes.

9. Mini project/Industrial visit/Simulation of fluid flow/Programming using any suitable software

Assignments using Virtual Laboratory *(Any Two Virtual Lab experiments from experiment # 1,2,5,7,8 mentioned above)*

Please visit the links given below for exploring and performing experiments on Fluid Mechanics using Virtual Laboratory. Write brief Reports using Virtual Laboratories:

1. https://eerc03-iiith.vlabs.ac.in/
2. http://fm-nitk.vlabs.ac.in/

202050 - Manufacturing Processes		
Teaching Scheme	**Credits**	**Examination Scheme**
Theory : 03 Hr./Week	**03** Theory : 03	In-Semester : 30 Marks End-Semester : 70 Marks

Prerequisite Courses

Material Science and Metallurgy, Engineering Physics, Systems in Mechanical Enginering

Course Objectives

1. Describe various sand and permanent mould casting methods, procedure and mould design aspects.
2. Understand basics of metal forming processes, equipment and tooling.
3. Understand sheet metal forming operations and die design procedure.
4. Classify, describe and configure the principles of various welding techniques.
5. Understand plastic processing techniques.
6. To know about composites, its fabrication processes.

Course Outcomes

On completion of the course, learner will be able to

CO1. SELECT appropriate moulding, core making and melting practice and estimate pouring time, solidification rate and DESIGN riser size and location for sand casting process

CO2. UNDERSTAND mechanism of metal forming techniques and CALCULATE load required for flat rolling

CO3. DEMONSTRATE press working operations and APPLY the basic principles to DESIGN dies and tools for forming and shearing operations

CO4. CLASSIFY and EXPLAIN different welding processes and EVALUATE welding characteristics

CO5. DIFFERENTIATE thermoplastics and thermosetting and EXPLAIN polymer processing techniques

CO6. UNDERSTAND the principle of manufacturing of fibre-reinforce composites and metal matrix composites

Course Contents

Unit I — Casting Processes — [07 Hr.]

Introduction to casting processes, Patterns: Pattern materials, types of pattern, allowances pattern design, Moulding sand, Properties of moulding sands, Core making, Melting practices and furnaces, Pouring and Gating system design, Numerical estimation to find mold filling time, Riser design and placement, Principles of cooling and solidification of casting, Directional and Progressive solidification Estimation of solidification rate, Cleaning and Finishing of casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting

Unit II — Metal Forming Processes — [08 Hr.]

Plastic deformation. Stress-strain diagram for different types of material, Hot and Cold working, Factors affecting plastic deformation, Yield criteria, Concept of flow stress, Forming Limit diagram

Rolling Process: Rolling terminology, Friction in rolling, Calculation of rolling load

Forging: Open and closed die forging, Forging operations

Extrusion: Types, Process parameter

Wire and Tube Drawing: Wire and tube drawing process, Die profile

Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes

Unit III — Sheet Metal Forming — [07 Hr.]

Types of sheet metal operations, Press working equipment and terminology, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Bending dies, Methods of reducing forces, Formability and forming limit diagrams

Unit IV **Welding Processes** **[08 Hr.]**

Classification of joining processes, Welding terminology and types of joints

Arc Welding Processes: Principles and equipments of Single carbon arc welding, FCAW, TIG, MIG, SAW

Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding

Gas Welding and Cutting, Soldering, brazing and braze welding

Welding Metallurgy and Heat Affected Zone, Weld inspection, Defects in various joints and their remedies

Unit V **Processing of polymers** **[07 Hr.]**

Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion

Moulding: Compression moulding, Transfer moulding, Blow moulding, Rotation moulding, Injection moulding - Process and equipment

Extrusion of Plastic: Type of extruder, extrusion of film, pipe, Cable and Sheet – Principle

Pressure forming and Vacuum forming

Unit VI **Manufacturing of Composites** **[08 Hr.]**

Introduction to composites, Composite properties, Matrices, Fiber reinforcement

Composite Manufacturing Processes: Hand lay-up Process, Spray lay-up, Filament winding process, Resin transfer moulding, Pultrusion, and Compression moulding process, Vacuum impregnation process, Processing of metal matrix composites, Fabrication of ceramic matrix composites, Carbon-carbon composites, Polymer matrix and nano-composites

Books & Other Resources

Text Books

1. P. N. Rao, "Manufacturing Technology Vol. I & II" , Tata McGraw Hill Publishers
2. P. C. Sharma, "Production Engineering", Khanna Publishers

Reference Books

1. R. K. Jain, "Production Technology", Khanna Publishers
2. K. C. Chawala, "Composite Materials", Springer, ISBN 978-0387743646, ISBN 978-0387743653
3. Brent Strong, "Fundamentals of Composites Manufacturing: Materials, Methods", SME Book series

202051 - Machine Shop

Teaching Scheme	Credits	Examination Scheme
Practical : 02 Hr./Week	**01** Practical : 01	In-Semester : 30 Marks End-Semester : 70 Marks Term Work : 50 Marks

Prerequisite Courses
Workshop Practice

Course Objectives
1. To understand the basic procedures, types of equipment, tooling used for sand casting and metal forming processes through demonstrations and/(or) Industry visits..
2. To understand TIG/ MIG/ Resistance/Gas welding welding techniques.
3. To acquire skills to handle grinding and milling machine and to produce gear by milling.
4. To acquire skills to produce a composite part by manual process.

Course Outcomes
On completion of the course, learner will be able to
CO1. PERFORM welding using TIG/ MIG/ Resistance/Gas welding technique
CO2. MAKE Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques
CO3. PERFORM cylindrical/surface grinding operation and CALCULATE its machining time
CO4. DETERMINE number of indexing movements required and acquire skills to PRODUCE a spur gear on a horizontal milling machine
CO5. PREPARE industry visit report
CO6. UNDERSTAND procedure of plastic processing

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Practical *(Select any One Practical from Practical # 1 & 2; Select any Five Practical from Practical # 3 to 8; Perform Total Six Practicals)*
1. To study and observe various stages of casting through demonstration of sand casting process from pattern making, sand mould preparation and melting and pouring of metal.
2. Visit to any foundry/ permanent mould casting industry to demonstrate various stages of casting and make a report on it.
3. A compulsory visit to any one metal forming industry out of: Rolling mill, Forging plant, Wire/Tube drawing unit and prepare a report on it.
4. A demonstration of any one welding technique out of TIG/ MIG/Resistance/Gas welding. A job drawing to be prepared by an individual institute with details of welding process parameters with weld joint design such as edge preparation, type and size of electrode used, welding current, voltage etc.
5. Manufacturing of Fibre-reinforced Composites by hand lay-up process or spray lay-up techniques.
6. Demonstration on any one plastic component like bottle, bottle caps, machine handles etc. by injection moulding process/ by additive manufacturing process.
7. Demonstration on cylindrical grinding/surface grinding operations, measurement of surface roughness produced and estimation of machining time.
8. Demonstration on indexing mechanism. Calculation of index crank and index plate movement by simple/compound/differential indexing and manufacture of spur gear on a milling machine using indexing head.

Instructions for Laboratory Conduction

Please note following instructions regarding Laboratory Conduction:
1. Industrial Visits to be conducted by the Teaching **Faculty** (subject Teacher).
2. Demonstration of Welding machines, Surface/Cylindrical Grinding, Milling machine, Indexing head and calculation of indexing to be taught by a **subject Teacher in Practical slot**.

202052 - Project Based Learning - II		
Teaching Scheme	**Credits**	**Examination Scheme**
Practical : 04 Hr./Week	**02** Practical : 02	Term Work : 50 Marks

Preamble

Currently, engineering education is undergoing significant structural changes worldwide. The rapidly evolving technological landscape forces educators to constantly reassess the content of engineering curricula in the context of emerging fields and with a multidisciplinary focus. In this process, it is necessary to devise, implement and evaluate innovative pedagogical approaches for the incorporation of these novel subjects into the educational programs without compromising the cultivation of the traditional skills. In this context, the educational community is showing rapidly rising interest in project-based learning approaches.

The mainstream engineering education follows traditional classroom teaching, in which the major focus is mainly on the lecture and the student has very little (if any) choice on the learning process. However rapid development in engineering and technology requires adopting a teaching approach that would assist students not only in developing a core set of industry relevant skills, but also enable them to adapt to changes in their professional career.

Course Objectives

1. To emphasize project based learning activities that are long-term, interdisciplinary and student-centric.
2. To inculcate independent and group learning by solving real world problems with the help of available resources.
3. To be able to develop applications based on the fundamentals of mechanical engineering by possibly applying previously acquired knowledge.
4. To get practical experience in all steps in the life cycle of the development of mechanical systems: specification, design, implementation, and testing.
5. To be able to select and utilize appropriate concepts of mechanical engineering to design and analyze selected mechanical system.

Course Outcomes

On completion of the course, learner will be able to

CO1. IDENTIFY the real-world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate / set relevant aims and objectives.

CO2. ANALYZE the results and arrive at valid conclusions.

CO3. PROPOSE a suitable solution based on the fundamentals of mechanical engineering by possibly integration of previously acquired knowledge.

CO4. CONTRIBUTE to society through proposed solutions by strictly following professional ethics and safety measures.

CO5. USE of technology in proposed work and demonstrate learning in oral and written form.

CO6. DEVELOP ability to work as an individual and as a team member.

Group Structure

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 5 (five) to 6 (six) students in each class
2. A supervisor/mentor teacher is assigned to 3-4 groups or one batch

Project Selection

The project can be selected by undertaking a survey of journal papers, patents or field visit (A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific). The problem shall consist of following facets: feasibility of arriving at a solution, analyzing the problem, design and development of the system (hardware or virtual).

There are no commonly shared criteria/ guidelines for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity undertaken.

Solution to problem-based projects through ***"learning by doing"*** is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students" wandering within different disciplines and professional environments. As stated in the preamble as the world has adapted and propagated multidisciplinary approach, hence the proposed project activity preferably should not be restricted to only mechanical domain specific projects rather should be Interdisciplinary in nature. However the chosen problem should be integration of other streams of engineering with Mechanical engineering.

Although in a genuine case 100% software/ virtual project topic may be allowed.

Ethical Practices, teamwork and project management:
Use Indian standards or any relevant standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation
In order to make our engineering graduates capable of preparing effective documentation, it is required for the students to learn the effective writing skills. The PBL final report is expected to consist of the Literature Survey, Problem Statement, Aim and Objectives, System Block Diagram, System Implementation Details, Discussion and Analysis of Results, Conclusion, System Limitations and Future Scope. Many freely available software tools (for instance Mendley (Elsevier), Grammarly) are expected to be used during the preparation of PBL synopsis and final report. It is expected that the PBL guides/mentors shall teach students about utilizing valid sources of information (such as reference papers, books, magazines, etc) related to their PBL topic.

Evaluation & Continuous Assessment
The institution/head shall be committed to ensuring the effective and rigorous implementation of the idea of project based learning. Progress of PBL shall be monitored regularly on a weekly basis. Weekly review of the work shall be necessary. During the process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

The effectiveness of the concept PBL lies in rigorous and continuous assessment and evaluation of the student performance. It is recommended that all activities are required to be recorded regularly. A regular assessment of PBL work is required to be maintained at the department in PBL log book by students. It is expected that the PBL log book must include following:

1. Information of students and guide
2. Weekly monitoring by the PBL guide,
3. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC).

The PEC structure shall consist of Head of the department, 1/2 senior faculties of the department and one industry expert (optional). Continuous Assessment Sheet (CAS) is to be maintained by the department.

Recommended parameters for assessment, evaluation and weightage

1. Idea Inception (kind of survey). (10%)
2. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
3. Attended reviews, poster presentation and model exhibition. (10%)

4. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
5. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)
6. Outcome (physical model/prototype/ virtual model/ product development/ assembly & disassembly and analysis of standard mechanism or system, design and development of small applications using Arduino, design of control systems, development of various systems/ subsystems of BAJA/SUPRA/Robots/GoKart/ Sunrisers/Hackathon/ application development and similar activities/ System performance and analysis) (40%)
7. Participation in various competitions/ publication/ copyright/ patent) (10%)

Learning Resources

Reference Books / Research Articles

1. John Larmer, John R. Mergendoller, and Suzie Boss, “Setting the Standard for Project Based Learning”
2. John Larmer and Suzie Boss, “Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences”
3. Erin M. Murphy and Ross Cooper, “Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry”

Web resources

1. https://www.edutopia.org/project-based-learning
2. www.howstuffworks.com
3. https://www.pblworks.org/
4. www.wikipedia.org

202053 - Audit Course - IV		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course IV

- Language & Mind Emotional Intelligence
- Advanced Foreign Language (preferably German/ Japanese)
- Human Behaviour
- Speaking Effectively
- Business Ethics
- Technical writing/ Research writing

The titles indicated above are subject to change in time to come and such an alteration (if any) should be brought to the notice of the BoS.

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the mark sheet.

SAVITRIBAI PHULE PUNE UNIVERSITY

Board of Studies in Civil Engineering

Structure and Syllabus for B.E. Civil 2015 Course (w. e. f. June, 2018)

SAVITRIBAI PHULE PUNE UNIVERSITY

Board of Studies in Civil Engineering

Structure for B.E. Civil 2015 Course (w. e. f. June 2018)

	Semester-I										
Subject code	**Subject**	**Teaching Scheme Hrs/Week**			**In-Semester Assessment**	**TW**	**Pract /Or**	**End-Semester Exam**	**Total**	**Credit**	
		Lect	**Tu**	**Pr**						**Th**	**Lab**
401 001	Environmental Engineering II	3	--	2	30	--	50	70	150	3	1
401002	Transportation Engineering	3	--	2	30	50	--	70	150	3	1
401 003	Structural Design and Drawing III	4	--	2	30	--	50	70	150	4	1
401 004	Elective I	3	--	2	30	50	--	70	150	3	1
401 005	Elective II	3	--	--	30	--	--	70	100	3	--
401 006	Project (Phase-I)	--	2	--	--	--	50	--	50	--	2
Total :		16	2	8	150	100	150	350	750	16	6
										22 Credits	

	Semester-II										
Subject code	**Subject**	**Teaching Scheme Hrs/Week**			**In-Semester Assessment**	**TW**	**Or**	**End-Semester Exam**	**Total**	**Credit**	
		Lect	**Tu**	**Pr**						**Th**	**Pr**
401 007	Dams and Hydraulic Structures	3	--	2	30	--	50	70	150	3	1
401008	Quantity Surveying, Contracts and tenders	3	--	2	30	--	50	70	150	3	1
401 009	Elective III	3	--	2	30	50	--	70	150	3	1
401 010	Elective IV	3	--	2	30	50	--	70	150	3	1
401 006	Project	--	6	--	--	50	100	--	150	--	6
Total :		12	6	8	120	150	200	280	750	12	10
										22 Credits	

Following will be the list of electives.

Semester I

Elective-I 401 004	Elective-II 401 005
1. Structural Design of Bridges	1. Matrix Methods of Structural Analysis
2. Systems Approach in Civil Engineering	2. Integrated Water Resources Planning and Management
3. Advanced Concrete Technology	3. TQM & MIS in Civil Engineering
4. Architecture and Town Planning	4. Earthquake Engineering
5. Advanced Engineering Geology with Rock Mechanics	5. Advanced Geotechnical Engineering

Semester-II

Elective-III 401 009	Elective-IV 401 010
1. Advanced Structural Design	1. Construction Management
2. Statistical Analysis and Computational Methods in Civil Engineering	2. Advanced Transportation Engineering
	3. Advanced foundation Engineering.
3. Hydropower Engineering	4. Coastal Engineering
4. Air Pollution and control	**5. Open Elective**
5. Finite Element Method in Civil Engineering	a) Plumbing Engineering
6. Airport and Bridge Engineering	b) Green Building Technology
	c) Ferrocement Technology
	d) Sub sea Engineering
	e) Geoinformatics

Savitribai Phule Pune University, Pune

BE Civil 2015 Course

Syllabus

Semester-I

401 001 Environmental Engineering – II

Teaching Scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Paper In-sem : 30 Marks (1Hr.)
Paper End-sem : 70 Marks (2.5 Hrs.)
Oral : 50 Marks

Unit I **(6 Hrs.)**

Sewage quantity: Collection and conveyance of sewage, sources of sewage, variations in sewage flow, Flow quantity estimation (sewage and storm water quantification), design of storm water system, Design of circular sanitary sewers. Pumping of sewage, necessity, location. Effect of change of life style on sewage quality.

Characteristics of sewage: Methods of sampling, Physical, chemical and biological characteristics, Quality requirements for disposal and recycle/reuse of sewage as per CPCB norms.

Stream sanitation: Self-purification of natural streams, river classification as per MoEF & CC, Govt. of India; Oxygen Sag Curve, Streeter - Phelps equation and terminology (without derivation and numerical). National river cleaning plan.

Unit II **(6Hrs.)**

Sewage treatment: Pollution due to improper disposal of sewage, Introduction to sewage treatment, preliminary, primary, secondary and tertiary treatment, Unit operation and Process flow diagram for sewage treatment, Theory and design of screen chamber, Grit Chamber and Primary sedimentation tank as per the Manual of CPHEEO.

Unit III **(6 Hrs.)**

Theory & design of secondary treatment units: Introduction to unit operations and processes for secondary treatment. Principles of biological treatments, role of microorganism in wastewater treatment.

Activated sludge process: Theory and design of ASP, sludge volume index, sludge bulking & control, modifications in ASP. Operational problems and maintenance in ASP.
Concept of Sequential batch reactor (SBR) .

Trickling filter: Biological principle, different T.F media & their characteristics, design of standard rate and high rate filters using NRC formula, single stage & two stage filters, recirculation, ventilation, operational problems, control measures, theory of rotating biological contactors.

Unit IV **(6 Hrs.)**

Low cost treatment methods for rural areas

Oxidation pond: Bacteria – algae symbiosis, design of oxidation pond as per the manual of CPHEEO, advantages & disadvantages of oxidation ponds.

Aerated lagoons: Principle, aeration method, advantages & disadvantages of aerated Lagoons, design of aerated lagoon.

Introduction and theory of Phytoremediation technology for wastewater treatment. Introduction and theory of root zone cleaning system.

Unit V **(6 Hrs.)**

Onsite Sanitation Treatment systems: Septic tank**,** up-flow anaerobic filter. and Package Sewage Treatment Plant- Working principle, advantages and disadvantages. Introduction to MBR, MBBR and FMBR.

Anaerobic digester: Principle of anaerobic digestion, stages of digestion, bio – gas production its characteristics & application, factors governing anaerobic digestion,. Dewatering of sludge by gravity thickener, sludge drying bed, decanters. Methods of sludge treatment and disposal, advantages & disadvantages. Up-flow Anaerobic Sludge Blanket (UASB) Reactor– Principle, advantages & disadvantages.

Unit VI **(6 Hrs.)**

Industrial waste water treatment: Equalization and neutralization. Application of preliminary, primary and secondary treatment for industrial wastewater as per the CPCB norms.

Sources of waste water generation from manufacturing process, characteristics of effluent, different methods of treatment & disposal of effluent for the following industries: Sugar, dairy and distillery. Discharge standards as per CPCB norms.

Recycle & reuse of treated wastewater: Gardening, sewage farming, W.C. Flushing, reuse in industry.

Term Work:

A. Compulsory Assignment:

1. Brief report on Sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.
2. Design of septic tank.

B. Experiments:

The term work shall consist of a journal giving details of at least 8 out of 12 of the following experiments conducted in Environmental Engineering laboratory, of which, **Sr.No.12 is compulsory**.

Determination of

1. Solids -Total solids, suspended solids, volatile solids, settle able solids & non settle able solids.
2. Sludge Volume Index.
3. Dissolved oxygen.
4. Bio-Chemical Oxygen Demand.
5. Chemical Oxygen Demand.
6. Electrical Conductivity.
7. Determination of Phosphates by spectrophotometer.
8. Determination of Nitrates by spectrophotometer.
9. Determination of heavy metals like Cr6+ or Zn or Ni or Cd.
10. Determination of total nitrogen by Kjeldal method.
11. Visit to domestic / Industrial wastewater treatment plant & its detailed reports.

12. Computer aided design of Sewage Treatment Plant (STP) OR Effluent Treatment Plant (ETP) of Sugar or Dairy Industry using suitable software (C programming or any other suitable software).

Note: - Term Work should include a detailed analysis of practical interpretation, significance and application of test results.

Text Books:

1. Environmental studies by Rajgopalan- Oxford University Press.
2. Waste Water Treatment & Disposal – Metcalf & Eddy - TMH publication.
3. Environmental Engg. - Peavy, Rowe - McGraw Hill Publication.
4. Waste Water Treatment – Rao & Dutta.

Reference Books:

5. Waste Water Engg. – B.C. Punmia & Ashok Jain - Arihant Publications.
6. Water Supply & Waste Water Engg.- B.S.N. Raju – TMH publication.
7. Sewage Disposal & Air Pollution Engg. – S. K. Garg – Khanna Publication.
8. Environmental Engg. – Davis - McGraw Hill Publication.
9. Manual on sewerage and sewage treatment – Public Health Dept., Govt. of India.
10. Standard Methods by APHA.

I.S. Codes:

I.S. 3025 (all parts).

e – Resources:

i) http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.

ii) http://cpcb.nic .in

iii) http://moef.nic .in

401 002 Transportation Engineering

Teaching scheme
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme
In-Sem Exam: 30 Marks 1 Hr.
End-Sem Exam: 70 Marks 2.5 Hrs.
Term work: 50 Marks

Unit I **(6 Hrs.)**

Highway Development & Planning:

History, Development Plans, Classification of roads, Road Patterns, road development in India - Vision 2021 & Rural Road Development Vision 2025, Current road projects in India; highway alignment and highway project report preparation (Planning surveys & Master Plans based on saturation system).

Unit II: **(6 Hrs.)**

Geometric design of highways:

Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems, Highway drainage, Importance of highway drainage, subsurface and surface drainage systems.

Unit III **(6 Hrs.)**

Traffic engineering & control:

Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings); Accident studies, types of road intersections; parking studies; highway lighting.

Unit IV **(6 Hrs.)**

Pavement materials:

Materials used in Highway Construction and related tests - Soil subgrade and CBR Test, Stone aggregates, bituminous binders, bituminous paving mixes, viscosity based gradation of bitumen, Modified Bitumen (Cutbacks, Emulsions, Crumbed Rubber Modified Bitumen – CRMB, Polymer Modified Bitumen-PMB, Foamed Bitumen), Marshall Stability Mix Design and Test (All 5 test parameters).

Unit V **(6 Hrs.)**

Pavement Design:

Introduction; flexible pavements – Computation of design traffic (Vehicle Damage Factor VDF, Lane distribution factor LDF, Traffic growth rate); stresses in flexible pavements; design guidelines for flexible pavements as per IRC 37-2012 (steps only); rigid pavements- components and functions; factors affecting design; stresses in rigid pavements (ESWL); design guidelines for concrete pavements as per IRC 58-2015 (steps only); joints in CC pavements, problems.

Unit VI **(6 Hrs.)**

A. Pavement Construction:

Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat, Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC).

B. Modern Trends in Highway Materials, Construction & Maintenance:

Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflectometer FWD).

Term work:

Term work shall consist of the following:

A. Practicals:

I. Tests on Aggregate (Any Five) :

1. Aggregate Impact Value Test
2. Aggregate Crushing Strength Test
3. Los Angeles Abrasion Test
4. Shape Test (Flakiness Index and Elongation Index)
5. Specific Gravity and Water Absorption Test by basket method
6. Stripping Value Test
7. Soundness Test

II. Tests on Bitumen (Any Five):

1. Penetration Test
2. Ductility Test
3. Viscosity Test (Tar Viscometer)
4. Softening Point Test
5. Flash Point & Fire Point Test
6. Specific Gravity Test
7. Bitumen Extraction Test

III. Tests on Aggregate Bitumen Combined:

1. Marshall Stability Test

IV. Tests on Soil Subgrade:

1. California Bearing Ratio Test (CBR Test)

B. Technical visits to:

1) Road Construction and/or RAP Site
2) Hot mix Plant with detailed report

Text Books:

1. Highway engineering – S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Brothers, Roorkee
2. Principles of Highway Engineering and Traffic Analysis (4th edition) F. L. Mannering, Scott S. Washburn, Wiley India
3. Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna Publishers Delhi.

Reference Books:

1. A Course in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi.
2. Principles of Transportation Engineering – G.V. Rao Tata MacGraw Hill Publication
3. Highway Engineering – Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Highway and Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

Other References:

1. National Cooperative Highway Research Program (NCHRP)
2. Federal Highway Authority (FHWA)

Codes:

1. I.S. 1201 TO 1220-1978, IS 73, IS 2386 PART I toV
2. I.R.C. 58- 2015, IRC 37-2012
3. Specifications for Road and Bridge works (MORTH) 5th Revision, New Delhi.

e – Resources:

1. www.nptel.iitm.ac.in/courses/iitkanpur
2. www.cdeep.iitb.ac.in/nptel
3. www.fhwa.dot

401 003 Structural Design and Drawing III

Teaching Scheme:
Lectures: 4 Hrs / week
Practical: 2 Hrs/week

Examination Scheme:
In Sem: 30 and End Sem : 70 Marks
Oral: 50 Marks
Duration: In-Sem: 1.5 Hrs.
End-Sem: 3 Hrs.

Unit 1 **(8 Hrs.)**

Prestressed concrete – Analysis:

Introduction, Basic concepts, materials, various Pre-tensioning and Post-tensioning systems, concept of losses, Stress calculations, and concept of cable profile.

Unit 2 **(8 Hrs.)**

Prestressed concrete – Design:

Design of post tensioned prestressed concrete simply supported rectangular and flanged sections for flexure and shear including end block.

Design of one way and two way post tensioned slabs (Single panel only).

Unit 3 **(8 Hrs.)**

Design of Flat slab:

Introduction to flat slab, Design of prestressed two way flat slab by direct design method.

Unit 4 **(8 Hrs.)**

Earth retaining structures:

Introduction, Functions and types of retaining walls, Analysis and design of RCC cantilever type of retaining wall for various types of backfill conditions.

Unit 5 **(8 Hrs.)**

Liquid retaining structures:

Introduction, types, function, codal provisions, methods of analysis, Design of circular, square, and rectangular water tanks resting on ground by working stress method, Introduction to limit state design of water tanks.

Unit 6 **(8 Hrs.)**

Introduction to vibration and earthquake analysis:

Introduction to single and multi-degree of freedom systems: free, forced, un-damped and damped vibration, Estimation of earthquake forces by seismic coefficient method, Estimation of combined effect of lateral forces and vertical loading on G+2 storied frames.

Note: Design based on above unit shall conform to latest versions of IS 456, IS 875, IS 1343, IS 3370, IS 1893, IS 13920.

Term Work:

Term work shall be based on the above syllabus. It consists of

1) Assignment on calculation of losses in prestress.
2) Assignment on stress calculation in prestressed structures.
3) Design and detailing of design of prestressed girder.
4) Design and detailing of prestressed flat slab by direct design method.
5) Design and detailing of retaining wall for various loading conditions.
6) Design and detailing of ground resting water tank.
7) Report on analysis and design of any one of the structures listed in the syllabus using software or computer program.
8) Two site visit reports, one each on RCC and Prestressed concrete structure.

Note:

(a) There should be separate design problem statement for a group of students not exceeding *four* in numbers.

(b) Minimum four full imperial sheets based on two projects on design of RCC and two projects on design of prestressed concrete structural elements.

Text Books:

1. Limit state theory and design of reinforced - Dr. V. L. Shah and Dr S. R. Karve - Structures Publications, Pune.
2. Fundamentals of Reinforced Concrete- N.C. Sinha, S.K. Roy – S. Chand & Co. Ltd
3. Advanced design of structures- Krishnaraju - Mc Graw Hill.
4. Design of Prestressed concrete structures- T. Y. Lin.
5. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co.
6. Earthquake resistant design of structures- Agarwal, Shrikhande, PHI learning.

Reference Books:

7. Comprehensive RCC Design - Punmia, Jain & Jain - Laxmi Publications.
8. Design of design of reinforced Concrete structures- M. L. Gambhir –PHI.
9. Reinforced Concrete, Vol I- Dr.H J. Shah Charotar Publishing House
10. Prestressed Concrete – A Fundamental Approach- Edward Nawy – PHI..
11. Reinforced concrete design- Pillai and Menon TMH.
12. Elementary Structural Dynamics-Selvam, Dhanpatrai Publications.

I.S. Codes

1. IS: 456: Indian Standard code of practice for plain and reinforced concrete, BIS, New Delhi.
2. IS: 1343: Indian Standard code of practice for Prestressed concrete, BIS, New Delhi.
3. IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, BIS, New Delhi.
4. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

401 004 Elective I: (1) Structural Design of Bridges

Teaching Scheme:
Lecture: 3 Hrs/week.
Practical:- 2 Hrs/week

Examination Scheme:
In-sem. Exam.: 30 Marks (1 Hr.)
End Sem. Exam.: 70 Marks (2.5 Hrs.)
Term work: 50 Marks.

Unit 1 **(6 Hrs.)**

Introduction to RC highway bridges and steel railway bridges: Types of bridges, classification, IRC codal provisions for RC highway bridges, IRS codal provisions for railway steel bridges, loading standards.

Unit 2 **(6 Hrs.)**

RC highway bridges: Slab culvert and T-beam deck slab bridges – Design of slab culvert, Deck slab: Structural configuration, Piegaud's method, analysis and design of deck slab.

Unit 3 **(6 Hrs.)**

RC highway bridges: T-beam deck slab bridges – Post tensioned girders: Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders.

Unit 4 **(6 Hrs.)**

Railway steel bridges – Truss bridges: Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit 5 **(6 Hrs.)**

Bearings: Function of bearings, types of bearings, design of steel bearings and elastomeric bearings.

Unit 6 **(6 Hrs.)**

Sub-structure: Function, loads, analysis and design of RC abutments and piers, design of well foundation.

Note: The designs should conform to the latest codal provisions.

Term Work:

a) One project on RC highway bridges which shall include - the design of deck slab, longitudinal girder, cross-girder, bearings and abutment and pier.

The detailing shall be shown in at least three full imperial sheets.

b) One project on railway steel bridges which shall include – the design of truss elements, longitudinal girder, cross-girder, and bearings.

The detailing shall be shown in at least two full imperial sheets.

c) The term work can be prepared in a group of not more than four students in a group.

d) Report of at least two site visits covering the contents of the syllabus.

e) The projects can be done using any drafting software.

Reference Books:

1. Design of Bridges, N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd.
2. Design of Bridge Structures, M.A. Jayaram Prentice-Hall Of India Pvt. Limited. Prestressed Concrete, N. Krishna Raju, Tata-McGraw Hill.
3. Design of Steel Structures, Ramachandra, Standard Publications New-Delhi.

401 004 Elective I (2) - Systems Approach in Civil Engineering

Teaching scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.
Term Work: 50 marks.

Unit 1: Introduction of systems approach **(6 Hrs)**

(A) Introduction to System approach, Operations Research and Optimization Techniques, Applications of systems approach in Civil Engineering.

(B) Introduction to Linear and Non linear programming methods (with reference to objective function, constraints), Graphical solutions to LP problems.

(C) Local & Global optima, unimodal function, convex and concave function.

Unit 2: Stochastic Programming **(6 Hrs)**

(A) Sequencing– n jobs through 2, 3 and M machines.

(B) Queuing Theory : elements of Queuing system and it's operating characteristics, waiting time and ideal time costs, Kendall's notation, classification of Queuing models, single channel Queuing theory : Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1) : (FCFS/ /).

(C) Simulation : Monte Carlo Simulation.

Unit3: Linear programming (A) **(6 Hrs)**

(A) The Transportation Model and its variants.

(B) Assignment Model, and its variants.

Unit 4: Linear programming (B) **(6 Hrs)**

(A) Formulation of Linear optimization models for Civil engineering applications. The simplex method.

(B) Method of Big M, Two phase method, duality.

Unit 5: Nonlinear programming **(6 Hrs)**

(A) Single variable unconstrained optimization: Sequential Search Techniques-Dichotomous, Fibonacci, Golden section.

(B) Multivariable optimization without constraints-The gradient vector and Hessian Matrix, Gradient techniques, steepest ascent/decent technique, Newton’s Method.

(C) Multivariable optimization with equality constraints - Lagrange Multiplier Technique.

Unit 6: Dynamic programming, Games Theory & Replacement Model (6 Hrs)

(A) Multi stage decision processes, Principle of optimality, recursive equation, Applications of D. P.

(B) Games Theory – 2 persons games theory, various definitions, application of games theory to construction Management.

(C) Replacement of items whose maintenance and repair cost increase with time, ignoring time value of money.

Term Work :

1. One exercise/assignment on each unit. Out of these any one exercise/assignment to be solved using Computer.
2. One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution).

Text Books :

1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).
2. Engineering Optimization: Methods and Application-- A. Ravindran, K. M. Ragsdell—Wiley India.
3. Engineering Optimization by S. S. Rao.
4. Operations Research by Hamdy A. Taha.
5. Quantitative Techniques in Management by N.D. Vohra (Mc Graw Hill) .
6. Operations Research by Pannerselvam, PHI publications.

Reference Books :

1. Topics in Management Science by Robert E. Markland(Wiley Publication).
2. An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen.
3. A System Approach to Civil Engineering Planning & Design by Thomas K. Jewell (Harper Row Publishers).

e - Resources

1. Mathematical Model for Optimization (MMO Software).
2. nptel.iitm.ac.in/courses/webcourse-contents/IISc-Bang/OPTIMISATION METHODS/New-index1.html.

401004 Elective I (3) - Advanced Concrete Technology

Teaching scheme
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme
In semester exam: 30 Marks-1 Hr.
End semester exam: 70 Marks—2.5 Hrs.
Term Work: 50 Marks

Unit I **(6 Hrs.)**

Cement and its types: general, hydration of cement, alkali aggregate reaction. Grading curves of aggregates, Manufactured sand as fine aggregate, copper slag as fine aggregate.

Concrete: properties of concrete, w/b ratio, gel space ratio, Problems on maturity concept, aggregate cement bond strength, Green concrete, Guidelines for Quality control & Quality assurance of concrete, Effect of admixtures.

Unit II **(6 Hrs.)**

Structural Light weight concrete, ultra light weight concrete, vacuum concrete, mass concrete, waste material based concrete, sulphur concrete and sulphur infiltrated concrete, Jet cement concrete (ultra rapid hardening), gap graded concrete, high strength concrete, high performance concrete ,Self curing concrete, Pervious concrete, Geo polymer concrete .

Unit III **(6 Hrs.)**

Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly ash cement concrete mixes, design of high density concrete mixes, Design of pump able concrete mixes, Design of self-compacting concrete.

Advanced non-destructive testing methods: ground penetration radar, probe penetration, break off maturity method, stress wave propagation method, electrical/magnetic methods, nuclear methods and infrared thermographs**.**

Unit IV **(6 Hrs.)**

Historical development of fibre reinforced concrete, properties of metallic fibre, polymeric fibres, carbon fibres, glass fibres, Basalt fibres and naturally occurring fibres. Interaction between fibres and matrix (uncracked and cracked matrix), basic concepts and mechanical properties: tension and bending.

Unit V **(6 Hrs.)**

Properties of hardened frc, behavior under compression, tension and flexure of steel fibres and polymeric fibres, GFRC, SFRC, SIFCON,SIMCON -development, constituent materials, casting, quality control tests and physical properties.

Unit VI **(6 Hrs.)**

Ferrocement: Properties & specifications of ferrocement materials ,analysis and design of prefabricated concrete structural elements,manufacturing process of industrial concrete elements, precast construction, erection and assembly techniques.

Termwork / Labwork :

The Termwork / Labwork will be based on completion of assignments / practicals / reports of site visits, confined to the course in that semester.

1. Write a review on any recent research article from standard peer-reviewed journal.
2. Report on at least one patent (national/international)– on any topic related to concrete technology.
3. Concrete mix design and production in lab of any one – Self compacting concrete, Fiber reinforced concrete, light-weight concrete, high strength or ultra-high strength concrete . Comparison with traditional concrete mix is to be clearly stated in the report. 4. Cost analysis (material, labour, equipment, others) of any type of concrete for lab, in-situ and RMC production.
4. Perform any two Fresh (workability tests – Slump Flow Test, T-50, J-Ring, Visual Stability Index, Column Segregation, L-Box, U-box) and Hardened (Compressive, tensile, flexural) properties tests on any high performance concrete.
5. Any one experiment on any one of the topics – NDTs; Microscopic examination of cement/concrete; Performance study of any one admixture (Mineral/Chemical) in concrete.
6. Visit reports on minimum two site visits - exploring the field and practical aspects of concrete technology.

Note:

Term Work should include a detailed analysis of practical interpretation, significance and application of test results including above contents and site visit report in form of journal.

Text books:

1. Concrete Technology --M.S. Shetty, S. Chand Publications.
2. Concrete Technology -- A R Santhakumar, Oxford University Press.
3. Concrete technology -- M. L. Gambhir, Tata Mcgraw Hill Publications.
4. Fiber Reinforced Cement Composite- P.N.Balguru & P.N.Shah.
5. Concrete: Microstructure, Properties and Materials-- P. Kumar Mehta and P. S. M. Monteiro-- Tata Mc-Graw Hill Education Pvt. Ltd.

Reference Books:

1. Handbook on Advanced concrete Technology Edited by N V Nayak,A .K.Jain, Narosa Publishing House .
2. Design of concrete mixes by Raju N Krishna, CBS Publisher.
3. Properties of concrete by A. M. Neville, Longman Publishers.
4. Concrete Technology by R.S. Varshney, Oxford and IBH.
5. Concrete technology by A M. Neville, J.J. Brooks, Pearson.
6. Ferrocement Construction Mannual-Dr. D.B.Divekar-1030, Shivaji Nagar,Model Colony, Pune.
7. Concrete Mix Design-A.P.Remideos--Himalaya Publishing House (ISBN-978-81-8318-996-5
8. Concrete, by P. Kumar Metha, Gujrat Ambuja.
9. Learning from failures ---- R.N.Raikar.
10. Structural Diagnosis ---- R. N. Raikar.
11. Concrete Mix Design---Prof. Gajanan Sabnis.

General Reading suggested:

1) Codes : i) IS 456 ii) IS 383 iii) IS 10262-2009 iv) IS 9103.

2) Ambuja cement booklets on concrete Vol .1 to 158.

3) ACC booklets on concrete.

401 004 Elective I (4)- Architecture and Town Planning

Teaching scheme:
Lectures: 3 Hours/week
Practical: 2 Hrs/week

Examination scheme:
In semester exam: 30 marks-1 Hr.
End semester exam: 70 marks-2.5 Hrs.
Term Work: 50 marks

Unit I **(6 Hrs.)**

• Principles and elements of Architectural Composition.

• Qualities of Architecture: user friendly, contextual, ecofriendly, utility of spaces, future growth etc.

• Role of "Urban Planner and Architect" in planning and designing in relation with spatial organization, utility, demand of the area and supply.

Unit II: **(6 Hrs.)**

• Landscaping: importance , objectives, principles, elements, material (soft and hard).

• Urban renewal for quality of life and livability.

• Importance of sustainable architecture with case study.

Unit III: **(6 Hrs.)**

• Goals and Objectives of planning; components of planning; benefits of planning.

• Levels of planning: Regional plan, Development Plan, Town Planning Scheme.

• Neighborhood plan; Types of Development plans: Master Plan, City Development Plan, Structure Plan.

Unit IV: **(6 Hrs.)**

• Various types of civic surveys for DP: demographic, housing, land use, Water Supply & sanitation, etc.

• Planning agencies for various levels of planning. Their organization and purpose (CIDCO-MHADA-MIDC, MMRDA/ PMRDA etc).

• Traffic transportation systems: urban road, hierarchy, traffic management, Intelligent Transport Systems.

Unit V: **(6 Hrs.)**

• Legislative mechanism for preparation of DP: MRTP Act 1966.

• UDPFI guidelines (for land use, infrastructure etc.), SEZ, CRZ, Smart City Guidelines.

Unit VI : **(6 Hrs.)**

• Special townships, Land Acquisition Rehabilitation and Resettlement Act 2013.

• Application of GIS, GPS, remote sensing in planning.

Term Work: - 50 Marks

Sr. no. 1 and 2 are compulsory and any four from remaining.

1. Study and analysis of Development Plan with respect to land use, services, infrastructure, street furniture, housing etc. (group work).
2. Neighborhood- planning (group work).
3. Report on contribution of Engineers, Planners and Architects in post-independence India (individual work).
4. Report on any existing new towns and planned towns like new Mumbai, Gandhinagar, PCNTDA etc.(infrastructure, disaster management etc), (individual work).
5. Study of salient features of urban renewal schemes (group work).
6. Study of any existing town planning scheme (group work).
7. Smart City approaches (individual work).
8. Study of Special Townships: (site visit) (group work).
9. Study of urban housing and housing change (group work).

Text Books:

1. Town Planning By G K Hiraskar --Town Planning by S Rangwala.
2. Building Drawing and Built Environment- 5th Edition – Shah, Kale, Patki--Planning Legislation by Koperdekar and Diwan.
3. G. K. Bandopadhyaya, "Text Book of Town Planning".
4. Climate Responsive Architecture – Arvind Krishnan.
5. Introduction to Landscape Architecture by Michael Laurie.

Reference Books:

- MRTP Act 1966.
- Manual Of Tropical Housing And Building By Koenigsbeger.

- Sustainable Building Design Manual.
- UDPFI Guidelines.
- "The Urban Pattern: City planning and design" by Gallion and Eisner.
- Design of cities by Edmond bacon.
- LARR Act 2013.
- MoUD By GoI.
- Web sites of NRSA, CIDCO, MHADA, MIDC, MMRDA, PMRDA.

401004 Elective-I (5) Advanced Engineering Geology with Rock Mechanics

Teaching Scheme:
Lecture: 3 Hrs/week
Practical: 2 Hrs/week

Exam. Scheme:
In Sem: 30 Marks (1 Hr.)
End Sem: 70 Marks (2.5 Hrs.)
Termwork: 50 Marks

Unit I: (6 Hrs.)

Indian Geology, Seismic Zones and Geological Studies in Engineering Projects.

Geological Map of India with special reference to Maharashtra. Distribution and Geological characters of Major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India. Engineering characters of major rock formations of India.

The study of Plate Tectonics and highlights of Seismic Zones of India. Importance of geological studies in engineering investigations.

Unit II (6 Hrs.)

Geohydrological characters of rock formations and Geological process of Soil formations

Geohydrological characters of major rock formations of India:

Geohydrological characters and factors controlling various characters of rocks. Introduction to morphometric analysis. Various water conservation techniques, effect of over exploitation of tube wells, bore wells and dug wells. Artificial recharge, rainwater harvesting, watershed development and necessity of geological studies. Relevant case studies highlighting success and failure of these techniques.

Geological Process of Soil formations:

Effect of climate on formation of soil. Soil profile of different states in India.

Rock weathering conditions favorable for decomposition, disintegration, residual and transported soils.

UNIT III (5 Hrs.)

Resource Engineering, Role of Geology in planning and development.

Resource Engineering:

Utility of various rock formations as construction material. Illustrative case studies.

Geological Hazards and mitigation.

Role of Geology in planning and development:

Influence of geological factors upon urban development & planning. Reclamation of abandoned grounds and mining regions, illustrative examples.

UNIT IV: (6 Hrs.)

Rock Mechanics and Geophysical techniques.

Rock Mechanics:

General principles of rock mechanics. Dependence of physical and mechanical properties of rocks on geological characters.

Analyzing and evaluating of core recovery, R.Q.D. and Joint Frequency Index.

Various Methods of Geomechanical classifications of rocks such as Terzahagi, U.S.B.M, R.M.R., R.S.R., Q- system, Deer and Miller, Bieniawaski's geomechanical classification etc.

Geophysical techniques :

Electrical Resistivity method and Seismic method of exploration. Evaluation and analyzing the data produced through electrical resistivity for the determination of thickness of overburden, locating ground water potential zones which leads for strengthening the major civil projects.

UNIT V (7 Hrs.)

Subsurface Geological Explorations for various projects; Foundation Treatments, Tail Channel Erosion.

Subsurface Explorations for Dams, Reservoir, Percolation Tanks:

The strength and water tightness of rocks found at the dam, reservoir and percolation tank site.

Case studies illustrating the success and failure of major projects owing to negligence of geological studies. Earthquakes occurring in the areas of some dams and RIS theories.

Geological Foundation Treatments for various Civil Engineering Projects:

Foundation investigation during construction of projects for assessing various geological defects in rocks and suggesting appropriate remedial measures by various methods of grouting.

Erosion of Tail Channels:

Geological reasons for selection of site for spillway, causes of erosion of tail channel. Relevant Case studies.

Unit VI: **(6 Hrs.)**

Geological exploration for Tunnels and Bridges

Geological exploration for Tunnels:

Variations in methodology of investigation for different types of tunnels for different purposes, location, spacing, angles & depths of drill holes suitable for different types of tunnels.

Difficulties introduced in various geological formation and their unfavorable field characters. Standup time of rock masses and limitations of it.

Dependence of protective measures such as guniting, rock bolting, shotcreting, steel fiber shotcreting, permanent steel supports, lagging concreting & grouting above permanent steel supports on geological conditions. Illustrative case studies.

Bridges Investigation for bridge foundation, difference in objectives of investigation of bridge foundation. Bridge foundation based on nature & structure of rock. Foundation settlements. Case studies.

Practical Work / Term Work

i. Study of Geological map and seismic zone map of India **(2 Practicals)**

ii. Study of Morphometric Analysis of river, (topsheet will be made available by the college) **(1 Practical)**

iii. Study of Soil Profile, weathering index and clay geology. **(1 Practical)**

iv. Use of electrical resistivity method for determining depth of bedrock. **(1 Practical)**

v. Engineering Classification of rocks and Computation of RQD & Joint Frequency Index **(1 Practical)**

vi. Interpretation of drill hole data. Logging of drill cover, preparation of Litho logs & interpretation of drill data. Preparing geological cross sections from drill hole data & using them for designing of civil engineering structures representing following case studies.

1. Dipping sedimentary formation.
2. Faulted region.
3. Folded region.
4. Locating spillway.
5. Tunnels in Tectonic areas.
6. Tunnels and open cuts in non-tectonic areas. **(6 Practicals)**

vii. A compulsory guided tour to study geological aspects of an engineering projects & writing a report based on studies carried out during visits to civil engineering projects.

Note:

Field visits will be made to different places around study area and one study tour to important geological places.

The practical journal will be examined as term work**.**

REFERENCE BOOKS AND TEXT BOOKS:

1. Jaeger J. C., Cook N. & Zimmerman R. – Fundamentals of Rock Mechanics, Blackwell Scientific Publications.
2. Goodman R. E. – Introduction to Rock Mechanics, John Wiley & Sons.
3. Bieniawski Z. T. - Engineering Classification of jointed Rock Masses.
4. M. B. Dobbrin - Introduction to Geophysical Prospecting, McGraw Hill Inc., USA.
5. B. P. Verma - Introduction to Rock Mechanics, Khanna Pub New Delhi.
6. Keller E A - Environmental Geology, Prentice – Hall Publication.
7. Subinoy Gangopadhyay - Engineering Geology, Oxford University Press.
8. Vasudev Kanithi – Engineering Geology, Universities Press.
9. Dr. J. B. Auden Commemorative Volume – Indian Soc. Of Engineering Geology, Culcutta.
10. Seminar on Engineering and Geological Problems in Tunneling (Part 1 & 2) – Indian Society of Engineering Geology, New Delhi.

Handbooks:

a. Gupte R. B. (1980) – P. W. D. Handbook Chapter –6, Part-II 'Engineering Geology Government of Maharashtra.

b. Tunneling India '94, "Central Board of Irrigation and Power", New Delhi.

c. Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi, 1988.

d. Handbook of Geology in Civil engineering, Robert Fergussion, Legget, Mc- Graw hill.

I. S. Codes

a. IRC code of practice for Road Tunnels. IRC-78-2000; IS-12070; IS-1336 Part I and II.

b. I. S. 4453-1967 Code of practice for Exploration, pits, trenches, drifts & shaft.

c. I. S. 6926-1973 Code of practice for diamond drilling for site investigation river valley project.

d. I. S. 4078-1967 Code of practice for Logging and Storage of Drilling Core.

e. I. S. 5313-1969 Guide for core drilling observation.

e- Resources:

1. www.ebd.co.in/undergraduate/eng
2. www.library.iisc.ernet.in
3. www.iitb.ac.in
4. www.nptel.iitm.ac.in
5. Free online course-swayam-https//swayam.gov.in
6. Open source course management – https//moodle.org

401 005 Elective-II (1) Matrix Methods of Structural Analysis

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks (1 Hr.)
End semester exam: 70 marks (2.5 Hrs.)

Unit I: Computational Techniques (6 Hrs)

Review of matrix algebra, computer oriented numerical methods-Gauss elimination, Gauss Jordon and Gauss Seidel. Computer algorithm and flowcharts of above methods.

Unit II: Flexibility matrix method for beams and frame (6 Hrs)

Degree of static indeterminacy, flexibility, selection of redundant, flexibility matrix, analysis of indeterminate continuous beams and simple portal frames involving not more than three unknowns.

Unit III: Stiffness matrix method for bars and trusses (6 Hrs)

a) Degree of kinematic indeterminacy (degrees of freedom), local and global coordinate systems, stiffness matrices of a axially loaded bar members, global stiffness matrix, analysis of determinate/indeterminate bars involving not more than three unknowns using member approach.

b) Stiffness matrices of a truss member with four DOF, transformation matrix, global stiffness matrix, analysis of determinate/indeterminate trusses involving not more than three unknowns using member approach.

Unit IV: Stiffness matrix method for beams (6 Hrs)

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.

b) Member approach: Derivation of stiffness matrix for beam member, Global stiffness matrix, problems involving not more than three unknowns.

Unit V: Stiffness matrix method for frames (6 Hrs)

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.

b) Member approach: Derivation of stiffness matrix for plane and space frame member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

Unit VI: Stiffness matrix method for grid structures **(6 Hrs)**

a) Structure approach: Degree of kinematic indeterminacy, problems involving not more than three unknowns.

b) Member approach: Derivation of stiffness matrix for grid member, transformation matrix, global stiffness matrix, problems involving not more than three unknowns.

Reference Books:

[1] Matrix Methods of Structural Analysis- Wang, C. K., International Textbook Co., 1970.

[2] Matrix Analysis of Framed Structures – Gere & Weaver- CBS Publications, Delhi.

[3] Matrix & Finite Element analysis of structures – A.H. Shaikh and Madhujit Mukhopadhyay.

[4] Numerical Methods for Engineering – S.C. Chapra& R.P. Canale Tata McGraw Hill Publication.

[5] Structural Analysis – A Matrix Approach – Pandit & Gupta - Tata McGraw Hill Publication.

[6] Matrix Methods of Structural Analysis – Meghre & Deshmukh- Charotar Publishing House, Anand.

401005 Elective-II (2) Integrated Water Resources Planning & Management

Teaching Scheme: Lectures: 3 Hrs / week

Examination Scheme:
Paper In-sem. 30 Marks (1 hr),
Paper End-sem : 70 Marks (2.5 hr)

Unit1: (6 Hrs)

a) Introduction :World water resources, water resources in India, water as finite resource, variability of water in time & space, history of water resources development, water infrastructure-problems and perspectives, present institutional framework for water management.

b) Water laws: Constitutional provisions, National Water Policy, riparian rights / ground water owner ship, prior appropriation, permit systems, acquisition and use of rights, scope for privatization. EPA 1986, MWRRA act.

Unit2: Economics & Paradigm shift in water management (6 Hrs)

a) Economics of water :Water as economic good, intrinsic value, principles of water pricing & water allocation, capital cost, opportunity cost, internal rate of return, benefit cost analysis, principles of planning and financing of water resources project : Discussion on any two case studies.

b) Paradigm shift in water management:

Global and national perspectives of water crisis, water scarcity, water availability and requirements for human and nature, concepts of 'blue water', 'Green water', and 'virtual water', and their roles in water management. Sustainability principles for water management, framework for planning a sustainable water future.

Unit 3: Basin scale flogy (6 Hrs)

a) Estimation of surface water, estimation of ground water draft/recharge import/export of water (inter basin water transfer, interlinking of national river), recycling and reuse and storage, control of water logging, salinity, & siltation of storages.

b) Flood & Drought management: causes of floods, structural and non-structural measures, mitigation plan, flood damage assessment, use of geoinformatics for flood management. Types of droughts, severity index, drought forecasting, damage assessment, mitigation plan, use of geoinformatics for drought management.

Unit 4: Water demand and supply based management (6 Hrs)

a) Consumptive & non consumptive demands, irrigation demand estimation, water utilization, irrigation efficiency, water management in irrigation sector.

b) Demand estimation in hydro/thermal/nuclear power sector, estimation & forecasting of water demands of domestic & industrial sector, navigation and recreational water demands.

Unit 5: Environmental and social aspects (6 Hrs)

a) Environmental management: protection of vital ecosystem, water requirements for environmental management, aquaculture, minimum flows, environmental flow, water quality management for various uses.

b) Social impact of water resources development: direct/ indirect benefits, employment generation, industrial growth, agro-industry, enhanced living standards, education & health, co-operative movement, management of rehabilitation & resettlement, interstate dispute of water sharing and tribunals, sectorial conflicts.

Unit6: Basin planning &Watershed management (6 Hrs)

a) Perspective plan for basin development & management, Decision support system for Integrated Water Resources Management (IWRM), use of data driven techniques like Artificial Neural Networks, Genetic programming, Model Tree in water resources planning, development & management.

b) Watershed Management:

Watershed definition, classification of watersheds, integrated approach for watershed management, role of RS & GIS in watershed management, soil and water conservation-necessity- soil erosion-causes- effects-remedial measures, contour bunding-strip cropping-bench terracing-check dams, farm ponds, percolation tank.

Text Books:

1) Water Resources Systems Engg, D. P. Loucks, Prentice Hall
2) Water Resources Systems Planning and Management, Chaturvedi, M.C. Tata McGraw Hill
3) Economics of Water Resources Planning, James L.D and Lee R.R, McGraw Hill
4) Water resources hand book; Larry W. Mays, McGraw International Edition
5) Design of Water Resources Systems, Arthur Mass, MacMillan 1962
6) Water resource system, Pramod .R. Bhave - Narosa Publication

Reference Books:

1. Economics of Water Recourses Planning, L. D. James & R.R.Leo, McGraw Hills, NY 1971.
2. Water Resources Systems Engineering, W. A. Hill & J. A. Dracup.
3. Water shed Management – B.M. Tideman
4. Watershed management –J. V. S. MURTY, new Age International Publisher.
5. Integrated Watershed Management Perspectives and Problems - Beheim, E., Rajwar, G.S., Haigh, M., Krecek, J. (Eds.) , Springer Publication.
6. Managing Water in River Basins: Hydrology, Economics and Institutions -- M. Dinesh
7. Kumar, Publisher: Oxford Universit Press
8. Water Resources Design Planning Engg. and Economic; Edward Kuiper, Butterworth & Co.
9. ANN in Hydrology; Govinda Raju & Ramachandra Rao; PHI
10. Integrated Water Resources Management in Practice: Better Water Management for Development - R. L. Lenton, Mike Muller , Publisher Earthscan.
11. Sustainability of Integrated Water Resources Management - Editors**:** Setegn, Shimelis Gebriye, Donoso**,** Maria Concepcion (Eds.) Publisher Springer International Publishing .
12. Integrated Water Resources Management in the 21st Century: Revisiting the paradigm -Pedro Martinez-Santos, Maite M. Aldaya, M. Ramón Llamas, Publisher CRC Press, Taylor & Francis Group.
13. Key Concepts in Water Resource Management: A Review and Critical Evaluation - Jonathan Lautze, publisher Routledge.
14. Water Management – Jasapal Singh, M.S.Achrya, Arun Sharma – Himanshu Publication.

e – Resources:

1. nptel.iitm.ac.in/courses /webcourse-contents / IISc-Bang/water resource management.

401 005 Elective II (3) TQM and MIS in Civil Engineering

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.

Unit I: Quality in Construction (6 Hrs)

a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality of construction, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus(Juran, Deming, Crossby, Ishikawa).

b) Evolution of TQM- QC, TQC, QA, QMS, TQM.

Unit II: TQM & Six Sigma (6 Hrs)

a) TQM – Necessity, advantages , 7QC tools, Quality Function Deployment(QFD).
b) Six sigma – Importance, levels.
c) Defects & it's classification in construction. Measures to prevent and rectify defects.

Unit III: ISO & Quality Manual (6 Hrs)

a) Study of ISO 9001 principles.
b) Quality manual – Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, formwork activity, steel reinforcement activity.
c) Corrective and Preventive actions, Conformity and NC reports.

Unit IV: Management Control & Certifications (6 Hrs)

a) Benchmarking in TQM, Kaizen in TQM.
b) Quality Circle.
c) Categories of cost of Quality.
d) CONQAS, CIDC-CQRA certifications.

Unit V: Techniques in TQM Implementation and awards (6 Hrs)

a) 5 'S' techniques.
b) Kaizen.
c) Failure Mode Effect Analysis (FMEA).

d) Zero Defects.

e) National & International quality awards- Rajeev Gandhi Award, Jamuna lal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award.

Unit VI: MIS **(6 Hrs)**

a) Introduction to Management Information systems (MIS) Overview, Definition.

b) MIS and decision support systems, Information resources, Management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control.

c) Study of an MIS for a construction organization associated with building works.

Text Books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ. Company.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference Books:

1. Juran's Quality Handbook – Juran Publication. Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges.
2. Management –Principal, process and practices by Bhat – Oxford University Press.
3. Financial management by Shrivastava- Oxford University Press.
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co.
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.

E- Sources:

www.nptel.ac.in , www.mobile.enterpriseappstoday.com

401 005 Elective II (4) Earthquake Engineering

Teaching scheme:
Lectures: 3 Hrs/week

Examination scheme:
In semester exam: 30 marks---1 Hr.
End semester exam: 70 marks—2.5 Hrs.

Unit I

Introduction to earthquakes: **(6 Hrs.)**

Geology of earth, configuration of tectonic plates in a globe, influence of Geology on earthquake, behavior of plates, their motion and effects, causes of earthquake and their Characteristics, Earthquake parameters, magnitudes, intensity, scales, classification of earthquake seismic zoning of India, seismic coefficients for different zones, .Lessons from past earthquake: - Study of damages caused due to past, earthquakes in/ outside India and remedial measures.

Unit II **(6 Hrs.)**

Theory of vibrations:

Vibrations - definition, causes, classifications. Single Degree of Freedom systems (SDOF) - Free, forced, damped, un-damped vibrations with basic examples. Introduction to Multi-degrees of Freedom systems (MDOF) - derivations of related equations and solutions to two degree and three degree of freedom systems.

Unit III **(6 Hrs.)**

Static analysis of earthquake forces:

Introduction to IS1893 (Part-I): Seismic design Philosophy, provision, Seismic coefficient method.

Unit IV **(6 Hrs.)**

Dynamic analysis of earthquake forces:

Response Spectra, estimation of story shear, effect of unsymmetrical geometry and masses, mass center and stiffness center, estimation of story shear for symmetrical and torsion for unsymmetrical buildings. Effect of infill masonry and shear walls.

Unit V **(6 Hrs.)**

Earthquake force calculation and analysis and design of frames

Estimation of combined effect of lateral forces and vertical loading on multi storeyed frames. Design any intermediate continuous beam of the frames for combined effect of loadings, Concept of ductile detailing, IS 13920 provisions for RC frame.

Unit VI **(6 Hrs.)**

Introduction of different control systems: Passive control: base isolation and active control: bracing system. Strengthening and Retrofitting techniques, methodology of retrofitting for walls, slabs roofs columns, foundations etc. for buildings in stones, bricks, RCC. Introduction to Disaster Management: Types of Disaster, Phases of disaster management, Disaster rescue, psychology and plan of rescue operations.

Notes:

Every design should confirm to latest versions of IS 1893, 4326, 13920, 13827, 13828, 13935

Text Books:

1. Earthquake resistance design of structure by Duggal- Oxford University Press.
2. Earthquake – Resistant Design of Building Structures-Dr. Vinod Hosur-- Wiley India.
3. Earthquake Tips NICEE, IIT, Kanpur.
4. Elements of Earthquake Engineering by Jaikrishna and Chandarsekaran.
5. Earthquake resistant design of structures- Agarwal, Shrikhande, PHI learning.

Reference Books:

1. Dynamics of structure by Clough R.W. and Penzin J. McGraw Hill Civil Engineering Series.
2. Dynamics of structure by Anil Chopra, Prentice Hall India Publication.
3. Dynamics of structure by Mario Paz, CBSPD Publication.
4. Geo-technical Earthquake Engineering by Kramer S. L. Prentice Hall India Publication.
5. Introduction to Structural Dynamics by John M. Biggs.
6. Mechanical Vibrations by V. P. Singh.
7. Relevant Latest Revisions of IS codes.

401 005 Elective II (5)- Advanced Geotechnical Engineering

Teaching scheme:
Lectures: 3 hours/week

Examination scheme:
In semester exam: 30 marks---1 hour
End semester exam: 70 marks—2.5 hours

Unit I **(6 Hrs.)**

(a) Soil classification Identification and classification, criteria for classifying soil - classification on the basis of grain size, plasticity, symbolic & graphic presentation. Classified soils and engineering properties. (b) Soil structure & clay minerals Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II **(6 Hrs.)**

(a) Earth pressure theory Earth pressure theories for calculation of active and passive pressure, Rankines and coulombs earth pressure theories, analytical and graphical methods. (b) Design of earth retaining structures Design of gravity and cantilever retaining walls, design - cantilever sheet pile walls, anchored sheet pile walls, timbering and bracing for open cuts.

Unit III **(6 Hrs.)**

(a) Geosynthetics Geosynthetics- types, functions, properties and functional requirements. Application of geosynthetics in geoenviroment. (b) Reinforced soil Mechanism, reinforcement soil – interaction. Applications – reinforcement soil structures with vertical faces, reinforced soil embankments. Reinforcement soil beneath unpaved roads, reinforcement of soil beneath foundations. Open excavation and slope stabilization using soil nails.

Unit IV **(6 Hrs.)**

(a) Soil behavior under dynamic loads Soil behavior under static and dynamic loads. Acceptable levels of strain under static and dynamic loading. Soil properties relevant for dynamic loading and its determination.

(b) Machine foundations: Types of machine foundations, design criteria, methods of analysis – elastic half space method, linear elastic weightless spring method. Evaluation of soil parameters. Design procedure for a block foundation for cyclic loading and impact loading.

Unit V **(6 Hrs.)**

Ground Improvement In-situ ground improvement by compaction piles, dynamic loads, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation.

Unit VI **(6 Hrs.)**

Rheology Rheological elements, basic and composite rheological models. Examples of compound models used to explain different soil phenomena; such as secondary consolidation, creep etc.

Reference Books:

1. Physical and Geotechnical properties of soils- Joseph E. Bowels, Tata Mac-Grawhill.
2. Advance Soil Mechanics – Braja Mohan Das- Tata Mc- Grawhill.
3. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta – Tata Mc-Grawhill.
4. Basic and Applied Soil Mechanics- Gopal Ranjan & A.S. Rao- New Age Publication.

Codes:

1. I.S .Codes 1. IS: 1892-1979 – "Code of Practice for Subsurface Investigation for Foundation".
2. 2. IS: 2131-1981 (Reaffirmed 1997), "Method for Standard penetration Test for Soils".

Handbooks:

1. Bolt, Bruce A.(1999),"Earthquakes", W. H. Freeman.
2. Baghi, A., (1994)" Design, Construction and Monitoring of Landfills." John Wiley & Sons.
3. Day. R.W.(2002),"Geotechnical Earthquake Engineering Handbook",McGraw Hill.

e -Resources:

1. Website www.nptel.iitm.ac.in

401006 Project Phase-I

Teaching Scheme:	**Examination Scheme:**
Tutorial: 2 Hrs/week	**TW: 50 Marks.**

Project phase I Term Work will be evaluated for an individual student based on the seminar presented on the work done in first semester and submission of the report. If the student fails to present the seminar and submit the report, he / she will be marked absent in project examination. The project work phase I shall be consist of any one of the following nature in Civil Engineering related subjects.

1. Experimental investigation.
2. Software development.
3. Benefits cost economic analysis.
4. Case study with own design.
5. Working model design and fabrication.
6. Case study with development of methodology using soft computing tools.

It is mandatory to present a seminar in presence of Internal and External Examiners and submit preliminary project report based on work done in first semester. The report shall contain finalization of topic, literature survey, planning schedule/ flow chart for completion of project. The report shall be typed or printed and hard/spiral bound. The project work to be taken up individually or in groups. The group shall not be of more than 4 students. References shall be mentioned at the end as per universal standards as mentioned in any international journal of professional body.

Format of project report: Sequence of pages:

i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Synopsis v) Contents vi) Notations vii) List of Tables viii) List of Figures ix) List of Graphs.

Chapter 1 Introduction (This consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives and 1.4 Scope of the Project Works, 1.5 Research Methodology, 1.6 Limitations of study, 1.7 Expected outcome.

Chapter 2 Literature Review from minimum 10 articles (It shall include theoretical support, details regarding work done by various persons, methods established, any new approach. It should preferably highlight the development in the field of research chronologically as reflected from books, journals etc.).

Chapter 3 Planning Schedule/ Flow Chart For Completion of Project References and Bibliography (The references and bibliography shall include name of author/code/manual/book, title of paper/code/manual/book, name of the journal, month & year of publication, volume number/ISBN number, page number x-y. The references and bibliography shall be as per universal standards as mentioned in any international journal of professional body).

Report Printing details:

1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on Both sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters-Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Semester-II

Savitribai Phule Pune University Board of Studies in Civil Engineering B.E. Civil 2015 Course (w. e. f. June 2018)

401007 Dams and Hydraulic Structures

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
In-sem: 30 marks (1 Hour)
End-sem :70 marks (2.5 Hours)
Oral : 50 marks

Unit I **(4 Hrs.)**

a) Introduction to dams

Introduction, Historical development of dams, Different terms related to dams, Selection of site for dam, Factors governing selection of type of dam, Classification of dams, Classification based on purpose, Classification based on materials, Classification based on size of project, Classification based on hydraulic action, Classification based on structural action, Dams and earthquakes, Dams and social issues, Large dams verses small dams, Displacement and rehabilitation, Dams and climate change.

b) Dam Safety and Instrumentation

Introduction, Objectives of dam safety and instrumentation, Types of measurements, Instrumentation data system, Working principles and functions of instruments, Selection of Equipment's, Different Instruments, Piezometers, Porous tube piezometer, Pneumatic piezometer, Vibrating wire piezometer ,Settlement measurement system Vibrating wire settlement cell, Magnetic settlement system, Inclinometer, Joint meter, Pendulums, Inverted Pendulum, Hanging Pendulum, Automatic pendulum coordinator ,Vibrating wire pressure cell, Extensometer, Embedment strain gauge, Temperature gauge, distributed fiber optics temperature tool, seismograph.

UNIT 2 **(7 Hrs.)**

a) Gravity Dams

Introduction, Components of gravity dam, Conditions favoring gravity dams, Forces acting on gravity dam, Combinations of loading for design, Seismic analysis of dam, Terms related to seismic analysis, Determination of Seismic forces (Zangar's method) , Effect of horizontal earthquake acceleration, Effect of vertical earthquake acceleration, Stress analysis in gravity dam (Only concept, no derivations), Vertical or normal stress , Principal stresses, Shear stress, Middle third rule, Modes of failure of gravity dam, Elementary profile of gravity dam, Concept of low and high gravity dams, Various Design methods of gravity dam (Introduction only)— Details of Gravity method or 2 D method, ,Construction of gravity dams, Colgrout masonry, Roller Compacted Concrete (R.C.C.),Temperature control in mass concreting, Crack formation in gravity dam, Control of crack formation in dams, Construction joints, Keys, Water seal, Retrofitting.

b) Arch Dam and Other Dams (Introduction only)

Introduction, Concept of Arch Dam, Conditions favoring an arch dam, Classification of an arch dam, Constant angle arch dam, Constant radius arch dam, Variable radius arch dam, Arch gravity dam, Double curvature arch dam, Buttress dams, Advantages of Buttress dams, Limitations of Buttress dams, Types of buttress dams.

Unit III **(7 Hrs.)**

a) Spillway and Gates [6 Lectures]

Introduction, Location of Spillway, Different key levels and heads in spillway, Spillway Capacity, Components of spillway, Approach channel, Control structure, Discharge channel, Energy dissipation device, Tail channel, Classification of spillway, Classification based on operation, Main or service spillway, Auxiliary spillway, Emergency spillway, Classification based on gates, Gated spillway, Ungated spillway, Classification based on features, Straight drop spillway(Free overflow spillway),Saddle spillway, Side channel spillway, Overflow or ogee spillway, Chute or open channel or trough spillway, Shaft or morning glory spillway, Siphon spillway, Conduit or tunnel spillway, Stepped spillway,

Design of Ogee spillway or overflow spillway, Shape of crest, Equations for spillway profile on upstream and downstream, Energy dissipation below spillway, Classification of energy dissipation devices, Energy dissipation in stilling basin, Stilling basin, Components of stilling basin, Types of stilling basins, Indian standard stilling basins, Energy dissipation through buckets, Solid roller bucket, Slotted roller bucket, Ski jump bucket, Correlation between jump height and tail water depth.

b) Spillway Gates

Introduction of Spillway gates , Classification of spillway crest gates, Classification based on function, Classification based on movement of gates, Classification based on special features, Introduction to automatic gates, Maintenance of gates, Inspection of gates.

Unit IV **(7 Hrs.)**

a) Earth Dam

Introduction, Conditions favoring an earth dam, Limitations of earth dam, Classification of earth dam, Classification based on---materials, method of construction, height; Selection of type of earth dam, Components of an earth dam, Requirements for safe design of earth dam, Hydraulic (Seepage) Analysis, Plotting of seepage line, Case 1: Homogeneous earth dam with horizontal drainage blanket, Determination of seepage discharge using phreatic line.

Case II: Composite earth dam with casing and hearting, Properties of phreatic line, Determination of seepage discharge through earth dam using flownet, Structural stability analysis of homogeneous and zoned earth dam, Forces acting on earth dam, Method of stability analysis of an earth dam, Procedure of analysis by Swedish slip circle method, Fellenius Method of Locating Centre of Critical Slip circle, Stability analysis for foundation, Failure of earth dam, Classification of failure of earth dams, Hydraulic Failure, Seepage failure, Structural failure, Seepage control in earth dams, causes of seepage, Seepage control measures, Construction of earth dam,

b) Diversion head works

Introduction, Function of diversion headworks, Selection of site for diversion headworks, Layout of diversion headworks, Components of diversion headworks, Design of weir on permeable foundation, Criteria for safe design of weir floor, Brief introduction to Bligh and Lane's theory, Khosla's theory based on potential theory approach, Khosla's theory of independent variables, Design criteria of weirs on permeable foundations, Checks for stability and safety of weirs.

Unit V **(6 Hrs.)**

a) Canals

Introduction, Classification of canals, Classification based on alignment, Classification based on soil, Classification based on source of supply, Classification based on discharge, Classification based on lining, Classification based on excavation, Components of canal , Data required for canal design, Selection of canal alignment, Design of stable canal in alluvial beds, Kennedy's theory, Design of canal by Kennedy's theory, Limitations of Kennedy's theory, Lacey's regime theory, Design of canal by Lacey's theory, Canal lining, Need of canal lining, Requirements of lining material, Classification of canal lining, Hard surface lining including Ferrocement lining, Soft surface lining, Burried lining, Advantages of canal lining, Design of lined canal, Benefit – cost analysis for canal lining.

b) Canal Structures

Canal falls Introduction, Necessity of canal fall, Selection of site for canal fall, Classification of canal fall, Types of falls, Free fall or open fall, Notch fall, Ogee Fall, Rapid Stepped fall, Straight glacis fall, Sarda fall, Semi pressure fall, Baffle or Englis Fall, Montague fall Siphon well or cylinder fall, Pressure or closed conduit fall, Shaft or Pipe fall, Selection of type of fall, **Canal outlets-** Introduction of Canal outlet or module, **Canal escapes-** Introduction of Escapes, Significance of canal escape, **Canal regulators--**Canal regulators.

Unit VI **(5 Hrs.)**

a) C. D. Works

Introduction, Necessity of cross drainage works, Selection of site for Cross Drainage work, Data required for design of Cross Drainage work, Classification of Cross Drainage works, Drain over canal-Siphon, Super passage, Canal over drain—Aqueduct, Siphon aqueduct, Canal and drain water mixed in each other--Level crossing, Inlet and Outlet, Selection of suitable type of C. D. works, Design considerations for cross drainage works.

b) River Training Structures

Introduction, Classification of rivers, Classification based on topography, regime, alignment, source, Behaviour of rivers, River training, Objectives of river training, Classification of river training, purpose, orientation, River training structures, Embankment or Levee, Guide banks, Groynes or spurs, Artificial cut off, Pitched island, Submerged sill or dykes, Closing dykes.

Term Work (A+B+C)

A) Analysis /Design Assignments. (Compulsory)

1) Stability analysis of gravity dam
2) Design of profile of spillway and energy dissipation device below the spillway
3) Stability analysis of zoned earthen dam
4) Analysis of weirs on permeable foundations.
5) Design of unlined and lined canal.

B) Site visits and reports with photographs (compulsory)

1. Gravity dam.
2. Earth dam.
3. D. work/ Canal structure(s)/Weirs/Barrage.

C) Review of any one case study of failure of hydraulic structure from the published literature or patent related to Hydraulic structures (in a group of five students).

Note:-

Visit report should consist of Name of project, date of visit , need and practical significance of project, salient features of project, technical details of project, detailed description and figures of different components of project, special features of project, the technical, social, financial and environmental impact of project on downstream and upstream, photographs of technical details of visit, if allowed . If not allowed for technical details, the photograph near board of project or site as a proof of visit.

Reference Books :-

1. Design of Small Dams- United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, first ed, 2005.
3. Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D. 13th ed, 1998.
4. Design Textbook in Civil Engineering: Volume Six: Dams- Leliavsky, Serge – Oxford and IBH Publishing Co. Pvt. Ltd., 1981.
5. Roller Compacted Concrete Dams- MehrotraV.K- Standard Publishers Distributors, Delhi, 1st ed, 2004.
6. Irrigation, Water Resources and Water Power Engineering- Modi, P.N. - Standard Book House, New Delhi, 2nd ed, 1990.
7. Irrigation and Water Power Engineering - Punmia B.C. - Laxmi Publication.

I.S. Codes:

1. I.S. 8605 – 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, third reprint, July 1999, B.I.S. New Delhi.
2. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
3. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.

4. I.S. 10135 – 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi.
5. I.S. 14591 – 1999, Temperature control mass concrete for dams – guidelines, B.I.S.
6. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
7. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi.
8. I.S. 11155- 1994, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi.
9. I.S. 5186 – 1994, Design of chute and side channel spillway – criteria, first revision, B.I.S. New Delhi.
10. I.S. 10137- 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, B.I.S. New Delhi.
11. I.S. 4997 – 1968 (Reaffirmed 1995) Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, 1998, B.I.S. New Delhi.
12. I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi.

01 008 Quantity Surveying, Contracts & Tenders

Teaching scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination scheme:
In semester exam: 30 Marks---1 Hr.
End semester exam: 70 Marks—2.5 Hrs.
Oral: 50 Marks

Unit I **(6 Hrs.)**

Introduction and Approximate Estimates:

a) **Introduction to estimates and related terms:** Definition of estimation and valuation. Significance (application) of the Course. Purpose of estimation. Type of estimates, data required for estimation as a pre requisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, abstract sheet (BOQ), measurement sheet, Rate Analysis, lead statement. Provisional sum& prime cost items, contingencies, work charge establishment, centage charges. Introduction to D. S. R.

b) **Approximate Estimates**: Meaning, purpose, methods of approximate estimation of building & other civil engineering projects like roads, irrigation/ water supply, sanitary engineering, electrical works.(Theory & Numericals).

Unit-II **(6 Hrs.)**

Taking out quantities &Detailed estimate:

a) Detailed estimates: Factors to be considered while Preparing Detailed Estimate, Detailed estimate of R.C.C framed structures using IS 1200, Concept of Estimation of Load Bearing Structure (PWD & Centre Line Method).

b) **Bar Bending Schedule:** Preparing Bar Bending Schedule for all RCC members of building.

Unit-III **(6 Hrs.)**

Specifications and Rate Analysis:

a) Specifications: Meaning & purpose, types. Drafting detailed specifications for materials, quality, workmanship, method of execution, mode of measurement and payment for major items like, excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work.

b) Rate Analysis: Meaning and factors affecting rate of an item of work, materials, sundries, labour, tools & plant, overheads & profit. Task work or out turn, factors effecting task work. Working out Rate Analysis for the items mentioned in specifications above.

Unit IV **(6 Hrs.)**

Valuation:

a) **Valuation:** Purpose of valuation. Meaning of price, cost and value. Factors affecting 'Value'. Types of value: only Fair Market Value, Book Value, Salvage/ Scrap Value, Distressed Value and Sentimental Value. Concept of free hold and lease hold property. Estimation versus valuation. Methods of depreciation & obsolescence, Sinking Fund, Years Purchase.

b) **Methods of Valuation of Building:** Rental Basis, Land & Building basis, Direct Comparison Method, Profit based method, Belting of Land, Development method.

Unit V **(6 Hrs.)**

Tendering and Execution of Works:

a) Tenders: Definition. Methods of inviting tenders, tender notice, tendering procedure, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, Pre-bid conference, acceptance/ rejection of tenders. Various forms of BOT &Global Tendering, E-tendering.

b) Methods of Executing Works: PWD procedure of work execution, administrative approval, budget provision, technical sanction. Methods of execution of minor works in PWD: Piecework, Rate List, Daily Labour. Introduction to registration as a contractor in PWD.

Unit VI **(6 Hrs.)**

Contracts and Arbitration:

a) **Contracts**: Definition, objectives & essentials of a valid contract as per Indian Contract Act (1872), termination of contract. Types of contracts: only lump sum, item rate, cost plus. **Conditions of contract**: General and Specific conditions. Conditions regarding EM, SD, and time as an essence of contract, conditions for addition, alteration, extra items, testing of materials, defective work, subletting, etc. Defect liability period, liquidated damages, retention money, interim payment or running account bills, advance payment, secured advance, final bill.

b) **Arbitration**: Introduction to Arbitrations as per Indian Arbitration & Conciliation Act (1996) Meaning and need of arbitration, qualities and powers of an Arbitrator.

Term Work:

The following exercises should be prepared and submitted:

1. Report on contents, use of current DSR & Drafting detailed specification for major items of works.
2. Working out quantities using C-L and PWD method for a small single storied load bearing structure up to plinth and Preparing Abstract Sheet using DSR(Regional)
3. Detailed Estimate of a single storied R.C.C framed building using D.S.R.
4. Working out quantities of steel reinforcement for a column footing, a column, a beam and a slab by preparing bar bending schedule.
5. Working out rate analysis for the items as in the specifications of Assignment No. 1.
6. Preparing Valuation of a Residential building and writing report using O-1 form.
7. Estimating quantities for any one of the following using appropriate software.
   a) A Factory Shed of Steel Frame
   b) Underground Water Tank
   c) Pipe Culvert
   d) Road / Railway Track/ Runway
8. Drafting of tender notice, Preparation of Schedule A & B and Conditions of Contract regarding time, labour payment, damages for RCC Framed Structure (Assignment No. 3) and collecting minimum of 3 tender notices of Civil Engineering Works.

Oral Examination: Based on the Term Work.

Reference Books:

1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N Dutta - S. Dutta & Company, Lucknow.
2. Estimating, Costing Specifications & valuation in Civil Engineering: M. Chakraborty.
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand.
4. Theory and Practice of Valuation: Dr. RoshanNamavati, Lakhani Publications.
5. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.
6. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO-

CARE,5/B,/Sagarika Society,Juhu Tara Road,Juhu,Santacruz(W),Mumbai-400049 procure@technolegal.org).

Handbooks:

1. Standard Contract Clauses for Domestic Bidding Contracts: Ministry of Statistics and Program Implementation, Government of India.
2. FIDIC Document: Federation International Des Ingenieurs Conseils i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.
3. Indian Practical Civil Engineers' Handbook: P. N. Khanna, UBS Publi. Distri. Pvt. Ltd. (UBSDP).

Codes:

1. IS 1200 (Part 1 to 25): Methods of Measurement of Building & Civil Engg.Works.
2. IS 3861-1966: Method of Measurement of Areas and Cubical Contents of buildings.
3. D. S. R. (District Schedule of Rates) for current year.
4. PWD Redbooks, Vol 1 & 2.

e – Resources: nptel.iitm.ac.in

401 009 Elective III (1) Advanced Structural Design

Teaching Scheme
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme
Theory Examination:
In-sem : 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit 1 **(6 Hrs.)**

Cold-formed light gauge steel structural members: Design of axially loaded compression members, tension members and beams (not more than two spans).

Unit 2 **(6 Hrs.)**

Frames: Uniqueness theorem, lower bound and upper bound theorems, mechanisms, analysis and design of frames (single story), design of connections.

Unit 3 **(6 Hrs.)**

Composite deck slab: Design of composite deck slab with cold form light gauge profile and shear connectors.

Unit 4 **(6 Hrs.)**

Yield line analysis and design of slabs: Yield line theory, yield lines, ultimate moment along a yield line, principle of virtual work, analysis and design of slabs of different geometry, support conditions and loading conditions.

Unit 5 **(6 Hrs.)**

Elevated water tanks: Analysis and design for gravity and earthquake loads (static analysis) for square, rectangular and circular water tanks (excluding Intze tank) supported on staging, design of staging and foundation system.

Unit 6 **(6 Hrs.)**

Shear walls: Function, types, analysis and design of cantilever type shear walls.

Note: The designs should conform to the latest codal provisions.

Term Work:

a) At least three plates showing the details of cold-formed light gauge steel sections used in compression, tension and flexural members

b) At least three plates showing the details based on yield line analysis and design of slabs

c) Sheet 1: Detailing of any one design problem from Unit 2 or Unit 3

d) Sheet 2: Detailing of any one design problem from Unit 5 or Unit 6

e) Report of two site visits covering the contents of the syllabus mentioned above.

References:

1). Design of Steel Structures, Ramachandra, Standard Publications New-Delhi

2). Structural and Stress Analysis, T.H.G. Megson, Butterworth-Heinemann

3). Design of Concrete Structures, J. N. Bandyopadhyay, PHI

4). Punmia, Reinforced Concrete Structures Vol. 1 and 2, Standard Book House NewDelhi.

5). Sinha and Roy., RCC Analysis and Design . S. Chand and Co. New-Delhi

6). Ramachandra, Design of Steel Structures Vol.-II Standard Publications New-Delhi.

7). Punmia,B. C. and Jain and Jain, Comprehensive Design of Steel Structures, Standard Book House

8) INSDAG publications

401009 Elective=III (2) Statistical Analysis and Computational Methods in Civil Engineering

Teaching Scheme	**Examination Scheme**
Lectures : 3 hours/week	**In-sem : 30 marks (1 Hour)**
Practical: 2 hours/week	**End-sem:70 marks (2.5.Hours)**
	Term work: 50 Mark

Unit I: (6 Hrs.)

Numerical methods: Bisection method, False Position method, Newton Raphson, Secant method.

Unit II: (6 Hrs.)

Numerical Integration Need and scope, trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule, Gauss Quadrature method.

Unit III: (6 Hrs.)

Optimization techniques: Introduction to optimization techniques-concepts and applications, direct solution of linear equations-Gauss elimination and Gauss Jordon method. Iterative solution of linear equations- Gauss Seidel method.

Unit IV: (6 Hrs.)

Statistical methods: Introduction, collection, classification and representation of data, measures of central value (mean, median, mode), measures of dispersion, sampling.

Unit V: (6 Hrs.)

Probability and Probability distributions including Binomial, Poisson, Normal, test of hypothesis, chi-square test.

Unit VI: (6 Hrs.)

Correlation analysis, regression analysis. Coefficient of correlation, probable error, single and multiple regression, curve fitting, Interpolation and extrapolation.

Term Work:

1. One exercise on each unit.
2. Any two problems to be solved using c, c++, excel or using softwares like SPSS, minitab, etc.
3. One exercise on formulation and solution of an optimization problem applicable to any field of Civil Engineering.

Reference Books:

1. Statistical methods – S.P.Gupta.
2. Probability and Statistics for Engineers – Richard A Johnson 3. Probability and Statistics for Science and Engineering – G Shankar Rao.
4. Numerical Methods – E Balagurusamy.
5. Numerical methods for Engineers – S. Chapra, R.P.Canale.
6. Higher Engg. Mathematics – B.S. Grewa.

401009 Elective III (3): Hydro Power Engineering

Teaching Scheme
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme
Theory Examination
In-sem: 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Marks

Unit I **(6 Hrs.)**

Energy Resources – Planning and Potential:

Power resources – Conventional and Nonconventional, Need and advantages, Overview of World Energy Scenario, energy and development linkage, Environmental Impacts of energy use, Green House Effect, Trends in energy use patterns in India, Hydropower development in India, Hydropower potential basin wise and region wise, investigation in hydropower plants.

Unit II **(6 Hrs.)**

Hydropower Plants:

Hydrological Analysis, Classification of hydropower plants based on hydraulic characteristics - Run of river plants, Storage or Valley dam plants, Pumped storage plants, Classification based on head, Classification based on operating function, Classification based on plant capacity, Classification based on nature of topography, Introduction to micro hydro, advantages and disadvantages, Principle Components of hydropower plants.

Unit III **(6 Hrs.)**

Load Assessment:

Estimation of electrical load on turbines. Load factor, Plant factor, peak demand and utilization factor, installed capacity, diversity factor, firm power, secondary power, load curve, load duration curve, Prediction of load and significance, Tariffs, Hydro-Thermal Mix, Combined Efficiency of Hydro-Thermal-Nuclear Power Plants.

Unit IV **(6 Hrs.)**

Water Conductor System and Powerhouse:

Water Conductor System – Alignment, Intake Structures- Location and Types, Trash Rack. Headrace tunnel/ Canal, Penstock and pressure shaft, Types of Powerhouses, Typical layout of powerhouse, Components, Power plant equipments, Instrumentation and control.

Unit V **(6 Hrs.)**

Turbines:

Classification, Principles and design of impulse and reaction turbines, Selection of Turbine, Specific Speed, Governing of turbines, Water hammer, Hydraulic Transients and Surge tanks, Draft tubes, Cavitation.

Unit VI **(6 Hrs.)**

Economics of Hydroelectric Power:

Hydropower - Economic Value and Cost and Total Annual Cost. Economic considerations – pricing of electricity, laws and regulatory aspects, Policies, Electricity act – 2003, Investment in the power sector, Carbon credits, Participation of private sector.

Term Work:

Minimum eight assignments as per the list given below. **Assignments 1 and 10 are compulsory.**

1. Calculating the electricity bill of upper middle class family that uses various electrical appliances.
2. Determination of power output for a run of river plant with and without pondage.
3. Justification of economics of Pumped storage plants.
4. Design of Kaplan / Francis / Pelton turbine.
5. Determination of diameter of penstock using different methods.
6. Design of surge tank.
7. Design of straight conical draft tube.
8. Use of any software to calculate water hammer pressure.
9. Case study of any hydropower project.
10. Report based on visit to any micro/small/mega hydropower project

Reference Books:

1. Water Power Engineering – M. M. Dandekar and K. N. Sharma, Vikas Publishing House.
2. Water Power Engineering – R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.
3. Handbook of Hydroelectric Engineering – P.S. Nigam
4. Modern Power System Planning – Wang.
5. Hydropower Resources in India – CBIP.

6. Hydro Power Structures – R. S. Varshney.
7. Water Power Development – E. Mosonvi, Vol. I & II.
8. Hydro-electric Engineering Practice – G. Brown, Vol. I, II & III.
9. Hydro – Electric Hand Book – Creager and Justin.
10. Water Power Engineering – P. K. Bhattacharya, Khanna Pub., Delhi.
11. Water Power Engineering – M. M. Deshmukh, Dhanpat Rai Pub.
12. Manual of "Energy Group" of 'PRAYAS', an NGO.

401009 Elective-III: (4) Air Pollution and Control

Teaching Scheme:
Lectures: 3 Hrs/week
Practical: 2 Hrs/week

Examination Scheme:
Paper In-sem. 30 Marks (1 hr),
Paper End-sem : 70 Marks (2.5 hrs)
TW : 50 Marks

Unit I **(6 hrs)**

Meteorological aspects: Zones of atmosphere, Scales of meteorology, Meteorological parameters, Temperature lapse rate, Plume behaviour. Gaussion diffusion model for finding ground level concentration, Plume rise, Types & quality of fuels, Formulae for effective stack height and determination of minimum stack height as per CPCB norms.

Unit II **(6 hrs)**

Ambient Air sampling and analysis: Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Emission inventory and source apportionment studies. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009.

Unit III **(6 hrs)**

Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, factors affecting exposure to indoor air pollution, sick building syndrome. Investigation of indoor air quality problems, changes in indoor air quality, control of indoor air pollutants and air cleaning systems. Use of various plants to control indoor air pollution. Radon and its decay products in indoor air.

Odour pollution: Theory, sources, measurement and methods of control of odour pollution.

Unit IV **(6 hrs)**

Control of air pollution: By process modification, change of raw materials, fuels, process equipment and process operation. Control of particulate matters. Working principle and design of control equipment as Settling chamber, Cyclone, Fabric filter and Electro Static Precipitator. Control of gaseous pollutants. Combustion chemistry & control of air pollution from automobiles.

Unit V **(6 hrs)**

Land use planning: As a method of control. Economics of air pollution control: Cost/benefit ratio and optimization. Legislation and regulation: Air (Prevention and Control) Pollution Act, 1981. The Environment (Protection) Act 1986. Emission standards for stationary and mobile sources.

Unit VI **(6 hrs)**

Environmental impact assessment and management: Methodology for preparing environmental impact assessment (Identifying the sources of air pollution, calculating the incremental values, prediction of impacts and mitigation measures). Role of regulatory agencies and control boards in obtaining environmental clearance for project. Public hearing. Environmental impacts of thermal power plants, sugar and cement industry. Environmental management plan. The environmental rules 1999 (sitting of industries).

Term Work:

Term work shall consist of

A. One assignment on each unit.

B. Detailed industrial visit report on Sugar/Cement/Steel//Thermal/Rubber/Dairy industry with reference to air pollution Control device(s).

Reference Books:

1. Air Pollution – H. V. N. Rao and M. N. Rao, TMH, Pub.
2. Air pollution – KVSG Murali krishna.
3. Air Pollution – Perkins.
4. Environmental Engineering – Davis, McGraw Hill- Pub.
5. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.
6. Air Pollution – Stern.
7. Air Pollution Control – Martin Crawford.
8. Air Pollution Control: its origin and control, K. Wark, C.F. Warner & W.T.Davis .
9. Fundamentals of Air Pollution-Richard W. and Donald L. Academic Press.

I.S. Codes:

1. I.S. 5182 (all parts), and
2. I.S. 15442 (2004)

e – Resources:

1. http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras.
2. http://cpcb.nic .in
3. http://moef.nic .in

401009 Elective III (5): Finite Element Method in Civil Engineering

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
Theory Examination:
In-sem: 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit I **(6 Hrs.)**

Theory of elasticity: Strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems.

Unit II **(6 Hrs.)**

General steps of the finite element method, Applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria.

Principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit III **(6 Hrs.)**

Displacement function for 2D triangular (CST and LST) and rectangular elements, Use of shape functions, Area co-ordinates for CST element, Shape functions in cartesian and natural coordinate systems, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.

Unit IV **(6 Hrs.)**

Introduction to 3D elements such as tetrahedron and hexahedron. Iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, Formulation of stiffness matrix for 1D and 2D Iso-parametric elements in plane elasticity problem.

Unit V **(6 Hrs.)**

Formulation of stiffness matrix, analysis of spring assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, applications to truss and beam not involving unknowns more than three.

Unit VI **(6 Hrs.)**

Formulation of stiffness matrix using member approach for portal frame and grid elements, transformation matrix, applications to frame and grid not involving unknowns more than three.

Termwork:

The Termwork shall be based on completion of assignments as given below.

1. At least one assignment on each unit.
2. One assignment based on FEM by using coding tools for
   a) Formulation of stiffness matrix for any 1-D element
   b) Formulation of stiffness matrix for any 2-D element
3. Finite Element Method -Software applications of any one of following cases using any standard available software.
   a) Truss/ grid problem
   b) Plane stress / plane strain problem

Reference Books

1. A first course in the finite element method-Daryl L. Logon, Thomson Publication.
2. Nonlinear finite element analysis by Reddy- Oxford University Press.
3. Introduction to the Finite Element Method – Desai & Abel, CBS Publishers & Distributors, Delhi
4. Introduction to Finite Elements in Engineering – T.R. Chandrupatla & A.D. Belegundu Prentice Hall of India Pvt. Ltd.
5. Matrix, Finite Element, Computer & Structural Analysis – M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.
6. Finite Element Analysis – Theory & Programming – C.S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.
7. An Introduction to the Finite Element Method – J.N. Reddy, TATA Mc Graw Hil Publishing Co. Ltd.
8. Theory & Problems – Finite Element Analysis – Gorge R. Buchanan, Schaum's Outline series. TATA Mc Graw Hill Publishing Co. Ltd.
9. The Finite Element Method – O.C. Zien kiewicz, TATA Mc Graw Hill Publishing Co. Ltd.
10. Finite Element Analysis – S.S. Bhavikatti, New Age International (P) Ltd.

401 0010 Elective III (6): Airport & Bridge Engineering

Teaching scheme
Lectures: 3 hours/week
Practical: 2 hrs

Examination Scheme
In-Sem Exam: 30 marks 1 hour
End-Sem Exam: 70 marks 2.5 hrs
Termwork: 50 marks

Unit 1: **(6 hrs)**

Introduction:

Advantages and limitations of air transportation. Aeroplane component parts and important technical terms, Organizations related to Air Transportation (ICAO, FAA, AAI) Roles and Responsibilities.

Airport planning:

Aircraft characteristics, which influence judicious and scientific planning of airports, Selection of sites, survey and drawings to be prepared for airport planning, Air Travel Demand forecasting, Airport classification by ICAO.

Unit 2: **(6 hrs.)**

Airport layout:

Characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons and hangers. Zoning requirements regarding permissible heights of constructions and landing within the airport boundary, Airport landslide planning, Navigation and landing aids – ILS, Air Traffic Control (ATC).

Design of Runways and taxiways:

Runway orientation, wind coverage, use of wind rose diagram, basic runway length, corrections for elevation, temperature and gradient as per ICAO and FAA recommendation, Taxiways – Concept, types, design criteria.

Unit 3: **(6 hrs.)**

Structural Design of Runways and taxiways:

Runway pavement design criteria, aircraft loading, Design methods for flexible and rigid runways, Airport drainage.

Unit 4: **(6 hrs.)**

Heliports

Helicoptor characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, Heliport marking and lighting, Vertical Takeoff and Landing (VTOL).

Unit 5: **(6 hrs.)**

Bridge engineering:

Introduction:

Classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, determination of discharge – empirical formula, direct methods, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads.

Loads on bridges:

Brief specifications of different loads, forces, stresses coming on bridges, IRC load specification, requirements of traffic in the design of highway bridges.

Substructure:

Abutment, Piers, and wing walls with their types based on requirement and suitability.

Unit 6: **(6 hrs)**

Types of bridges

Various types of bridges:

Culvert: Definition, waterway of culvert and types.

Temporary bridges: Definition, materials used brief general ideas about timber, floating and pantoon bridges.

Movable Bridges: Bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability.

Fixed span bridges: Simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure.

Bearing: Definition, purpose and importance. Types of bearings with their suitability.

Erection of bridge super structure and maintenance:

Introduction to different techniques of erection of bridge super structure and maintenance of bridges.

Term work:

Term work shall consist of: (Any eight)

1. Recent Trends in Airport planning and design (report expected)
2. Assignment on study and use of Windrose Type 1 and 2 diagram
3. Assignment on Runway Design for length and related corrections
4. Structural Design of Flexible or Rigid Runway
5. Selection of Bridge site, alignment and collection of design data
6. Assignment on conditional assessment of existing Bridges
7. Seminar on one topic each in Airport Engineering or Bridge Engineering
8. Report on Guest lecture in Airport Engineering or Bridge Engineering
9. Site visit to Bridge site or Airport site

Text Books:

1. Bridge engineering – S. Ponnuswamy, Tata Mc Graw – Hill publishing co. Ltd. New Delhi.
2. Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee.
3. Airport Engineering - Rangawala, Charotar publishing House, Anand 388001 (Gujrat)
4. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi.
5. Bridge engineering – Rangawala, Charotar Publishing House, Anand –388 001.
6. Principles and practice of Bridge Engineering – S.P. Bindra, Dhanpatrai and Sons, Delhi.

401 010 Elective IV (1): Construction Management

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Examination Scheme:
Theory Examination:
In-sem : 30 marks (1 Hour)
End-sem:70 marks (2.5.Hours)
Term work: 50 Mark

Unit – I **(6 Hrs.)**

Overview of construction sector:

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management – necessity, applications, project management consultants – role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities. (*At least 2 expert lectures by experts from field are to be conducted on above topics).

Unit – II **(6 Hrs.)**

Construction scheduling, work study and work measurement Construction scheduling. Construction project scheduling – purpose, factors affecting scheduling, time as a control tool, work breakdown structure, project work breakdown levels, line of balance technique, repetitive project management Work study and work measurement .

Definition, objectives, basic procedure of work study, symbols, activity charts, string diagrams, time and motion studies.

Unit – III **(6 Hrs.)**

Labour laws and financial aspects of construction projects Labour laws. Need and importance of labour laws, study of some important labour laws associated with construction sector-workmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act Financial aspects of construction projects. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit – IV **(6 Hrs.)**

Elements of risk management and value engineering. Risk management. Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis, decision tree analysis, risk identification, analysis and mitigation of project risks, role of insurance in risk management. Value engineering Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit – V **(6 Hrs.)**

Materials management and human resource management . Materials management Materials flow system, role of materials management in construction management and its linkage with other functional areas, vendor networking, buyer-seller relationships, eoq model and its variations, material codification and classification, concept of logistics and supply chain management, role of ERP in materials management – material resource information systems Human resource management. Human Resource in Construction Sector, Staffing policy and patterns, Human Resource Management Process, Human Resource Development Process, Performance Appraisal and Job Evaluation, Training and Career planning, Role of ERP in Human Resource Management – Human Resource Information System (HRIS).

Unit – VI **(6 Hrs.)**

Introduction to artificial intelligence technique. Basic terminologies and applications in civil engineering (a) Artificial neural network (b) Fuzzi logic (c) Genetic algorithm.

Term Work:

1. Site Visit to a Construction project to study following documents and preparing a report –

a. Project Cash Flow Analysis.

b. Project Balance Sheet.

c. Work Break Down Structure.

d. Materials Flow System in the Project.

2. Scheduling of a Construction Project using Line of Balance Technique.

3. Assignment on Work Study on any two Construction Trades.

4. Assignment on EOQ Model and its variation.

5. Assignment on application of AI techniques in Civil Engineering.

6. Seminar on any one topic from above syllabus.

Reference Books:

1. Projects – Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw Hill Publications.
2. Construction Management and Planning – B. Sengupta and H. Guha, Tata McGraw Hill Publications.
3. Civil Engineering Project Management – C. Alan Twort and J. Gordon Rees, Elsevier Publications.
4. Total Project Management – The Indian Context – P. K. Joy, MacMillian Publications.
5. Materials Management–Gopalkrishnan & Sunderasan,Prentice Hall Publications.
6. Human Resource Management – Biswajeet Pattanayak, Prentice Hall Publishers.
7. Laws for Engineers : Dr. Vandana Bhat and PriyankaVyas –Published by PROCARE,5/B,/Sagarika Society,Juhu Tara Road,Juhu,Santacruz(W),Mumbai-400049 (procure@technolegal.org).
8. Labour and Industrial Laws – S. N. Mishra, Central Law Publications.
9. Artificial Neural Network – Veganarayanan – Prentice Hall.
10. Genetic Algorithm – David & Goldberg.
11. Fuzzi Logic & Engg Applications – Ross.
12. Principles of Construction Management by Roy Pilcher (McGraw Hill)

e-Resourses:

1. ERP Software-Builders Management Software.
2. Project mates Construction Software.

401 0010 Elective IV (2): Advanced Transportation Engineering

Teaching scheme
Lectures: 3 hours/week
Practical: 2 hrs

Examination Scheme
In-Sem Exam: 30 marks 1 hour
End-Sem Exam: 70 marks 2.5 hrs
Termwork: 50 marks

Unit I **(6 hrs.)**

Transport System Planning: Transportation planning process and types of surveys. Travel demand forecasting - trip generation, modal spilt analysis, trip distribution and route assignment analysis, Transportation System Management (TSM), application in Comprehensive Mobility Plan (CMP) and DPR.

Unit II **(6 hrs.)**

Urban Transport Technology: Classification- light, medium, mass and rapid transit system, Introduction to Intelligent Transportation System (ITS) and its components, Public Transport Policy. Introduction to BRT, Mono rail, Metro rail, Bullet train and Hyperloop. Concept of Integrated Inter Model Transit System and freight transportation.

Unit III **(6 hrs.)**

A. Transport Economics & Financing: Road user cost **-** Vehicle operations cost, running cost, value of travel time, road damage cost, accident cost. Economic evaluation – Benefit cost method, Net present value method, First year rate of return method, Internal rate of return method & comparison of various methods.

B. Environmental Impact Assessment: EIA requirement of highway projects, procedure and guidelines, pollution cost and concept of congestion pricing.

Unit IV **(6 hrs.)**

Traffic Engineering: Traffic studies, basic traffic theory, traffic analysis process, level of service, intersection studies- turning movements, grade separated intersection, signal design- IRC method and Webster's method, parking study and analysis, bicycle and pedestrian facility design, instrumentation of traffic monitoring.

Unit V **(6 hrs.)**

Study of flexible pavement: Philosophy of design and design criteria, design of flexible pavement using IRC 37-2012, Distresses in flexible pavement, evaluation of pavement – Benkelmen beam, Falling Weight Deflectometer (FWD), Pavement Management Systems (PMS).

Unit VI **(6 hrs.)**

a) **Study of rigid pavement:** Philosophy of rigid pavement, comparison of rigid pavement over flexible pavement, types of rigid pavements, design of rigid pavement using IRC 58-2015 including design of joints, distresses in rigid pavement.

b) **Overlay types and their design as per IRC:** Types of overlays, design of overlay using IRC 81-1997.

Term work:

1. Traffic counts using Manual Methods.
2. Design of a flexible pavement using IRC: 37-2012 using IITPAVE.
3. Design of rigid pavement using IRC: 58-2015.
4. Road deflections measurement using Benkelmen Beam method.
5. Design of an overlay using IRC: 81-1997.
6. Conduct of distress surveys on a flexible pavement or a rigid pavement and determining its condition index (PCI).
7. Study of any two softwares related to transportation engineering.
8. Study of format of household survey and recording sample measurements.
9. Parking survey and analysis.

Reference Books:

1. Highway Engineering - Laurence I Hewes & Clarkson H Oglesby
2. Traffic Engineering and Transport Planning - L R Kadiyali, Khanna Publishers.
3. The Design and Performance of Road Pavements - David Croney, Paul Croney.
4. Understanding Traffic System -Michel A Taylor, William Young, PeterW Bonsall.
5. Principles of Urban Transport Systems Planning - B. G.Hutchinson.
6. Introduction to transport planning - M. J. Bruton.

7. Transportation Engineering An Introduction – C. Jotin Khisty, B. Kent Lall, Pearson Publication.
8. Transportation Engineering & Planning – C. S. Papacostas, P. D. Prevedouros, Pearson Publication.
9. Principles of Pavement Design - E.F. Yoder (John Wiley & Sons, lnc USA).
10. Fundamentals of Transportation Engineering - C. S. Papacostas.
11. Pavement analysis and Design – Huang Y H, Prentice Hall, Englewood Cliff, New Jersey.
12. Introduction to Transportation Engg. and Planning – Morlok E K, McGraw-Hill company.
13. Fundamentals of Traffic flow Theory – Drew, McGraw-Hill book Co.
14. A course in Traffic Planning and design-Saxena Subhash,Dhanpat Rai & sons,Delhi
15. Traffic analysis (New technologies new solutions)-Taylor M P ,Hargreen Pub.Co. New Delhi.

Codes:

1. IRC 37-2012
2. IRC 58-2015
3. IRC 81-1997
4. IRC 82-2015
5. IRC 115-2014

Hand Books:

Handbook of Road Technology _Lay M. G.Gorden Breach Science Pub.Newyork.

e-Resources:

1) www.nptel.iitm.ac.in/courses/iitkanpur
2) www.cdeep.iitb.ac.in/nptel

401 010 Elective IV (3): Advanced Foundation Engineering

Teaching Scheme
Lectures: 3 Hours/week
Practical: 2 Hours/week

Examination Scheme
Theory Examination:
In-sem : 30 marks (1 Hr.)
End-sem:70 marks (2.5Hrs.)
Term work: 50 Mark

Unit I **(6 Hrs.)**

IS code provision in respect of subsoil exploration for dams, canals, tunnels, off shore structure, air ports and bridges. IRC, provisions for exploration in respect of roads. Case studies of failures of foundation.

Unit II **(6 Hrs.)**

Design of pile based on cyclic load test. Study of provision made in different IS codes related to deep foundation, various types of pile. Design of Racer piles & piles subjected to lateral load. Testing and Design of piles subjected to tensile loads.

Unit III **(6 Hrs.)**

Design of under reamed pile foundation subjected to tensile loads. Design of sand drains and stone columns.

Unit IV **(6 Hrs.)**

Design of shallow foundations subjected to inclined loads. Design of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement. Introduction to software available for geotechnical foundation design.

Unit V **(6 Hrs.)**

Study of various provisions made as per IRC and as per IS in respect of design of well foundation. Case studies of failure of well foundation. Design of Rock fill coffer Dams.

Unit VI **(6 Hrs.)**

Stress distribution in the shaft, tunnels, underground conduits, classification, load on ditch conduits, positive and negative projecting conduits, and Imperfect ditch conduits.

Term Work:

Term work will consist of

A) Any Four of following 6 assignments.

1) Comparative study of provisions made for the extent of exploration in IS, IRC codes adapted by Indian railways, and PWD.
2) Detailed study of any two Geophysical methods of exploration.
3) Computations of Bearing capacity and Settlement of a Shallow Foundation involving inclined loads.
4) Design of Pile foundations subjected to inclined load and tensile load.
5) Design of Sand Drains.
6) Comparative study of provisions for well Foundation as per IS, IRC and code adapted by Indian railways.

B) Computer Modeling:

Design of any one type of Deep foundation using computer software.

C) Site visit and Case study:

1) One site visit to any important deep foundation and submission of report on the same giving details of design and construction.
2) Any one case study of failure of foundation from the published literature.

Reference Books:

1. Foundation Analysis and Design- Joseph E. Bowels, TATA Mc-Graw hill.
2. Design Aids in Soil Mechanics and Foundation Engineerimg-Shenbage R Kaniraj, TATA Mc-Grawhill.
3. Foundation Design & Construction (4th Ed.)- M.J.Tamlinson, ELBS publication.
4. G. A. Leonards, Foundation Engineering, McGraw-Hill, 1962.
5. R.B. Peck, W.E. Hanson and T.H. Thornburn, Foundation Engineering, 2nd Edition, John Wiley and Sons, 1974.
6. “Principles of Foundation Engineering” by B.M. Das.
7. Theory and Practice of Pile Foundations Wei Dong Guo CRC Press.

I.S .Codes:

IS: 1892-1979 – “Code of Practice for Subsurface Investigation for Foundation”.

IS: 2131-1981 (Reaffiemed 1997), “Method for Standard penetration Test for Soils”.

IS: 6403-1981 – “Code of Practice for Determination of B.C. of Shallow Foundation”.

IS: 8009 (Part-1) 1976, “Code of Practice for Calculation of settlements of foundations”.

IS: 1904-1986, “Code of Practice for Design and Construction of Foundations in Soils, general Requirements”.

IS: 2911-1979, “Code of Practice for Design and Construction of Pile Foundation”.

Handbooks:

1. Fang , H.Y.,(1991),” Foundation Engineering Handbook”, Chapman & Hall, NY.
2. Teng .W.C.(1962), Foundation Design , Prentice Hall International.
3. Foundation Design Manual by Narayan V. Nayak, Dhanpat Rai & Sons.

401 0010 Elective IV (4): Coastal Engineering

Teaching Scheme
Lectures: 3 Hours/week
Practical: 2 Hours/week

Examination Scheme
Theory Examination:
In-sem: 30 marks (1 Hour)
End-sem: 70 marks (2.5.Hours)
Termwork : 50 marks

Unit I **(6 Hrs.)**
Basics of Ocean Waves:
Generation ,classification, Basic understanding of wave mechanics including wave propagation,wave theories,, wave diffraction , wave refection, wave breaking. Waves of unusal character-currents, giant waves , tsunami etc.

Unit II **(6 Hrs.)**
Tides:
Tide producing forces- earth moon and earth sun system , dynamic theory of tides-; types of tides- tides and tidal current in shallow sea, storm surges, tides in rivers and estuaries ,tidal power.

Unit III **(6 Hrs.)**
Coastal Processes:
Coastal process- Erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) estimate of wave induced sediment, budget. Tides, effect of Tides, stability of inlets. Effect of construction of coastal structures on stability of shoreline / beaches.

Unit IV **(6 Hrs.)**
Design of Marine Structures:
Design of Marine Structures: Seawalls, Revetments, Breakwater rubble mound, composite, floating and pneumatic types, and jetties. Offshore structures, Oil Production platform, sub marine pipelines. Model studies.

Unit V **(6 Hrs.)**
Design Technology:
Dredging Technology: Types of dredgers, design of disposal methods of dredged materials Environmental aspect of dredging , studies for feasibility of dumping ground for dredged material.

Unit-VI **(6 Hrs.)**
Coastal Management:
Pollution in Coastal zone, disposal of waste/dredged spoils, design criteria of coastal outfall inlets and system. Oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, Issues related to Integrated coastal zone management. Coastal regulation zone.

Reference Books:

1. Brunn Per ,B. U. Naik, “Shore Protection Manual”, NIO Goa.
2. Quinn A. D., “Port Planning”, Mc Grow Hill Book Co. New York.
3. Richard Silvester, “Coastal Engineering”, Vol-I-II, University of Western Australia.
4. Shore Protection Manual-U.S.Waterways Experiment Station Corps of Engineer.
5. Costal Engineering Research Center, Vickburg andU.S.A.1984.Coastal Protection Manual 2002.
6. Harbour and Coastal Engineering”, Vol. I&II, Ocean and Coastal Engineering Publication, NIOT, Chennai.

Term work-
One assignment on each unit.

401 010 Elective IV: Open Elective : 5 (a): Plumbing Engineering

Teaching Scheme:
Lectures: 3 hours/week
Practical: 2 hours/week

Theory Examination Scheme:
In-sem : 30 marks (1 Hour)
End-sem :70 marks (2.5 Hours)
Term work: 50 Marks

Unit I **(6Hrs.)**

Introduction to plumbing engineering Definition- plumbing engineering/public health engineering, Indian plumbing industry, Roles of plumbing contractor, plumber, plumbing consultant, plumbing terminology, Principles of plumbing,

a) Introduction to codes and standards:
Introduction to UPC-I and ITM, Green plumbing code supplement-India (GPCS-I) and other codes applicable in plumbing, Approvals of authority having jurisdiction, General regulations, Testing and labeling, Alternative materials, workmanship and minimum standards, Prohibited fittings and practices, Local laws related to plumbing.

b) Architectural and structural coordination, plumbing shafts, Sunken toilet floors, Ledge walls.

Unit II **(6 Hrs)**

Water Supply, fixtures and fittings.

a) Water Supply**:** Types of water supply pipes Fittings and joints, Galvanized iron, Copper, Stainless steel, HDPE, MDPE, Rigid PVC, CPVC, PPR, Composite pipes, (PE-AL-PE), PEX, Joints, Jointing methods and materials, Tools etc. Water hammering, Pipe protection, Velocity, pressure, temperature limitations, Water Supply Fixture Unit (WSFU), Sizing, testing, Valves and regulators, Backflow prevention, Commissioning, Water tanks.

b) Plumbing fixtures, Water conserving fixtures, Rating system for water efficient products, (WEP-I), Water closets, Bidets, Urinals, Flushing devices, Lavatory and bath units, Kitchen sinks, Water coolers, Purifiers, Drinking water fountain, Cloth washers, Mop sinks, Dish washers, Receptors Overflows, Strainers, Standard heights. Prohibited fixtures, Floor slopes, Minimum spacing.

Unit III **(6Hrs.)**

Sanitary system and Storm water Drainage:

a) Sanitary system: Fixtures, Appliances and appurtenance, Classification of fixtures, Soil and waste and grey water, Soil fixtures, Bathroom fixtures, Accessories, Indirect waste connections, Food handling establishments, Fixtures below invert level.

b) Building Drains:

Introduction, Four systems of plumbing, One pipe and two pipe system, Air admittance valves and solvents, Comparison of systems, Vent pipe, Symphonic action, Antisyphon and vent pipes, Loop, Circuits, Types of building drainage pipes, Fittings and jointing methods, Clean outs, Drainage fixture units (DFU), Sizing, Testing, Case study

Unit IV Traps and Interceptors **(6Hrs.)**

Traps-Purpose, Fixture traps and floor traps, Prohibited traps, Trap arm, Developed length, Trap seal, Trap seal protection, Venting of traps, Trap primers, Building traps, Clarifiers, Grease interceptors, Sizing, oil and sand interceptors.

b) Vents:

Vent requirement, Parts of vent system. Parts of vent system, Materials, Sizing, Vent connections, Flood rim level, Island sink venting, Venting of interceptors, Water curtain and hydraulic jump, Termination of vent stacks, Stack venting, Yoke vent, Wet venting.

Unit V **(6Hrs.)**

a) Building Sewers:

DFU, Change in direction of flow, Hydraulic jump,Sudsing stack, Cleanouts, Pipe grading, pipes and fittings suitable for building sewers, RCC, PVC, Nu-Drain, Stoneware., Sizing, testing, Types of traps, Gully, Chambers and manholes, Materials, Venting, Sizing, Testing, Sumps, Pumps, Sewage disposal, Septic tanks.

b) Plumbing in high rise buildings:

Definition of high rise building, Multiple storage tanks, Plumbing shafts, Break pressure tanks, Water supply, Hydro pneumatic system, Pressure reducing valves, Building drainage system, Rain water system, Sizing, Testing, Case study, Introduction to centralized hot water supply, Principles of design.

Unit VI **(6 Hrs)**

Design Parameters & Case Study

Introduction, Plumbing Drawings & Layouts, Water Supply Design Consideration, Sewer Network design consideration, Storm water design consideration as per CPHEEO manuals, Case study on each.

Term work

Term work will consist of 8 assignments with necessary plans /sketches.

1. Introduction of available codes in plumbing
2. Introduction of associations in plumbing in India and outside India
3. Detailed hydraulic design for High rise structure OR G+1 Bungalow by using software.
4. Compilation of rules and regulations of local governing bodies.
5. Roles of plumbing contractor and plumbing consultants.
6. Report on Plumbing fixtures and fittings and explain any ten.
7. Report on materials for water supply and drainage.
8. Report on necessity of traps, intercepts and vents

Books:

1. “Plumbing Engineering” by Deolalikar.
2. “Plumbing, Sanitation and Domestic Engineering” Volume – 1to 4 by G. S. Williams, Mc Graw Hill.
3. “Plumbing, Sanitation and Domestic Engineering, Data Sheets & Wall Charts” by G. S. Williams, Mc Graw Hill
4. “Plumbing Engineering, Theory and Practice” by Subhsh Patil. SEEMA Publishers Mumbai
5. “National Plumbing Codes Handbook”, by R. Dodge Woodson.
6. “Central Public Health and Environmental Engineering Organisation Manual (CPHEEO)”.

Codes:

1. Uniform Plumbing Code- India (UPC-I), 2008
2. Illustrated Training Manual (ITM), 2008.

401 010 Elective IV: Open Elective: 5 (b): Green Building Technology

Teaching Scheme:
Lectures: 3 Hours/week
Practical: 2 Hours/week

Examination Scheme:
Theory Examination:
In-sem : 30 Marks (1 Hour)
End-sem:70 Marks (2.5 Hours)
Term work: 50 Marks

Unit I: **(6 Hrs.)**

Materials and Its Applicability, Indoor Environmental Quality, Reuse and Recycle of Construction Waste.

A) Eco Friendly/ Green Building Materials: To understand Environmental impact of building materials. Eco Friendly building materials, their composition, availability, production, physical properties etc. Application of the Eco Friendly/ Green Building materials for different components of the buildings at different level, both internally and externally.

B) Indoor environmental quality, Low VOC materials: Adhesives - Sealants, Paints- Coatings etc.

C) Construction Waste as a Resource- Resource Economics, Disposable Materials, Recovery, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse.

Unit II **(6 Hrs.)**

Site / Building Planning

A) Sustainable Site planning: wind / sun path, water management , material use, landscape, topography.

B) Climate Responsive Architecture: orientation, solar- wind, Building envelope.

C) Thermal comfort indices. Heat flow through building materials. Thermal properties of common building materials available in India. Thermal performance of building envelope. Air movement and buildings. Ventilation and buildings. Wind an Stack effect. Mechanical ventilation. HVAC System, Day lighting. Passive and sustainable architecture. Passive and active systems.

Unit III **(6 Hrs.)**

Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

A) Embodied energy of various construction materials. Introduction to the Concept: "Life Cycle assessment of materials".

B) EIA : Introduction to EIA., Process of EIA and its application through a case study., EIA as a strategic tool for sustainable development.

C) Energy Management.

Unit IV **(6 Hrs.)**

Appropriate Technologies / Approaches for:

A) Water conservation / efficiency.

B) Sanitation (Grey water, black water management, SWM)

C) Treatments.

D) Biogas.

E) Composting.

F) Solar energy and its applicability through panels, photovoltaic cells etc.

G) Use of "LED, CFL, Fresnel Lens" etc.

H) Wind energy and its use.

I) Orientation aspects in site planning to achieve maximum daylight and natural ventilation.

UNIT V: **(6 Hrs.)**

A) Clean Development Mechanism.

B) Kyoto Protocol.

C) Energy Conservation Building Code.

UNIT VI **(6 Hrs.)**

Rating Systems: - Leadership in Energy and Environmental Design (LEED), Green Globes, National Association for Home Builders (NAHB) – For Homes, Building Research Establishment Environmental Assessment Method (BREEAM), Green Star by Green Building Council Australia (GBCA), LEED India, Comprehensive Assessment System for Built Environment Efficiency (CASBEE), Estimada -Abu Dhabi Urban Planning Council (UPC) etc.

Term Work:

Any Eight of the following:

A) To study: Innovative Materials Developed by CBRI, SERC.

B) To study: Environmental Audit of any existing building and prepare a report.

C) To study, analyze present scenario of organic waste collection and management of any of the premise; preferably hotels.

D) To compare the benefits under different rating systems.

E) To prepare detailed plan for a hypothetical site indicating utility of solar path, wind direction, rainfall intensity etc. to make it sustainable.

F) To prepare a report on carbon credit.

G) To prepare a report on energy efficient buildings in India.

H) To study sustainable planning aspects for urban housing.

I) Study of Design of On Site Sanitation Systems for Indian conditions developed by Appasaheb Patwardhan Safai V Paryavaran Tantraniketan, Dehugaon .

J) To study the benefits given by Municipal Corporations to Green Buildings.

Reference Books and Additional Reading material:

1. Manual of Tropical housing and climate by Koenisberger.
2. Climate responsive architecture by Arvind Krishnan.
3. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
4. Energy Efficient Buildings in India by Milli Mujumdar.
5. Green Building Materials by Ross Spiegel and Dru Meadows.
6. Publications from - CBRI – Roorkee, - IDC – Mumbai, NID – Ahmedabad.
7. Solar Energy in Architecture and Urban Planning by Herzog Thomas.
8. Solar Heating, Design Process by Kreider Jan F.
9. Energy - Manual for college teachers (CEE publications).
10. Renewable Energy & Environment - A policy analysis for India (CEE publications).
11. Sustainable Building Design Manual-Volume I and II –TERI Publication.
12. Mechanical and Electrical Systems in Construction and Architecture-by Frank R Dagostino.

Principles of Air conditioning-By V. Paul Lang:

1. Heating, Cooling and lighting design methods for architecture. By Lechor Worbert.
2. LEED Manual.
3. Green Globes Manual.
4. Florida Green Building Coalition Manual.
5. The green building process.
6. Green building codes and standards.
7. International Green Construction Code.
8. ASHRAE 189P.
9. ANSI/GG 01, TERI, BREEAM etc.

401 010 Elective IV: Open Elective: 5 (c): Ferrocement Technology

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours/week	**Theory Examination:**
Practical: 2 hours/week	**In-sem : 30 marks (1 Hour)**
	End-sem:70 marks (2.5 Hours)
	Term work: 50 Mark

Unit 1 **(6 Hrs.)**

What is Ferrocement?

a) Definition, Basic concept like bond increase. Comparison with concretes like RCC, Prestressed, Asbestos cement, Fiber reinforced, Polymer concretes. Composition of ferrocement. Special types of ferrocement. Ferrocement as substitute for conventional building materials. Typical characteristics and their applications.

b) Raw materials, skills, tools and plants. Ferrocement as material of construction. Forming a ferrocement structure. Properties and specifications of raw materials. Proportioning of cement mortar. Job requirements of required skills. Tools and plants.

Unit 2 **(6 Hrs.)**

Mechanical properties and construction methods:

a) Mechanical properties and typical features affecting design. Properties under static and dynamic loading. Shrinkage and creep. Testing of ferrocement.

b) Methods of constructing ferrocement structures. Standardizing method of construction. Planning the work. Fabricating skeleton, tying meshes and mortaring. Curing. Maintenance. Protective surface treatments. Damage to ferrocement structures.

Unit 3 **(6 Hrs.)**

Strength through shape and design:

a) Strength through shape. Design of structure based on form and shape. Forms in nature, various structural forma and their behavior. Typical strengths of different materials. Comparative study of various forms.

b) Design of ferrocement structures. Design, analysis and optimization. Special design considerations for ferrocement. Typical features of ferrocement affecting design. Conventional design methods like working stress, load factor, applied to ferrocement. Design based on equivalent area method for compression, tension and flexural members. Specific surface method and crack control method, Design of structures subjected to membrane stresses. Design of shaped structures in ferrocement like stiffened plates, arch faced walls, stiffened cavity walls and hollow floors and beams, Design of forms like ‘T’ ‘U’ ‘T’ ‘+’ ‘L’

Unit 4 **(6 Hrs.)**

Cost analysis and ferrocement in Building construction.

a) Cost analysis : Factors governing cost analysis. Special considerations for ferrocement structures. Cost comparison with conventional construction. Specifications for ferrocement structures. Quantity analysis of material and labour for ferrocement items. Cost and value of ferrocement construction.

b) Ferrocement in building construction. Ferrocement in foundations, walls, floors roofs. Ferrocement single wall construction. Design and construction of houses with cavity walls, hollow floors and hollow beams. Staircases and other building accessories. Earthquake resisting structures. Special characteristics of ferrocement to resist shock loading design and construction of quake proof structures.

Unit 5 **(6 Hrs.)**

Hydraulic and soil retaining structures in ferrocement :

a) Hydraulic structures. Why ferrocement? Water retaining structures, Storage tanks of various types. Structures across streams. Ferrocement in layered form used for lining, water proofing and surface coating.

b) Soil retaining structures. Types of retaining walls and their comparison with ferrocement arch faced wall. Design and method of fabrication and casting. Ferrocement counterfort retaining wall. Ferrocement containers for storing granular materials.

Unit 6 **(6 Hrs.)**

Space structures and precast products:

a) Ferrocement large size special purpose structures. Space structures like shells, pyramids, domes corrugated catenaries.

b) Precast ferrocement products : Why ferrocement for precasting? Methods of precasting. Design of precast elements. Ferrocement precast walling and flooring panels. Joints in precast ferrocement elements.

Term Work :

Minimum 02 site visits with detailed reports and one assignment based on each unit (Journal consisting of total 6 assignments + 2 visit reports).

Books Recommended:

1) Ferrocrete Technology- A Construction Manual. -- Dr. B. N. Divekar Published by the Author.

2) Ferrocement --- : B. R. Paul and R. P. Pama.Published by International Ferrocement Information Centre. A.I.T. Bangkok, Thailand.

3) Ferrocement and laminated cementitious composites --: A.E. Naaman. Publisher : Techno-press, Ann Arbor, Michigan, USA.

4) Ferrocement - Materials and applications; Publication SP 61, A C I Detroit. USA

5) State of the art report and guide for design, Construction and repairs of Ferrocement; ACI Committee Report. No. ACI 549R-88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA.

6) Chapter 1 titled 'Ferrocement' by S. P. Shah and P. N. Balaguru in book 'Concrete Technology and Design Vol. II, Editor; R. N. Swamy.

7) Proceedings of International Symposiums on 'Ferrocement and thin reinforced composites – Ferro 1 to Ferro 10. Available with International Ferrocement Information Centre, A I T Bangkok, Thailand.

8) Ferrocement Conference Proceedings of Ferrocement Society, India--FS 2011, F.S.2013, F. S. 2015.

401 010 Elective IV: Open Elective: 5 (d): Sub Sea Engineering

Teaching Scheme
Lectures: 3 hours/week
Practical 2 hours/week

Examination Scheme
Theory Examination
In-sem: 30 marks (1 Hour)
End-sem: 70 marks (2.5.Hours)
Termwork: 50 Marks.

Unit1 **(6 Hrs.)**

Introduction to oil and gas industry: general view of oil and gas industry, technological challenges and future developments. Overview of deep water developments: introduction, deep water areas and potential, challenges, route for development Metaocean and environmental conditions: Overview of the determination of Metaocean conditions (meteorological and oceanographic) and the influence of wave, wind, tide and current on marine operations. Introduction to marine ecology and its impact on marine operations.

Unit 2 **(6 Hrs.)**

Introduction to subsea infrastructure development: Summarize the current state of the art and highlights the design challenges. Outlines the way in which water depth influences the architecture and technology of Oil and Gas infrastructure.

Flow assurance: overview of flow assurance and the fundamentals of flow management for subsea production systems, Introduction to flow assurance issues like paraffin deposition; hydrate formation and blockage; Asphaltene precipitation; emulsions; experimental methods, flow assurance assessment methods; prevention, mitigation and remediation tools for flow assurance issues; thermal management and insulation materials.

Unit 3 **(6 Hrs.)**

Subsea installation and intervention: Overview of the installation of subsea plant, risers and pipelines and the main intervention methods including AUVs, ROVs and divers.

Subsea operations and control: An overview of the principle methods of subsea control including electrical, acoustic and hydraulic systems.

Subsea processing and artificial lift: introduction the analytical and numerical models used to design subsea processing systems for sustained recovery of hydrocarbons.

Unit 4 **(6 Hrs.)**

Reliability and integrity management: Introduction to Risk Assessment, FMECA and HAZOPS, Monitoring, Intervention and Inspection Methods, Data Management Construction management of oil field, future challenges.

Unit 5 **(6 Hrs.)**

Subsea field equipment, structures and architectures: scale of operations, environmental factors, A description of each of the pieces of the subsea infrastructure, their use and interconnection including subsea trees, flow lines, umbilicals, risers, moorings and pipelines Materials and corrosion. Types of corrosion found in the oilfield with emphasis on the effects of acid gases (CO_2 and H_2S).

Unit 6 **(6 Hrs.)**

Pipelines and design: Introduction to pipeline engineering, the main pipeline design challenge in deep water. Analysis and design methods of pipelines that address stress analysis, buckling and collapse of deep water pipelines. Limit state based strength design methods. Geotechnical aspects of pipeline design and its installation.

Deepwater risers: different design options available for deep water risers, and defines the key design drivers for each. General principles of stress analysis: An introduction to the principles of stress analysis and the principles of reliability based design, finite element analysis.

Termwork:--Shall consist of one assignment per unit.

References:

1. A Primer of Offshore Operations by Petex

2. Subsea Engineering Handbook Hardcover by Yong Bai (Editor), Qiang Bai (Editor)

C. Norsok standard Common requirements Subsea structures and piping system U-cr-001 Rev. 1, January 1995.

D. Norsok codes, DNV codes : Design specifications for subsea system.

401 010 Elective IV : Open Elective : 5 (e): (Geoinformatics)

Teaching Scheme:
Lectures: 3 Hrs/week

Examination Scheme:
Paper In-sem. 30 Marks (1 Hrs),
Paper End-sem : 70 Marks (2.5 Hrs.)

Unit I **(6 Hrs.)**

Introduction to Remote Sensing GIS and SBPS:

Electro-magnetic radiations **(**EMR) - atmospheric scattering, Raleigh scattering, Mie scattering, non-selective scattering -atmospheric absorption - atmospheric windows, refraction - interaction of EMR earth‘s surface - reflection - transmission - spectral signature - Reflectance characteristics of Earth‘s cover type: Vegetation, water, soil

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements. Introduction to SBPS, Segments and errors in GPS.

Unit II **(6 Hrs.)**

THERMAL REMOTE SENSING: Thermal radiation principles – Thermal interaction sensors and characters – thermal image characters – image degradation sources & correction – interpretation of thermal images – Application and Case studies.

MICROWAVE REMOTE SENSING: Introduction-Plane waves-Interference, Radar remote sensing - Radar basics- Antenna Systems -Real aperture radar - Radar frequency bands - SLAR Imaging Geometry, Resolution Concepts - Geometric Distortions, SAR – Concepts - Doppler principle & Processing. RADAR Interaction with earth surface- RADAR equation.

Unit III Unit II **(6 Hrs.)**

DIGITAL IMAGE PROCESSING :

Fundamentals of Image Processing, sensors model and pre processing, image enhancement, image classification, object recognition.

Unit IV **(6 Hrs.)**

OPEN SOURCE GIS:

DESKTOP GIS WITH OPEN SOURCE GIS : View Graphics – Data exchanges- portability and interoperability – Raster handling and Image analysis – vector data management –Rater and vector analysis - 2D/3D vectors with topology, 3D Voxel, 2D Raster.

OPEN SOFTWARE AND WEB MAPPING : Open Source Software : GRASS, QGIS, OSSIM, PostopesSQL and (R) Environment – WEB Mapping Architecture and components – WEB mapping servers- Thin clients in WEB mapping - WMS,WFS, WCS,WPS and other web services- Open Server standards.

Unit V **(6 Hrs.)**

MAP PROJECTION:

Concepts of sphere, ellipsoid and geoid - latitudes, longitudes and graticules –map projections– shape, distance, area and direction properties - role of aspect, development surface, secant and light source / view points – perspective and mathematical projections – Indian maps and projections – Map co-ordinate systems – UTM and UPS references – common projections and selections– projections for hemispheres and the world maps , Map projection for cadastral maps.

Unit VI **(6 Hrs.)**

FUNDAMENTALS and GEOMETRIC GEODESY:

Definitions- Classifications, Problem of Geodesy and purpose of Geodesy Historical development and Organization of Geodesy. Reference Surfaces and their relationship. Applications, Engineering, Lunar, Planetary and interferometric Synthetic aperture radar Geodesy – Local and International Spheroid.

Geomentry of ellipsoid, fundamental mathematical relationship of ellipsoid, Geodetic, Geocentric and Reduced latitudes and their relationship. Ellipsoidal Co-ordinates in terms of Reduced, Geodetic and geocentric latitude. Radius of curvature in the meridian & prime vertical and their relationship. Mean Radius of curvature in any azimuth, Length of the meridian arcs and arcs of parallel and Area of trapezium on the ellipsoid. Curves on the ellipsoid, properties of Geodesic.

Reference Books:

1. Wolfgang Torge, Geodesy, Walter De Gruyter Inc., Berlin, 2001
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.
3. Neteler M, Helena M (2008) _Open source GIS: A GRASS GIS approach‘, 3rd edn, Springer, New York
4. Kang-Tsung Chang, Introduction to Geographic Information Systems, Mc-Graw Hill Publishing, 2nd Edition, 2011.
5. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey,2005 3rd edition
6. R.W. Anson and F.J. Ormeling, Basic Cartography for students and Technicians. Vol.I, II and III, Elsevier Applied Science Publishers, 3rd Edition, 2004.

401006 Project work

Teaching Scheme:
Tutorial: 6 Hrs/week

Examination Scheme:
TW : 50 Marks.
Oral : 100 Marks.

Project Work will be evaluated for an individual student based on the presentation of the work done in a year(I Sem + II Sem) and submission of the report .The student may work in a group during project work, if any.

The project work shall consist of any one of the following nature in Civil Engineering related subjects.

1. Experimental investigation.
2. Software development.
3. Benefit : Cost economic analysis.
4. Case study with own design.
5. Working model design and fabrication.
6. Case study with development of methodology using soft computing tools.

The details of report writing and preparation of report will be similar to that of as mentioned in syllabus of Project Phase I in first semester.

Evaluation of Project work in final exam. Will be done by the pair of internal guide having minimum 3 years approved experience as teacher and external guide.

It is recommended to promote the students to present a paper based on project work in appropriate conference / journal.

Faculty of Engineering
Savitribai Phule Pune University, Pune

Maharashtra, India

Syllabus

for

Fourth Year of Computer Engineering
(2015 Course)

(with effect from 2018-19)

Prologue

It is with great pleasure and honor that I share the syllabi for Fourth Year of Computer Engineering (2015 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the syllabus with the blend of core subjects, current developments and exotic subjects. By considering all the aspects with adequate prudence the contents are designed to make the graduate competent enough as far as employability is concerned. It is absolutely necessary and justified to add sufficient flexibility in the given constraints leading the curriculum design near to perfection.

It may be highly subjective to include or exclude the courses, but benefit of the learner is always the nucleus the process. Many thoughts, suggestions, recommendations and directions help us to come up with the final contents. For the final year finishing touch is absolutely necessary which is provided with project based learning at the most.

I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Dr. Varsha H. Patil
Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

[This document contents Program Educational Objectives - Program Outcomes - Program Specific Outcomes(page 3),Courses (teaching scheme, examination, marks and credit)(page 4-5), Courses syllabi(page 7-85) and FE to BE courses at a glance(Page 86-87)].

Other related Syllabus Links:
Syllabus for First Year Engineering (2015 Course)
Syllabus for Second Year Computer Engineering (2015 Course)
Syllabus for Third Year Computer Engineering (2015 Course)

Savitribai Phule Pune University, Pune
Bachelor of Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals, domain knowledge, updated with modern technology to provide the effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professional with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.
4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis and mathematical modeling to the solution of complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practice of lifelong learning.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

PSO2: Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
(with effect from 2018-19)

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410241	High Performance Computing	04	--	30	70	--	--	--	100	04	--
410242	Artificial Intelligence and Robotics	03	--	30	70	--	--	--	100	03	--
410243	Data Analytics	03	--	30	70	--	--	--	100	03	--
410244	Elective I	03	--	30	70	--	--	--	100	03	--
410245	Elective II	03	--	30	70	--	--	--	100	03	--
410246	Laboratory Practice I	--	04	--	--	50	50	--	100	--	02
410247	Laboratory Practice II	--	04	--	--	50	--	*50	100	--	02
410248	Project Work Stage I	--	02	--	--	--	--	*50	50	--	02
									Total Credit	**16**	**06**
Total		**16**	**10**	**150**	**350**	**100**	**50**	**100**	**750**	**22**	
410249	Audit Course 5									**Grade**	

Elective I	**Elective II**
410244 (A) Digital Signal Processing	**410245 (A)** Distributed Systems
410244 (B) Software Architecture and Design	**410245 (B)** Software Testing and Quality Assurance
410244 (C) Pervasive and Ubiquitous Computing	**410245 (C)** Operations Research
410244 (D) Data Mining and Warehousing	**410245 (D)** Mobile Communication

410249-Audit Course 5 (AC5) Options:

AC5-I Entrepreneurship Development

AC5-II: Botnet of Things

AC5-III: 3D Printing

AC5-IV: Industrial Safety and Environment Consciousness

AC5-V: Emotional Intelligence

AC5-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical

Sem: Semester *__PRE__: Project/ Mini-Project Presentation

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
(with effect from 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410250	Machine Learning	03	--	30	70	--	--	--	100	03	--
410251	Information and Cyber Security	03	--	30	70	--	--	--	100	03	--
410252	Elective III	03	--	30	70	--	--	--	100	03	--
410253	Elective IV	03	--	30	70	--	--	--	100	03	--
410254	Laboratory Practice III	--	04	--	--	50	50	--	100	--	02
410255	Laboratory Practice IV	--	04	--	--	50	--	*50	100	--	02
410256	Project Work Stage II	--	06	--	--	100	--	*50	150	02	04
									Total Credit	**12**	**10**
Total		**12**	**14**	**120**	**280**	**200**	**50**	**100**	**750**	**22**	
410257	Audit Course 6									**Grade**	

Elective III	**Elective IV**
410252 (A) Advanced Digital Signal Processing	**410253 (A)** Software Defined Networks
410252 (B) Compilers	**410253 (B)** Human Computer Interface
410252 (C) Embedded and Real Time Operating Systems	**410253 (C)** Cloud Computing
410252 (D) Soft Computing and Optimization Algorithms	**410253 (D)** Open Elective

410259-Audit Course 6 (AC6) Options:

AC6-I: Business Intelligence
AC6-II: Gamification
AC6-III: Quantum Computing
AC6-IV: Usability Engineering
AC6-V: Conversational Interfaces
AC6-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical
Sem: Semester *__PRE__: Project/ Mini-Project Presentation

SEMESTER

I

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410241: High Performance Computing

Home

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210253-Microprocessor, 210244- Computer Organization and Architecture, 210254-Principles of Programming Languages, 310251- Systems Programming and Operating System

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To study parallel computing hardware and programming models
- To be conversant with performance analysis and modeling of parallel programs
- To understand the options available to parallelize the programs
- To know the operating system requirements to qualify in handling the parallelization

Course Outcomes:

On completion of the course, student will be able to–

- Describe different parallel architectures, inter-connect networks, programming models
- Develop an efficient parallel algorithm to solve given problem
- Analyze and measure performance of modern parallel computing systems
- Build the logic to parallelize the programming task

Course Contents

Unit I	Introduction	09 Hours

Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II	Parallel Programming	09 Hours

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III	Basic Communication	09 Hours

Home

Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

Unit IV	**Analytical Models of Parallel Programs**	**09 Hours**

Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-Matrix Multiplication.

Unit V	**Parallel Algorithms- Sorting and Graph**	**09 Hours**

Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best-First Search.

Unit VI	**CUDA Architecture**	**09 Hours**

CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C-Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C.

Books:

Text:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

References:

1. Kai Hwang, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A Hardware/Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1
4. Rod Stephens, “ Essential Algorithms”, Wiley, ISBN: 978-1-118-61210-1

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410242: Artificial Intelligence and Robotics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210254-Principles of Programming Languages

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To understand the concept of Artificial Intelligence (AI)
- To learn various peculiar search strategies for AI
- To acquaint with the fundamentals of mobile robotics
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

On completion of the course, student will be able to–

- Identify and apply suitable Intelligent agents for various AI applications
- Design smart system using different informed search / uninformed search or heuristic approaches.
- Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem.
- Apply the suitable algorithms to solve AI problems

Course Contents

Unit I	Introduction	08 Hours

Artificial Intelligence: Introduction, Typical Applications. State Space Search: Depth Bounded DFS, Depth First Iterative Deepening. Heuristic Search: Heuristic Functions, Best First Search, Hill Climbing, Variable Neighborhood Descent, Beam Search, Tabu Search. Optimal Search: A^* algorithm, Iterative Deepening A^*, Recursive Best First Search, Pruning the CLOSED and OPEN Lists.

Unit II	Problem Decomposition and Planning	08 Hours

Problem Decomposition: Goal Trees, Rule Based Systems, Rule Based Expert Systems. Planning: STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning, A Unified Framework For Planning. Constraint Satisfaction : N-Queens, Constraint Propagation, Scene Labeling, Higher order and Directional Consistencies, Backtracking and Look ahead Strategies.

Unit III	Logic and Reasoning	08 Hours

Home

Knowledge Based Reasoning: Agents, Facets of Knowledge. Logic and Inferences: Formal Logic, Propositional and First Order Logic, Resolution in Propositional and First Order Logic, Deductive Retrieval, Backward Chaining, Second order Logic. Knowledge Representation: Conceptual Dependency, Frames, Semantic nets.

Unit IV	Natural Language Processing and ANN	08 Hours

Natural Language Processing: Introduction, Stages in natural language Processing, Application of NLP in Machine Translation, Information Retrieval and Big Data Information Retrieval. Learning: Supervised, Unsupervised and Reinforcement learning. **Artificial Neural Networks** (ANNs): Concept, Feed forward and Feedback ANNs, Error Back Propagation, Boltzmann Machine.

Unit V	Robotics	08 Hours

Robotics: Fundamentals, path Planning for Point Robot, Sensing and mapping for Point Robot, Mobile Robot Hardware, Non Visual Sensors like: Contact Sensors, Inertial Sensors, Infrared Sensors, Sonar, Radar, laser Rangefinders, Biological Sensing. Robot System Control: Horizontal and Vertical Decomposition, Hybrid Control Architectures, Middleware, High-Level Control, Human-Robot Interface.

Unit VI	Robots in Practice	08 Hours

Robot Pose Maintenance and Localization: Simple Landmark Measurement, Servo Control, Recursive Filtering, Global Localization. Mapping: Sensorial Maps, Topological Maps, Geometric Maps, Exploration. Robots in Practice: Delivery Robots, Intelligent Vehicles, Mining Automation, Space Robotics, Autonomous Aircrafts, Agriculture, Forestry, Domestic Robots.

Books:

Text:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
2. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5
3. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
4. Michael Jenkin, Gregory, " Computational Principals of Mobile Robotics", Cambridge University Press, 2010, ISBN : 978-0-52-187157-0

References:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410243: Data Analytics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310242-Database Management Systems

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To develop problem solving abilities using Mathematics
- To apply algorithmic strategies while solving problems
- To develop time and space efficient algorithms
- To study algorithmic examples in distributed, concurrent and parallel environments

Course Outcomes:

On completion of the course, student will be able to–

- Write case studies in Business Analytic and Intelligence using mathematical models
- Present a survey on applications for Business Analytic and Intelligence
- Provide problem solutions for multi-core or distributed, concurrent/Parallel environments

Course Contents

Unit I	Introduction and Life Cycle	08 Hours

Introduction: Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Opearationalize. Case Study: GINA

Unit II	Basic Data Analytic Methods	08 Hours

Statistical Methods for Evaluation- Hypothesis testing, difference of means, wilcoxon rank–sum test, type 1 type 2 errors, power and sample size, ANNOVA. Advanced Analytical Theory and Methods: Clustering- Overview, K means- Use cases, Overview of methods, determining number of clusters, diagnostics, reasons to choose and cautions.

Unit III	Association Rules and Regression	08 Hours

Home

Advanced Analytical Theory and Methods: Association Rules- Overview, a-priori algorithm, evaluation of candidate rules, case study-transactions in grocery store, validation and testing, diagnostics. Regression- linear, logistics, reasons to choose and cautions, additional regression models.		
Unit IV	**Classification**	**08 Hours**
Decision trees- Overview, general algorithm, decision tree algorithm, evaluating a decision tree. Naïve Bayes – Bayes' Algorithm, Naïve Bayes' Classifier, smoothing, diagnostics. Diagnostics of classifiers, additional classification methods.		
Unit V	**Big Data Visualization**	**08 Hours**
Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in Big data visualization.		
Unit VI	**Advanced Analytics-Technology and Tools**	**08 Hours**
Analytics for unstructured data- Use cases, Map Reduce, Apache Hadoop. The Hadoop Ecosystem- Pig, HIVE, HBase, Mahout, NoSQL. An Analytics Project-Communicating, operationalizing, creating final deliverables.		

Books:

Text:

1. David Dietrich, Barry Hiller, "Data Science and Big Data Analytics", EMC education services, Wiley publications, 2012, ISBN0-07-120413-X
2. Ashutosh Nandeshwar , "Tableau Data Visualization Codebook", Packt Publishing, ISBN 978-1-84968-978-6

References:

1. Maheshwari Anil, Rakshit, Acharya, "Data Analytics", McGraw Hill, ISBN: 789353160258.
2. Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication, ISBN: 978-1-118-16430-3
3. Luís Torgo, "Data Mining with R, Learning with Case Studies", CRC Press, Talay and Francis Group, ISBN9781482234893
4. Carlo Vercellis, "Business Intelligence - Data Mining and Optimization for Decision Making", Wiley Publications, ISBN: 9780470753866.

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(A): Digital Signal Processing

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 207003- Engineering Mathematics III

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand Design of filters as DT systems
- To get acquainted with the DSP Processors and DSP applications

Course Outcomes:

On completion of the course, student will be able to–

- Understand the mathematical models and representations of DT Signals and Systems
- Apply different transforms like Fourier and Z-Transform from applications point of view.
- Understand the design and implementation of DT systems as DT filters with filter structures and different transforms.
- Demonstrate the knowledge of signals and systems for design and analysis of systems
- Apply knowledge and use the signal transforms for digital processing applications

Course Contents

Unit I	Signals and Systems	08 Hours

Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding.

Unit II	Frequency Domain Representation of Signal	08 Hours

Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral leakage.

Unit III	Fast Fourier Transform (FFT) and Z-Transform (ZT)	08 Hours

Home

Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method.

Unit IV	Analysis of DT - LTI Systems	08 Hours

System function H(z), H(z) in terms of Nth order general difference equation, all poll and all zero systems, Analysis of LTI system using H(Z), Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of H(Z) and difference equation, Frequency response of system, Frequency response from pole-zero plot using simple geometric construction.

Unit V	Digital Filter Design	08 Hours

Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, Linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, Frequency Warping, Pre-warping, Design examples, Comparison of IIR and FIR Filters.

Unit VI	Filter Structures and DSP Processors	08 Hours

Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).

Books:

Text:

1. Proakis J, Manolakis D, "Digital Signal Processing", 4th Edition, Pearson Education, ISBN 9788131710005
2. Oppenheium A, Schafer R, Buck J, "Discrete time Signal Processing", 2nd Edition, Pearson Education, ISBN 9788131704929

Reference:

1. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
2. Ifleachor E. C., Jervis B. W., “Digital Signal Processing: A Practical Approach “, Pearson-Education, 2002, , ISBN-13: 978-0201596199,ISBN-10: 0201596199
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw-Hill, ISBN 0-07-463996-X
4. S. Poornachandra, B. Sasikala, “Digital Signal Processing”,3rd Edition, McGraw-Hill, ISBN-13:978-07- 067279-6

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(B): Software Architecture and Design

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce basic concepts and principles about software design and software architecture
- To learn practical approaches and methods for creating and analyzing software architecture
- To acquaint with the interaction between quality attributes and software architecture
- To experience with examples in design pattern application and case studies in software architecture

Course Outcomes:

On completion of the course, student will be able to–

- Express the analysis and design of an application
- Specify functional semantics of an application
- Evaluate software architectures
- Select and use appropriate architectural styles and software design patterns

Course Contents

Unit I	Introduction	08 Hours

Introduction to Software Architecture, Architecture Business Cycle- Where do architecture come from, Software processes and the Architecture Business cycle, What makes Good Architecture. What is software architecture- What Software Architecture is and what it is not, Other points of View, Architectural Patterns, Reference Models, Reference Architectures, Why is Software Architecture important, Architectural structure and Views. Case Study-A-7E Avionics System.

Unit II	Quality Attributes	08 Hours

Introduction to Quality Attributes, Understanding quality attributes- Functionality and Architecture, architecture and quality attributes, System Quality Attributes, Quality Attribute Scenario in Practice, Other System Quality Attributes, Business Qualities, and Architecture Qualities. Achieving quality attributes- Introducing Tactics, Availability tactics, Modifiability tactics, Performance tactics, Security tactics, Testability tactics, Usability tactics, Relationship of tactics to Architectural patterns, Architectural Patterns and Styles. Case study- Air Traffic Control.

Unit III	Designing the Architectures and Introduction to Design Patterns	08 Hours

Architecture in Life Cycle, Designing the Architecture, Forming the team structure, Creating a skeletal system, Case Study- Flight Simulation. Design Patterns: What is Design Pattern?, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design patterns solves design problems, How to select Design Patterns, How to use Design Patterns.

Unit IV	Design Pattern Catalog	08 Hours

Creational Patterns- Abstract Factory, Singleton. Structural Patterns- Adaptor, Facade, Proxy. Behavioral Patterns- Chain of Responsibility, Iterator, Mediator, Observer. What to expect from Design Patterns.

Unit V	Client Side Technologies	08 Hours

Introduction to three tier and n-Tier Web Architectures, Need of Client side technology in multi-tier architectures, XML, Client side technologies- HTML, DHTML, Java Applets, Active X controls, DOM, AJAX. Case study-Mobile or portable client side technologies.

Unit VI	Middleware and Server Side Technologies	08 Hours

Introduction to Middleware, Types of Middleware, Application servers, Introduction to Java EE, Introduction to Java EE technologies like JMS, JDBC, RPC, RMI, SOCKET. EJB 3.0 Architecture, Entity, Session, Message beans, XML, XSLT. Specifications and characteristics of Middleware technologies. Server Side Technologies- Need of server side technology in multi-tier architectures, Java Web Services, Server side technologies: JSP, JSF, SOA, MVC. Java Servlets, struts.

Books:

Text:

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
2. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2.
3. Kogent, "Java Server Programming Black Book", Dream Tech Press, PHI Publications, ISBN: 978-81-7722-835-9.

References:

1. James L. Weaver, Kevin Mukhar, "Beginning J2EE 1 .4: From Novice to Professional", ISBN-10: 1590593413, ISBN-13: 978-1590593417
2. Richard N.Taylor , Nenad M., "Software Architecture Foundation Theory and practice", Wiley ISBN: 978-81-265-2802-8.
3. Java6 Programming, Black Book DreamTech Press, ISBN:978-81-7722-736-9

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(C): Pervasive and Ubiquitous Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245- Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the characteristics and principles of Pervasive computing
- To introduce to the enabling technologies of pervasive computing
- To understand the basic issues and performance requirements of pervasive computing applications
- To learn the trends of pervasive computing

Course Outcomes:

On completion of the course, student will be able to–

- Design and implement primitive pervasive applications
- Analyze and estimate the impact of pervasive computing on future computing applications and society
- Develop skill sets to propose solutions for problems related to pervasive computing system
- Design a preliminary system to meet desired needs within the constraints of a particular problem space

Course Contents

Unit I	Pervasive Computing	08 Hours

Pervasive Computing, Applications, Pervasive Computing devices and Interfaces, Device technology trends, Connecting issues and protocols. Pervasive Computing- Principles, Characteristics, interaction transparency, context aware, automated experience capture. Architecture for pervasive computing.

Unit II	Open Protocols	08 Hours

Open protocols, Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data Synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications- Context aware security. Pervasive Computing and web based Applications - XML and its role in Pervasive Computing, Wireless Application Protocol (WAP) Architecture and Security, Wireless Mark-Up language (WML) – Introduction. Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences.

Unit III	Voice Enabled Pervasive Computing	08 Hours

Home

Voice Enabled Pervasive Computing, Voice Standards, Speech Applications in Pervasive Computing and security. Device Connectivity, Web application Concepts, WAP and Beyond. Voice Technology – Basis of speech Recognition, Voice Standards, Speech Applications, Speech and Pervasive Computing, Security, The Hitchhiker's Guide to UbiComp: Using techniques from Literary and Critical Theory to Reframe Scientific Agendas.

Unit IV	Personal Digital Assistant	08 Hours

Personal Digital Assistant – History, Device Categories, Device Characteristics, Software Components, Standards. Server side programming in Java, Pervasive Web application Architecture, Example Application, Access via PCs, Access via WAP, Access via PDA, and Access via Voice, Pinch Watch: A Wearable Device for One-Handed Micro interactions., Interfaces - Enabling mobile micro-interactions with physiological computing.

Unit V	User Interface	08 Hours

User Interface Issues in Pervasive Computing, Architecture, and Smart Card based Authentication Mechanisms, Wearable computing Architecture. Touche: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects

Unit VI	Context Awareness and Application Development	08 Hours

Location as context, Location Tracking, Co-ordinate models, Location Data Sources, sorting and search in location data. Sensing Activity based on various wearable sensors, smart phone sensors. Wearable Computing applications in Healthcare and Assistive Technologies. Developing, Deploying and Evaluating Pervasive computing applications. Application in Augmented Reality.

Books:

Text:

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec and Klaus Rindtorff, “Pervasive Computing Technology and Architecture of Mobile Internet Applications”, Addision Wesley, 2002. ISBN:13: 978-0-201-72215-4
2. Uwe Hansman, Lothat Merk, Martin S Nicklous and Thomas Stober: “Principles of Mobile Computing”, Second Edition, Springer- Verlag, New Delhi, 2003, ISBN: 9783662043189

References:

1. Mohammads, Obaidait, Denko, Woungang, “Pervasive Computing and Networking”, Wiley, ISBN:978-0-470-74772-8
2. Seng Loke, “Context-Aware Computing Pervasive Systems”, Auerbach Pub., New York, 2007, ISBN: 978-1-4471-5006-0
3. Uwe Hansmann etl, “Pervasive Computing”, Springer, New York,2001., ISBN: 10: 3540002189
4. John Krumm, "Ubiquitous Computing Fundamentals", Shroff Publishers, ISBN: 9781420093605
5. Adelstein, “Fundamental of Mobile and Pervasive Computing”, McGrawHill, ISBN: 0-07-141237-9

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(D): Data Mining and Warehousing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310242-Database Management Systems, 310244- Information Systems and Engineering Economics

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the fundamentals of Data Mining
- To identify the appropriateness and need of mining the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course the student should be able to-

- Apply basic, intermediate and advanced techniques to mine the data
- Analyze the output generated by the process of data mining
- Explore the hidden patterns in the data
- Optimize the mining process by choosing best data mining technique

Course Contents

Unit I	Introduction	08 Hours

Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis

Unit II	Data Warehouse	08 Hours

Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.

Unit III	Measuring Data Similarity and Dissimilarity	08 Hours

Home

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Unit IV	Association Rules Mining	08 Hours

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.

Unit V	Classification	08 Hours

Introduction to: Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning.

Unit VI	Multiclass Classification	08 Hours

Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning. Metrics for Evaluating Classifier Performance: Accuracy, Error Rate, precision, Recall, Sensitivity, Specificity; Evaluating the Accuracy of a Classifier: Holdout Method, Random Sub sampling and Cross-Validation.

Books:

Text:

1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807.
2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making" by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

References:

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068
2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(A): Distributed Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks, 310254-Web Technology, 210254-Principles of Programming Languages

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the concept of Distributed system, remote method invocation and Remote Procedure Calls.
- To learn communication methodology in distributed systems.
- To acquaint with the Distributed File Systems.
- To know the concepts of shared memory and security aspects in distributed system.

Course Outcomes:

On completion of the course, student will be able to–

- Able to learn and apply the concept of remote method invocation and Remote Procedure Calls
- Able to analyze the mechanism of peer to peer systems and Distributed File Systems
- Demonstrate an understanding of the challenges faced by current and future distributed systems

Course Contents

Unit I	Introduction	08 Hours

Characteristics of Distributed Systems(DS): Introduction, Examples of DS, Trends in DS, Sharing Resources, Challenges in DS. System Models: Physical, Architectural and Fundamental Models Remote Invocation : Request Reply protocols, RPC, RMI, Case Study- JAVA RMI.

Unit II	Distributed Algorithms	08 Hours

Representing Distributed Algorithms: Representation Guarded Actions, Non-determinism, Atomic actions, Fairness, Central vs Distributed Scheduler. Time in Distributed Systems: Logical clocks, Vector clocks, Physical Clock Synchronization, Algorithms for Internal and External Clock Synchronization. Mutual Exclusion: Solution to Message passing systems, Token-Passing algorithms, Solutions on shared memory models, Mutual exclusion using special instructions, Group mutual exclusion.

Unit III	Distributed Snapshot	08 Hours

Distributed Snapshot: Properties of Consistent snapshot, Chandy-Lamport algorithm, Lai-Yang algorithm, Distributed debugging. Global state collection : Elementary algorithm for All-to- All broadcasting, Termination Detection algorithm, Wave algorithm, Distributed deadlock detection Coordination Algorithms: Leader Elections, Algorithms like Bully, Maxima finding on the ring, election in arbitrary networks, Election in anonymous networks. Synchronizers: ABD synchronizer, Awerbuch's synchronizers.

Unit IV	Distributed Consensus	08 Hours

Distributed consensus: Consensus in asynchronous systems, Consensus in synchronous systems, Paxo's algorithm, Failure detectors. Distributed Transactions: Classification of transactions, Implementing Transactions, Concurrency control and serializability, Atomic Commit protocols, Recovery from Failures.

Unit V	Group Communication	08 Hours

Group Communication: Atomic multicast, IP Multicast, Application layer multicast, Ordered multicast, Reliable multicast, Open groups. Replicated Data Management: Architecture of replicated Data Management, Data-Centric Consistency models, Client centric consistency protocols, Implementation of Data-Centric Consistency models, Quorum based protocols, Replica Placement, Brewer's CAP algorithm.

Unit VI	Distributed Discrete-Event Simulation	08 Hours

Distributed Discrete-Event Simulation: Distributed simulation, Conservative Simulation, Optimistic simulation and Time warp. Security in DS: Security Mechanisms to thwart various attacks in DS. Social and Peer-to-Peer network: Metrics of Social networks, Modeling Social Networks, Centrality measure in Social network, Community detection, Koorde and De Brujin Graphs, Skip graph, Replication management, Bit-torrent and free riding, Censorship resistance and anonymity.

Books:

Text:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems, Concepts and Design", Fifth Edition, Addison Wesley, ISBN 0-13-214301-1.
2. Sukumar Ghosh, "Distribute Systems : An Algorithmic Approach", Chapman and Hall, CRC Press, Second Edition, 2015, ISBN 10: 1584885645 ISBN 13: 9781584885641
3. Andrew S. Tanenbaum and Maarten van Steen, "Distributed Systems –Principles and Paradigms" , PHI Publication, ISBN 0-13-239227-5

References:

1. Shvartsman, A.A., Weatherspoon, H.; Zhao, "Future Directions in Distributed Computing Research and Position Papers Series: Lecture Notes in Computer Science" , Vol. 2584 Schiper, (Eds.) 2003, X, 219 p., ISBN: 978-3-540- 00912-2
2. Sape Mullender, "Distributed Systems", (Editor),Addison-Wesley Publication, I*SBN* 10: 0201624273 - ISBN13: 9780201624274
3. Kenneth, P. Birman, "Reliable Distributed Systems: Technologies, Web Services, and Applications", Springer; 1 edition, ISBN-10: 0387215093; ISBN-13: 978-0387215099
4. Galli D.L., "Distributed Operating Systems: Concepts and Practice", Prentice-Hall 2000, ISBN0-13-079843-6

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(B): Software Testing and Quality Assurance

Home

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310243- Software Engineering and Project Management,310263- Software Modeling and Design

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- Introduce basic concepts of software testing
- Understand white box, block box, object oriented, web based and cloud testing
- Know in details automation testing and tools used for automation testing
- Understand the importance of software quality and assurance software systems development.

Course Outcomes:

On completion of the course, student will be able to–

- Describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance.
- Design and develop project test plan, design test cases, test data, and conduct test operations
- Apply recent automation tool for various software testing for testing software
- Apply different approaches of quality management, assurance, and quality standard to software system
- Apply and analyze effectiveness Software Quality Tools

Course Contents

Unit I	Introduction	08 Hours

Introduction, historical perspective, Definition, Core Components, Quality View, Financial Aspect, Customers suppliers and process, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, quality in different areas, Benchmarking and metrics, Problem Solving Techniques, Problem Solving Software Tools.

Software Quality- Introduction, Constraints of Software product Quality assessment, Customer is a King, Quality and Productivity Relationship, Requirements of Product, Organization Culture, Characteristics of Software, Software Development Process, Types of Product, Criticality Definitions, Problematic areas of SDLC, Software Quality Management, Why Software has defects, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.

Unit II	Test Planning and Management	08 Hours

Home

Review of Fundamentals of Software Testing, Testing during development life cycle, Requirement Traceability matrix, essentials, Work bench, Important Features of Testing Process, Misconceptions, Principles, salient and policy of Software testing, Test Strategy, Test Planning, Testing Process and number of defects found, Test teem efficiency, Mutation testing, challenges, test team approach, Process problem faced, Cost aspect, establishing testing policy, methods, structured approach, categories of defect, Defect/ error/ mistake in software, Developing Test Strategy and Plan, Testing process, Attitude towards testing, approaches, challenges, Raising management awareness for testing, skills required by tester.

Unit III	**Software Test Automation**	**08 Hours**

What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design and Architecture of automation, Generic requirement for Test Tool, Process Model for Automation, Selecting Test Tool, Automation for XP/Agile model, Challenges in Automation, Data-driven Testing. Automation Tools like JUnit, Jmeter

Unit IV	**Selenium Tool**	**08 Hours**

Introducing Selenium, Brief History of The Selenium Project, Selenium's Tool Suite, Selenium-IDE, Selenium RC, Selenium Webdriver, Selenium Grid, Test Design Considerations

Unit V	**Quality Management**	**08 Hours**

Software Quality, Software Quality Dilemma, Achieving Software Quality, Software Quality Assurance. Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan.

Unit VI	**Software Quality Tools**	**08 Hours**

Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness and Process Maturity Level.

Books:

Text:

1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata McGraw Hill, ISBN: 9780070139909 0070139903
2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X

References:

1. Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847
2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(C): Operations Research

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210241- Discrete Mathematics, 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce the learners the quantitative methods and techniques for effective analysis of decisions making
- To understand the model formulation and applications that is used in solving business decision problems.
- To introduce the optimization approaches and fundamental solution.
- To learn a variety of ways in which deterministic and stochastic models in Operations Research can be used

Course Outcomes:

On completion of the course, student will be able to–

- Identify the characteristics of different types of decision-making environments
- Use appropriate decision making approaches and tools
- Build various dynamic and adaptive models
- Develop critical thinking and objective analysis of decision problems
- Apply the OR techniques for efficacy

Course Contents

Unit I	Linear Programming	08 Hours

Introduction, Modeling with Liner Programming, Two variable LP model, Graphical LP solutions for both maximization and minimization models with various application examples, LP model in equation form, simplex method, special case in simplex method, artificial starting solution, Degeneracy in LPP, Unbounded and Infeasible solutions.

Unit II	Duality in Linear Programming and Revised Simplex Method	08 Hours

Duality theory: a fundamental insight. The essence of duality theory, Economic interpretation of duality, Primal dual relationship; Adapting to other primal forms, The revised simplex method-development of optimality and feasibility conditions, Revised Simplex Algorithms.

Unit III	The Transportation Problem and Assignment Problem	08 Hours

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Finding an initial feasible solution - North West-corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem. Assignment Problem: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.

Unit IV	Game Theory and Dynamic Programming	08 Hours

Introduction, 2 person zero sum games, Minimax, Maximin principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 2 games. Recursive nature of computations in Dynamic Programming, Forward and backward recursion, Dynamic Programming Applications – Knapsack, Equipment replacement, Investment models

Unit V	Integer Programming Problem and Project Management	08 Hours

Integer Programming Algorithms – BandB Algorithms, cutting plane algorithm, Gomory's All-IPP Method, Project Management: Rules for drawing the network diagram, Application of CPM and PERT techniques in project planning and control; Crashing and resource leveling of operations Simulation and its uses in Queuing theory and Materials Management

Unit VI	Decision Theory and Sensitivity Analysis	08 Hours

Decision making under certainty, uncertainty and risk, sensitivity analysis, Goal programming formulation and algorithms – The weights method, The preemptive method

Books:

Text:

1. Hamdy A. Taha, "Operations Research" , Pearson Education, 8th Edition, ISBN: 978-81-317-1104-0
2. Gillett, "Introduction to Operations Research", TMH, ISBN: 0070232458

References:

1. S.D. Sharma, Kedarnath, Ramnath and Co, "Operations Research", 2009, ISBN:978-81-224-2288-7
2. Hrvey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980, ISBN: 10: 0137095767, 13: 9780137095766..
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004, ISBN: 9788180548543, 8180548546.
4. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008, ISBN: 10: 8120329287,: 9788120329287.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(D): Mobile Communication

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the Personal Communication Services
- To learn the design parameters for setting up mobile network
- To know GSM architecture and support services
- To learn current technologies being used on field

Course Outcomes:

On completion of the course, student will be able to–

- Justify the Mobile Network performance parameters and design decisions.
- Choose the modulation technique for setting up mobile network.
- Formulate GSM/CDMA mobile network layout considering futuristic requirements which conforms to the technology.
- Use the 3G/4G technology based network with bandwidth capacity planning.
- Percept to the requirements of next generation mobile network and mobile applications.

Course Contents

Unit I	Introduction to Cellular Networks	08 Hours

Cell phone generation-1G to 5G, Personal Communication System (PCS), PCS Architecture, Mobile Station,, SIM, Base Station, Base Station Controller, Mobile Switching Center, MSC Gateways, HLR and VLR, AuC/EIR/OSS, Radio Spectrum, Free Space Path Loss, S/N Ratio, Line of sight transmission, Length of Antenna, Fading in Mobile Environment.

Unit II	Cellular Network Design	08 Hours

Performance Criterion, Handoff/Hanover, Frequency Reuse, Co-channel Interference and System Capacity, Channel Planning, Cell Splitting, Mobility Management in GSM and CDMA.

Unit III	Medium Access Control	08 Hours

Specialized MAC, SDMA, FDMA, TDMA, CDMA, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), GMSK Modulation, 8PSK, 64 QAM, 128 QAM and OFDM

Unit IV	GSM	08 Hours

GSM – Architecture, GSM Identifiers, Spectrum allocation, Physical and Logical Traffic and Control channels, GSM Bursts, GSM Frame, GSM Speech Encoding and decoding, Location Update, Incoming and Outgoing Call setup, GPRS.

Unit V	Current 3G and 4G Technologies for GSM and CDMA	08 Hours
EDGE, W-CDMA: Wideband CDMA, CDMA2000, UMTS, HSPA (High Speed Packet Access), HSDPA, HSUPA, HSPA+, LTE (E-UTRA) 3GPP2 family CDMA2000 1x, 1xRTT, EV-DO (Evolution-Data Optimized), Long Term Evolution (LTE) in 4G.		
Unit VI	**Advances in Mobile Technologies**	**08 Hours**
5GAA (Autonomous Automation), Millimetre Wave, URLLC, LTEA (Advanced), LTE based MULTIFIRE, Virtual Reality, Augmented Reality.		

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Books:

Text:

1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2004, ISBN: 13: 978-8131724262
2. Jason Yi-Bing Lin, Yi-Bing Lin, Imrich Chlamtac, "Wireless and Mobile network Architecture", 2005, Wiley Publication, ISBN: 978812651560
3. Martin Sauter, "3G, 4G and Beyond: Bringing Networks, Devices and the Web Together", 2012, ISBN-13: 978-1118341483

References:

1. Theodore S Rappaport, "Wireless Communications – Principles and Practice" , Pearson Education India, Second Edition, 2010, ISBN: 978-81-317-3186-4
2. Lee and Kappal, "Mobile Communication Engineering", Mc Graw Hill, ISBN:
3. William Stallings, "Wireless Communication and Networks", Prentice Hall, Second Edition, 2014, ISBN: 978-0131918351

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410246:Laboratory Practice I

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 50 Marks

Companion Courses: 410241, 410242 and 410243

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice I is for practical hands on for core courses High Performance Computing, AI & Robotics, and Data Analytics.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming Languages: C++/JAVA/PYTHON/R
Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

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Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments & Mini Projects

(any 04 assignments per High Performance Computing, AI, and Data Analytics and Mini-project per course)

410241:: High Performance Computing

Note: for all programming assignments of HPC-

- Select the suitable model of a parallel computation (Data parallel model, Task graph model, Work pool model, Master slave model , Producer consumer or pipeline model, Hybrid model or other) for algorithm to be developed by considering a strategy for dividing the data, processing method and suitable strategy to reduce interactions.
- Assume suitable processor model, topology, load distribution strategy and Communication.
- Utilize all available resources.
- Test on data set of sufficiently large size
- Compute Total cost and Efficiency as
  Total Cost = Time complexity × Number of processors used
  Efficiency = WCSA/ WCPA
  (WCSA--Worst case execution time of sequential algorithm and WCPA--Worst case execution time of the parallel algorithm)
- Compare performance by varying number of processors used and also with sequential algorithm.

1. a) Implement Parallel Reduction using Min, Max, Sum and Average operations.

b) Write a CUDA program that, given an N-element vector, find-

- The maximum element in the vector
- The minimum element in the vector

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	•The arithmetic mean of the vector •The standard deviation of the values in the vector Test for input N and generate a randomized vector V of length N (N should be large). The program should generate output as the two computed maximum values as well as the time taken to find each value.
2.	**Vector and Matrix Operations-** Design parallel algorithm to 1. Add two large vectors 2. Multiply Vector and Matrix 3. Multiply two N × N arrays using n^2 processors
3.	**Parallel Sorting Algorithms-** For Bubble Sort and Merger Sort, based on existing sequential algorithms, design and implement parallel algorithm utilizing all resources available.
4.	**Parallel Search Algorithm-** Design and implement parallel algorithm utilizing all resources available. for • **Binary Search for Sorted Array** • **Depth-First Search (** tree or an undirected graph) **OR** • **Breadth-First Search (** tree or an undirected graph) **OR** • **Best-First Search that (** traversal of graph to reach a target in the shortest possible path)
5.	Parallel Implementation of the K Nearest Neighbors Classifier
	Sample Mini Projects
6.	**Compression Module (Image /Video)** Large amount of bandwidth is required for transmission or storage of images. This has driven the research area of image compression to develop parallel algorithms that compress images. **OR** For video: RGB To YUV Transform concurrently on many core GPU
7.	**Generic Compression** Run length encoding concurrently on many core GPU
8.	**Encoding** Huffman encoding concurrently on many core GPU
9.	**Database Query Optimization** Long running database Query processing in parallel
	410242: Artificial Intelligence and Robotics
1.	Implement Tic-Tac-Toe using A* algorithm
2.	Implement 3 missionaries and 3 cannibals problem depicting appropriate graph. Use A* algorithm.
3.	Solve 8-puzzle problem using A* algorithm. Assume any initial configuration and define goal configuration clearly.
4.	Define the operators for controlling domestic robot; use these operators to plan an activity to be executed by the robot. For example, transferring two/three objects one over the other from one place to another. Use Means-Ends analysis with all the steps revealed.
5.	Implement any one of the following Expert System , • Medical Diagnosis of 10 diseases based on adequate symptoms

<table>
<tr><td></td><td>Identifying birds of India based on characteristics</td></tr>
<tr><td>6.</td><td>Implement alpha-beta pruning graphically with proper example and justify the pruning.</td></tr>
<tr><td>7.</td><td>Develop elementary chatbot for suggesting investment as per the customers need.</td></tr>
<tr><td>8.</td><td>Solve following 6-tiles problem stepwise using A* algorithm,

Initial Configuration<table><tr><td>B</td><td>W</td><td>B</td><td>W</td><td>B</td><td>W</td><td></td></tr></table>Final Configuration<table><tr><td>B</td><td>B</td><td>B</td><td>W</td><td>W</td><td>W</td><td></td></tr></table>
Constraint: Tiles can be shifted left or right 1 or 2 positions with cost 1 and 2 respectively.</td></tr>
<tr><td>9.</td><td>Implement goal stack planning for the following configurations from the blocks world,

Start Goal</td></tr>
<tr><td>10.</td><td>Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.</td></tr>
<tr><td>11.</td><td>Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).</td></tr>
<tr><td>12.</td><td>Constraint Satisfaction Problem:
Implement crypt-arithmetic problem or n-queens or graph coloring problem (Branch and Bound and Backtracking)</td></tr>
<tr><td>13.</td><td>Implement syntax analysis for the assertive English statements. The stages to be executed are,
Sentence segmentation
Word tokenization
Part-of-speech/morpho syntactic tagging
Syntactic parsing (Use any of the parser like Stanford)</td></tr>
<tr><td>14.</td><td>Mini Projects based on Robotics..</td></tr>
<tr><td colspan="2">410243:: Data Analytics</td></tr>
<tr><td>1.</td><td>Download the Iris flower dataset or any other dataset into a DataFrame. (eg https://archive.ics.uci.edu/ml/datasets/Iris) Use Python/R and Perform following –
How many features are there and what are their types (e.g., numeric, nominal)?
Compute and display summary statistics for each feature available in the dataset. (eg. minimum value, maximum value, mean, range, standard deviation, variance and percentiles
Data Visualization-Create a histogram for each feature in the dataset to illustrate the feature distributions. Plot each histogram.
Create a boxplot for each feature in the dataset. All of the boxplots should be combined into a single plot. Compare distributions and identify outliers.</td></tr>
<tr><td>2.</td><td>Download Pima Indians Diabetes dataset. Use Naive Bayes' Algorithm for classification
Load the data from CSV file and split it into training and test datasets.
summarize the properties in the training dataset so that we can calculate probabilities and make predictions.
Classify samples from a test dataset and a summarized training dataset.</td></tr>
<tr><td>3.</td><td>Write a Hadoop program that counts the number of occurrences of each word in a text file.</td></tr>
<tr><td>4.</td><td>Write a program that interacts with the weather database. Find the day and the station with the maximum snowfall in 2013.</td></tr>
<tr><td>5.</td><td>Use Movies Dataset. Write the map and reduce methods to determine the average ratings of</td></tr>
</table>

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	movies. The input consists of a series of lines, each containing a movie number, user number, rating, and a timestamp: The map should emit movie number and list of rating, and reduce should return for each movie number a list of average rating.
6.	Trip History Analysis: Use trip history dataset that is from a bike sharing service in the United States. The data is provided quarter-wise from 2010 (Q4) onwards. Each file has 7 columns. Predict the class of user. Sample Test data set available here https://www.capitalbikeshare.com/trip-history-data
7.	Bigmart Sales Analysis: For data comprising of transaction records of a sales store. The data has 8523 rows of 12 variables. **Predict the sales of a store.** Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/
8.	Twitter Data Analysis: **Use** Twitter data for sentiment analysis. The dataset is 3MB in size and has 31,962 tweets. **Identify the tweets which are hate tweets and which are not.** **S**ample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-twitter-sentiment-analysis/
9.	Time Series Analysis: Use time series and forecast traffic on a mode of transportation. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-time-series-2/

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410247:Laboratory Practice II

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Presentation: 50 Marks

Companion Courses: 410244 and 410245

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course I and elective course II.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend: MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

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Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments& Mini Projects

Recommended / Sample set of assignments and mini projects for reference for all four courses offered for Elective I and for all four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

410244: Elective I

410244(A) : Digital Signal Processing

1.	Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and sampling frequency (Fs)).
2.	Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence x(n). Observe the response by considering system as FIR and IIR system).
3.	Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity).
4.	Find the N point DFT / IDFT of the given sequence x (n). Plot the magnitude spectrum |X(K)| Vs K. (Analyze the output for different N and the same input sequence x(n). Also observe the periodicity and symmetry property).
5.	Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6.	Develop a program to plot the magnitude and phase response of a given system (given: h(n): impulse response of system S) (Observe the frequency response for different systems.

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	Compare the frequency response of a system (filter) for different length h(n) i.e filter coefficients).
7.	**Mini-Project 1:** Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence x (n). (Analyze the output for different N. Program should work for any value of N and output should be generated for all intermediate stages.)
8.	**Mini-Project 2:** Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Henning, Kaiser. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes).
9.	**Mini-Project 3:** Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency).
10.	**Mini-Project 4:** Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function H(Z). Application should work for different types of filter specifications that is LPF, HPF, BPF etc. and for different transfer functions of an analog filter).
	410244(B): Software Architecture and Design Patterns
1.	**Mini-Project 1**: Narrate concise System Requirements Specification and organize the problem domain area into broad subject areas and identify the boundaries of problem/system. Identify and categorize the target system services with detailed service specifications modeled with component diagram incorporating appropriate architectural style and coupling. Design the service layers and tiers modeled with deployment diagram accommodating abstraction, autonomy, statelessness and reuse. Map the service levels and primitives to appropriate Strategies for data processing using Client-Server Technologies as applicable.
2.	**Mini-Project 2:** Select a moderately complex system and narrate concise requirement specification for the same. Design the system indicating system elements organizations using applicable architectural styles and design patterns with the help of a detailed Class diagram depicting logical architecture. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.
	410244(C): Pervasive and Ubiquitous Computing
	Mini-Projects are to be designed so as to use, • No / minimal extra hardware, • uses open source software's, • need hardly any subscription / telephony / data charges.
1.	Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
2.	Design and build a mobile application with context awareness to determine the remaining battery level depending on the users current usage patterns.
3.	Design and build a music streaming system and a smart mobile application to use the speakers or headphones of the smart phone of multiple phones to stream stored / live music during a party (instead of using large speakers).
4.	Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device. -OR- Smart Mobile Application with ambient sound / noise sensing to adjust the volume of the phone automatically. -OR- Smart Mobile Application with ambient light sensing to adjust the screen brightness automatically.

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5.	**Mini-Project 1:** Smart Mobile Application for Location-Based Messaging Design and build a Location-Based Messaging system where users have commented on various eating joints in the area you currently are. The mobile application should give you inputs / recommendations / suggestions on which eating joints are preferred by whom and for what eating items, with their ratings etc.
6.	**Mini-Project 2:** Smart Mobile Application as a Museum Guide Build a Mobile Application as a museum guide, the device scans the QR codes on the artifacts and gives an interactive detailed explanation using Audio / Text / Video about the museum artifact. using location of the user and the list of previously seen artifacts, the mobile application can suggest / recommend which next artifacts to be seen be the user
7.	**Mini-Project 3:** Smart Mobile Application as a Travel / Route Guide, Scenario - You are visiting an ancient monument. There is no local guide available. The previous users have commented on various locations where artifacts can be seen, photo are uploaded. The smart mobile application will give you directions / recommendations / suggestions on what to see and where, including narratives on the same.
8.	**Mini-Project 4:** Design and build a 'Multifunctional Application' in the Mobile and Pervasive domain. The choice of application is to be determined so as to leverage the capabilities of typical smart devices. These include such characteristics as, • Location awareness and GPS systems • Accelerometers • Messaging • Sensor detection capability • Microphone and Camera • Media Player • Touch screen • Mapping Technology • Mobile Web Services
	410244(D): Data Mining and Warehousing
1.	For an organization of your choice, choose a set of business processes. Design star / snow flake schemas for analyzing these processes. Create a fact constellation schema by combining them. Extract data from different data sources, apply suitable transformations and load into destination tables using an ETL tool. **For Example:** Business Origination: Sales, Order, Marketing Process.
2.	Consider a suitable dataset. For clustering of data instances in different groups, apply different clustering techniques (minimum 2). Visualize the clusters using suitable tool.
3.	Apply a-priori algorithm to find frequently occurring items from given data and generate strong association rules using support and confidence thresholds. **For Example:** Market Basket Analysis
4.	Consider a suitable text dataset. Remove stop words, apply stemming and feature selection techniques to represent documents as vectors. Classify documents and evaluate precision, recall.
5.	**Mini project on classification:** Consider a labeled dataset belonging to an application domain. Apply suitable data preprocessing steps such as handling of null values, data reduction, discretization. For prediction of class labels of given data instances, build classifier models using different techniques (minimum 3), analyze the confusion matrix and compare these models. Also apply cross validation while preparing the training and testing datasets.

	For Example: Health Care Domain for predicting disease.

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410245: Elective II

410245(A): Distributed Systems

1.	Design and develop a basic prototype distributed system (e.g. a DFS).
2.	Design and implement client server application using RPC/ RMI mechanism (Java)
3.	Design and implement a clock synchronization algorithm for prototype DS
4.	Implement Ring or Bully election algorithm for prototype DS.
5.	Implement Ricart Agrawala's distributed algorithm for mutual exclusion.
6.	Problem solving of Wait-die and Wait –wound scheme for deadlock prevention.
7.	Simulate Wait for Graph based Centralized or Hierarchical or Distributed algorithm for deadlock detection.
8.	Implementation of 2PC / Byzantine Generals Problem

Mini-Projects

Important properties your system should have:
• The system must support multiple, autonomous agents (either human or automated) contending for shared resources and performing real-time updates to some form of shared state.
• The state of the system should be distributed across multiple client or server nodes.
The only centralized service should be one that supports users logging on, adding or removing clients or servers, and other housekeeping tasks.
•The system should be robust
The system should be able to continue operation even if one of the participant nodes crashes.
It should be possible to recover the state of a node following a crash, so that it can resume operation.
We will let you choose your own application, and we will give you wide latitude in the overall and the detailed design of your implementation.

Design, implement, and thoroughly test a distributed system, implementing - Shared document editing, in the style of Google docs. The system should support real-time editing and viewing by multiple participants. Multiple replicas would be maintained for fault tolerance. Caching and/or copy migration would be useful to minimize application response time.

Design, implement, and thoroughly test a distributed system, implementing - A low-latency notification system. E.g., watch a whole bunch of RSS feeds and send all subscribers an email when one is updated. Interface with both the raw RSS feeds and Google's update notification service. Replicate and partition the state of the monitoring system so that it can scale and survive node failures.

Design, implement, and thoroughly test a distributed system, implementing - An airline reservation system. Each airline would maintain its own collection of servers, with enough state replication to enable automatic fail-over. It would be possible to book travel that involves multiple airlines.

Design, implement, and thoroughly test a distributed system, implementing - Implement a distributed file system that does something interesting. Maybe you want one for storing your MP3s or movies. Or perhaps for something entirely different.

410245(B): Software Testing and Quality Assurance

1.	**Mini-Project 1:** Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective Black-box and White-box testing covering Unit and Integration test by using suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed.

Home

2.	**Mini-Project 2:** Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDEand generate test reports encompassing exploratory testing.

410245(C):: Operations Research

1. The Transportation Problem:

Milk in a milk shed area is collected on three routes A, B and C. There are four chilling centers P, Q, R and S where milk is kept before transporting it to a milk plant. Each route is able to supply on an average one thousand liters of milk per day. The supply of milk on routes A, B and C are 150, 160 and 90 thousand liters respectively. Daily capacity in thousand liters of chilling centers is 140, 120, 90 and 50 respectively. The cost of transporting 1000 liters of milk from each route (source) to each chilling center (destination) differs according to the distance. These costs (in Rs.) are shown in the following table

Routes	Chilling Centers			
	P	Q	R	S
A	16	18	21	12
B	17	19	14	13
C	32	11	15	10

The problem is to determine how many thousand liters of milk is to be transported from each route on daily basis in order to minimize the total cost of transportation.

2. Investment Problem:

A portfolio manager with a fixed budget of $100 million is considering the eight investment opportunities shown in Table 1. The manager must choose an investment level for each alternative ranging from $0 to $40 million. Although an acceptable investment may assume any value within the range, we discretize the permissible allocations to intervals of $10 million to facilitate the modeling. This restriction is important to what follows. For convenience we define a unit of investment to be $10 million. In these terms, the budget is 10 and the amounts to invest are the integers in the range from 0 to 4. Following table provides the net annual returns from the investment opportunities expressed in millions of dollars. A ninth opportunity, not shown in the table, is available for funds left over from the first eight investments. The return is 5% per year for the amount invested, or equivalently, $0.5 million for each $10 million invested. The manager's goal is to maximize the total annual return without exceeding the budget

Returns from Investment Opportunities

Amount	*Opportunity*							
Invested ($10 million)	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	4.1	1.8	1.5	2.2	1.3	4.2	2.2	1.0
2	5.8	3.0	2.5	3.8	2.4	5.9	3.5	1.7
3	6.5	3.9	3.3	4.8	3.2	6.6	4.2	2.3
4	6.8	4.5	3.8	5.5	3.9	6.8	4.6	2.8

410245(D):: Mobile Communication

1.	Design simple GUI application with activity and intents e.g. Design an android Application for Phone Call or Calculator
2.	Design an android application for media player.
3.	Design an android Application for SMS Manager

4.	Design an android Application using Google Map To Trace The Location of Device
5.	Design an android Application for Frame Animation
6.	**Mini-Project 1:** Design mobile app to perform the task of creating the splash screen for the application using timer, camera options and integrate Google map API on the first page of the application. Make sure map has following features: • Zoom and View change • Navigation to specific locations • Marker and getting location with touch • Monitoring of location
7.	**Mini-Project 2:** Create an app to add of a product to SQLite database and make sure to add following features • SMS messaging and email provision • Bluetooth options • Accessing Web services • Asynchronous remote method call • Use Alert box for user notification
8.	**Mini-Project 3:** Create the module for collecting cellular mobile network performance parameters using telephony API Manager • Nearest Base Station • Signal Strengths • SIM Module Details • Mobility Management Information
9.	**Mini-Project 4:** Create an application for Bank using spinner, intent • Form 1: Create a new account for customer, Form 2: Deposit money in customer account. Link both forms, after completing of first form the user should be directed to the second form. Provide different menu options
10.	**Mini-Project 5:** Create the module for payment of fees for College by demonstrating the following methods. • Fees Method()- for calculation of fees, Use customized Toast for successful payment of fees, Implement an alarm in case someone misses out on the fee submission deadline • Demonstrate the online payment gateway.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410248:Project Work Stage I

Home

Teaching Scheme: Practical : 02 Hours/Week	Credit 02	Examination Scheme: Presentation: 50 Marks

Course Objectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods,
- To Reflect upon the experience gained and lessons learned,
- To Consider relevant social, ethical and legal issues,
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in TEAM and learn professionalism.

Course Outcomes:

On completion of the course, student will be able to–

- Solve real life problems by applying knowledge.
- Analyze alternative approaches, apply and use most appropriate one for feasible solution.
- Write precise reports and technical documents in a nutshell.
- Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work, Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project at least up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment(Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC5- I	Entrepreneurship Development
AC5-II	Botnet of Things
AC5-III	3D Printing
AC5-IV	Industrial Safety and Environment Consciousness
AC5-V	Emotional Intelligence
AC5-VI	MOOC-Learn New Skill

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – I: Entrepreneurship Development

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are and what competences are needed to become an entrepreneur.

Course Objectives:

- To introduce the aspects of Entrepreneurship
- To acquaint with legalities in product development
- To understand IPR, Trademarks, Copyright and patenting
- To know the facets of functional plans, Entrepreneurial Finance and Enterprise Management

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the legalities in product development
- Undertake the process of IPR, Trademarks, Copyright and patenting
- Understand and apply functional plans
- Manage Entrepreneurial Finance
- Inculcate managerial skill as an entrepreneur

Course Contents:

1. **Introduction:** Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.
2. **Creating Entrepreneurial Venture :** Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights.
3. **Functional plans:** Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, Ratio Analysis.
4. **Entrepreneurial Finance:** Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.
5. **Enterprise Management:** Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers and acquisitions

Books:

1. Kumar, Arya,`` Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson ISBN-10: 8131765784; ISBN-13: 978-8131765784 ...
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise'', ISBN 0-256-14147- 9
3. Irwin Taneja, ``Entrepreneurship,'' Galgotia Publishers. ISBN: 978-93-84044-82-4
4. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,'' Pearson Education, ISBN, 8177582607, 9788177582604.

Home

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – II: Botnet of Things

This course aims to provide an understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities. It gives an outline of the techniques for developing a secure application.

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To learn the concept of Botnet

Course Outcomes:

On completion of the course, learner will be able to–

- Implement security as a culture and show mistakes that make applications vulnerable to attacks.
- Understand various attacks like DoS, buffer overflow, web specific, database specific, web - spoofing attacks.
- Demonstrate skills needed to deal with common programming errors that lead to most security problems and to learn how to develop secure applications

Course Contents:

1. **Introduction**
2. **IRC-Based Bot Networks**
3. **Anatomy of a Botnet: The Gaobot Worm**
4. **IoT Senosors and Security :** Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots and Botnet
5. **Service Layer Protocols and Security :** Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport and Session layer protocols- transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

1. Bernd Scholz - Reiter, Florian Michahelles, “Architecting the Internet of Things”, Springer ISBN 978 – 3 – 642 – 19156 - 5 e - ISBN 978 – 3 -642 - 19157 - 2,
2. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1 st Edition 2004
3. Gunter Ollmann 2007. The Phishing Guide Understanding and Preventing Phishing Attacks. IBM Internet Security Systems.
4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978 – 1 – 118 – 47347 - 4, Willy Publications
5. White Papers :- https://www.sans.org/reading-room/whitepapers/malicious/bots-botnet-overview-1299
6. https://www-01.ibm.com/marketing/iwm/dre
7. Mike Kuniavsky, “Smart Things: Ubiquitous Computing User Experience Design,” Morgan Kaufmann Publishers.

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – III: 3D Printing

Home

Course Objectives:

- To understand the principle of 3D printing
- To understand resource requirements of 3D printing
- To know the basic artwork needed for 3D printing

Course Outcomes:

On completion of the course, learner will be able to–

- Apply models for 3D printing
- Plan the resources for 3D printing
- Apply principles in 3D printing in real world

Course Contents:

1. Getting Started with 3D Printing: How 3D Printers Fit into Modern Manufacturing, Exploring the Types of 3D Printing, Exploring Applications of 3D Printing.

2. Outlining 3D Printing Resources: Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.

3. Exploring the Business Side of 3D Printing: Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.

4. Employing Personal 3D printing Devices: Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, " 3D Printing for Dummies", Taschenbuch, ISBN: 9781119386315
2. Greg Norton, "3D Printing Business - 3D Printing for Beginners - How to 3D Print" ,ISBN:9781514785669
3. Liza Wallach Kloski and Nick Kloski, " Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution", Maker Media, ISBN: 1680450204
4. Jeff Heldrich , "3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business"

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – IV: Industrial Safety and Environment Consciousness

Home

Objective of Industrial Safety, Health Environment and Security covers virtually every important area in administration of SHE. It broadly discusses the major problems in safety management, occupational health and today's dynamic environment management of rapidly changing ambience, technological advances, whole gamut of safety laws, safety policy and it's designing and their meticulous implementation.

Course Objectives:

- To understand Industrial hazards and Safety requirements with norms
- To learn the basics of Safety performance planning
- To know the means of accident prevention
- To understand the impact of industrialization on environment
- To know the diversified industrial requirements of safety and security

Course Outcomes:

On completion of the course, learner will be able to–

- Formulate the plan for Safety performance
- Formulate the action plan for accidents and hazards
- Follow the safety and security norms in the industry
- Consider critically the environmental issues of Industrialization

Course Contents:

1. Introduction: Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

2. Safety Performance Planning

Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.

3. Accident Prevention

What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.

4. Safety Organization

Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.

5. Environment

Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers,

6. Industrial Security(Industry wise)

General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments.

Books:

1. Basudev Panda ,"Industrial Safety, Health Environment and Security",Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439
2. L.M. Deshmukh, "Industrial Safety Management", TMH , ISBN: 9780070617681

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – V: Emotional Intelligence

Home

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

- Expand your knowledge of emotional patterns in yourself and others
- Discover how you can manage your emotions, and positively influence yourself and others
- Build more effective relationships with people at work and at home
- Positively influence and motivate colleagues, team members, managers
- Increase the leadership effectiveness by creating an atmosphere that engages others

Course Contents:

1. **Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. **Know and manage your emotions:** emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize 'negative' and 'positive' emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing 'negative' emotions, Techniques to manage your emotions in challenging situations
3. **Recognize emotions in others :**The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
4. **Relate to others**: Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books:

1. Daniel Goleman," Emotional Intelligence – Why It Matters More Than IQ," , Bantam Books, ISBN-10: 055338371X13: 978-0553383713
2. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
3. Drew Bird , "The Leader's Guide to Emotional Intelligence" , ISBN: 9781535176002

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
410249: Audit Course 5
410257: Audit Course 6
AC5 – VI & AC6-VI: MOOC-Learn New Skill

Home

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcomes:

On completion of the course, learner will acquire additional knowledge and skill.

About Course:

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.
The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses (not opted earlier) with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/
3. https://www.edx.org

SEMESTER II

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410250: Machine Learning

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 207003- Engineering Mathematics III

Companion Course: 410254- Laboratory Practice III

Course Objectives:

- To understand human learning aspects and relate it with machine learning concepts.
- To understand nature of the problem and apply machine learning algorithm.
- To find optimized solution for given problem.

Course Outcomes:

On completion of the course, student will be able to–

- Distinguish different learning based applications
- Apply different preprocessing methods to prepare training data set for machine learning.
- Design and implement supervised and unsupervised machine learning algorithm.
- Implement different learning models
- Learn Meta classifiers and deep learning concepts

Course Contents

Unit I	Introduction to Machine learning	08 Hours

Classic and adaptive machines, Machine learning matters, Beyond machine learning-deep learning and bio inspired adaptive systems, Machine learning and Big data.

Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory.

Unit II	Feature Selection	08 Hours

Scikit- learn Dataset, Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)-non negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.

Unit III	Regression	08 Hours

Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Robust regression with random sample consensus, Polynomial regression, Isotonic regression,

Logistic regression-Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descendent algorithms, Finding the optimal hyper-parameters through grid search, Classification metric, ROC Curve.

Unit IV	Naïve Bayes and Support Vector Machine	08 Hours

Home

Bayes' Theorom, Naïve Bayes' Classifiers, Naïve Bayes in Scikit- learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes.

Support Vector Machine(SVM)- Linear Support Vector Machines, Scikit- learn implementation- Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.

Unit V	Decision Trees and Ensemble Learning	08 Hours

Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit-learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier.

Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.

Introduction to Meta Classifier: Concepts of Weak and eager learner, Ensemble methods, Bagging, Boosting, Random Forests.

Unit VI	Clustering Techniques	08 Hours

Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering-Dendrograms, Agglomerative clustering in Scikit- learn, Connectivity Constraints.

Introduction to Recommendation Systems- Naïve User based systems, Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.

Fundamentals of Deep Networks-Defining Deep learning, common architectural principles of deep networks, building blocks of deep networks.

Books:

Text:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN-10: 1785889621, ISBN-13: 978-1785889622
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O'REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.

References:

1. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, *ISBN*-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN :0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O'REILLY publication, second edition 2017, ISBN: 1491925612

Home

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410251: Information and Cyber Security

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410254: Laboratory Practice III

Course Objectives:

- To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
- To know the basics of cryptography.
- To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
- To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics.

Course Outcomes:

On completion of the course, student will be able to–

- Gauge the security protections and limitations provided by today's technology.
- Identify information security and cyber security threats.
- Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
- Build appropriate security solutions against cyber-attacks.

Course Contents

Unit I	Security Basics	08 Hours

Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.

Unit II	Data Encryption Techniques And Standards	08 Hours

Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistal Cipher, Data Encryption Standard (DES), Triple DES, DES Design Criteria, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).

Unit III	Public Key And Management	08 Hours

Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Deffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service.

Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.

Unit IV	Security Requirements	08 Hours

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

Unit V	Firewall And Intrusion	08 Hours

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit VI	Confidentiality And Cyber Forensic	08 Hours

Introduction to Personally Identifiable Information (PII), Cyber Stalking, PII impact levels with examples Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective.

Books:

Text:

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
2. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1

References:

1. Eoghan Casey, "Digital Evidence and Computer Crime Forensic Science, Computers and the Internet", ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
3. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3
4. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080
5. Dr. Nilakshi Jain-Digital Forensic: The Fascinating World of Digital Evidences-Wiley India-ISBN: 9788126565740

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(A): Advanced Digital Signal Processing

Home

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 410244(A)Digital Signal Processing

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques and applications of adaptive filtering.
- To learn and understand Multi-rate DSP and applications
- To explore appropriate transforms
- Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech
- Acquire knowledge about different methods used for speech coding and understand various applications of speech processing
- Learn and understand basics of Image Processing and various image filters with its applications

Course Outcomes:

On completion of the course, student will be able to–

- Understand and apply different transforms for the design of DT/Digital systems
- Explore the knowledge of adaptive filtering and Multi-rate DSP
- Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rate DSP
- Explore use of DCT and WT in speech and image processing
- Develop algorithms in the field of speech , image processing and other DSP applications

Course Contents

Unit I	DFT and Applications	08 Hours

DFT and Applications – Linear filtering, spectral leakage, Spectral resolution and selection of Window Length, Frequency analysis, 2-D DFT, applications in Image and Speech Processing

Unit II	Adaptive FIR and IIR filter Design	08 Hours

Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design: Pade Approximation, Least square design, Applications

Unit III	Multi-rate DSP and applications	08 Hours

Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion, polyphone filter structures, multistage filter design, applications

Unit IV	Spectral Estimation	08 Hours

Spectral Estimation – Estimation of density spectrum, Nonparametric method, Parametric method, Evaluation ,DCT and WT – DCT and KL transform, STFT, WT, Harr Wavelet and Dubecheis Wavelet, Applications of DCT and WT.

Unit V	Speech processing	08 Hours

Speech processing - Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders. Fundamentals of Speech recognition, Speech segmentation, Text-to-speech conversion, speech enhancement, Speaker Verification, Applications.

Unit VI	Image Processing	08 Hours

Image Processing – Image as 2D signal and image enhancement techniques, filter design: low pass, highpass and bandpass for image smoothing and edge detection, Optimum linear filter and order statistic filter, Examples – Wiener and Median filters, Applications

Books:

Text:

1. J. G. Proakis, D. G. Manolakis, " Digital Signal Processing: Principles, Algorithms, and Applications," Prentice Hall, 2007, 4th edition, ISBN: 10: 0131873741
2. Dr. Shaila D. Apate , " Advanced Digital Signal Processing," Wiley Publ., 2013, *ISBN*-10: 8126541245
3. S. K. Mitra, "Digital Signal Processing : A Computer Based Approach", McGraw Hill Higher Education, 2006, 3rd edition, *ISBN*-10: 0070429537
4. Rabiner and Juang, "Fundamentals of Speech Recognition", Prentice Hall, 1994, ISBN:0-13-015157-2 .
5. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing and Analysis", Pearson Education, 3d Ed., 2007, ISBN: 81-7808-629-8

References:

1. Chanda, Muzumdar, "Digital Image Processing and Analysis," Estern Economy Edition, PHI, 2nd Ed., ISBN: 978-81-203-4096-*1*
2. TarunRawat, "Digital Signal Processing", Oxford University Press, 2015, ISBN-10: 0198062281
3. Roberto Crist, "Modern Digital Signal Processing," Thomson Brooks/Cole 2004, ISBN:978-93-80026-55-8.
4. Nelson Morgan and Ben Gold, " Speech and Audio Signal Processing: Processing and Perception Speech and Music", 1999, John Wiley and Sons, ISBN: 0387951547
5. Raghuveer. M. Rao, AjitS.Bopardikar, "Wavelet Transforms: Introduction to Theory and applications," Pearson Education, Asia, 2000.Dale Grover and John R. (Jack) Deller, "Digital Signal Processing and the Microcontroller", Prentice Hall, ISBN:0-13-754920-2

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(B): Compilers

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Theory of Computation(310241), 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To introduce process of compilation
- To introduce complier writing tools
- To address issues in code generation and optimization

Course Outcomes:

On completion of the course, student will be able to–

- Design and implement a lexical analyzer and a syntax analyzer
- Specify appropriate translations to generate intermediate code for the given programming language construct
- Compare and contrast different storage management schemes
- Identify sources for code optimization

Course Contents

Unit I	Notion and Concepts	08 Hours

Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.

Unit II	Parsing	08 Hours

Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.

Unit III	Syntax Translation Schemes	08 Hours

Home

Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.

Unit IV	Run-time Storage Management	08 Hours

Storage Management – Static, Stack and Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do -while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.

Unit V	Code Generation	08 Hours

Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.

Unit VI	Code Optimization	08 Hours

Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.

Books:

Text:

1. V Aho, R Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8
2. Dick Grune, Bal, Jacobs, Langendoen, " Modern Compiler Design", Wiley, ISBN 81-265-0418-8

References:

1. Anthony J. Dos Reis, "Compiler Construction Using Java", JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7
2. K Muneeswaran, "Compiler Design", Oxford University press, ISBN 0-19-806664-3
3. J R Levin, T Mason, D Brown, "Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(C): Embedded and Real Time Operating Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand a typical embedded system and its constituents
- To learn the selection process of processor and memory for the embedded systems
- To learn communication buses and protocols used in the embedded and real-time systems
- To understand real-time operating system (RTOS) and the types of RTOS
- To learn various approaches to real-time scheduling
- To learn software development process and tools for RTOS applications

Course Outcomes:

On completion of the course, student will be able to–

- Recognize and classify embedded and real-time systems
- Explain communication bus protocols used for embedded and real-time systems
- Classify and exemplify scheduling algorithms
- Apply software development process to a given RTOS application
- Design a given RTOS based application

Course Contents

Unit I	Embedded Systems	08 Hours

Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, hardware Unit s and devices in an embedded system – Power source, memory, real-time clocks, timers, reset circuits, watchdog-timer reset, Input-output ports, buses and interfaces, ADC, DAC, LCD, LED, Keypad, pulse dialer, modem, transceivers, embedded software, software are tools for designing an embedded system.

Unit II	Embedded System On Chip (SOC)	08 Hours

Embedded SOC, ASIC, IP core, ASIP, ASSP, examples of embedded systems. Advanced architectures/processors for embedded systems- ARM, SHARC, DSP, Superscalar Units. Processor organization, Memory organization, Performance metrics for a processor, memory map and addresses, Processor selection and memory selection for real-time applications.

Networked embedded systems- I2C, CAN, USB, Fire wire. Internet enabled systems- TCP, IP, UDP. Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee.

Unit III	I/O Communication	08 Hours

Devices and communication buses: Types of I/O communication, types of serial communication, Serial protocols, Devices and buses- RS-232C, RS-485, HDLC, SPI, SCI, SI, SDIO. Parallel ports and interfacing. Parallel device protocols: ISA, PCI, PCI/X, ARM bus, Wireless devices.

Unit IV	Real Time Operating System	08 Hours

Home

Introduction to real-time operating systems. Hard versus soft real-time systems and their timing constraints. Temporal parameters of real-time process: Fixed, Jittered and sporadic release times, execution time. Types of real-time tasks, Precedence constraints and data dependency among real-time tasks, other types of dependencies for real-time tasks. Functional parameters and Resource parameters of real-time process, Real-time applications: Guidance and control, Signal processing, Multimedia, real-time databases.

Real-time task and task states, task and data. Approaches to real-time scheduling: clock driver, weighted round-robin, priority-driven- Fixed priority and dynamic priority algorithms –Rate Monotonic (RM), Earliest-Deadline-First (EDF), Latest-Release-Time (LRT), Least-Slack-Time-First (LST). Static and Dynamic systems, on-line and off-line scheduling, Scheduling a-periodic and sporadic real-time tasks.

Unit V	Inter-process communication	08 Hours

Resources and resource access control-Assumption on resources and their usage, Enforcing mutual exclusion and critical sections, resource conflicts and blocking, Effects of resource contention and resource access control - priority inversion, priority inheritance.

Inter-process communication-semaphores, message queues, mailboxes and pipes. Other RTOS services-Timer function, events, Interrupts - enabling and disabling interrupts, saving and restoring context, interrupt latency, shared data problem while handling interrupts. Interrupt routines in an RTOS environment.

Unit VI	Multiprocessor Scheduling	08Hours

Multiprocessor Scheduling, resource access control and synchronization in Real-time Operating system. Real-time communication: Model, priority-based service disciplines for switched networks, weighted round-robin service disciplines, Medium access-control protocols for broadcast networks, internet and resource reservation protocols, real-time protocols. Software development process for embedded system: Requirements engineering, Architecture and design of an embedded system, Implementation aspects in an embedded system, estimation modeling in embedded software. Validation and debugging of embedded systems. Embedded software development tools. Debugging techniques. Real-time operating systems: Capabilities of commercial real-time operating systems, QNX/Neutrino, Microc/OS-II, VxWorks, Windows CE and RTLinux.

Books:

Text:

1. Raj Kamal, “Embedded Systems: Architecture, programming and Design”, 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253
2. Jane W. S. Liu, “Real-Time Systems”, Pearson Education, ISBN: 10: 0130996513
1. David E. Simon, “An Embedded Software Primer”, Pearson Education, ISBN: :8177581546

References:

1. Sriram V. Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming”, Tata McGraw-Hill, ISBN: 13: 9780070482845
2. Dr. K. V. K. K. Prasad, “Embedded Real-Time Systems: Concepts: Design and Programming”, Black Book, Dreamtech Press, ISBN: 10: 8177224611,13: 9788177224610

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(D): Soft Computing and Optimization Algorithms

Home

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310250-Design and Analysis of Algorithm

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To know the basics behind the Design and development intelligent systems in the framework of soft computing
- To acquire knowledge of Artificial Neural Networks Fuzzy sets, Fuzzy Logic, Evolutionary computing and swarm intelligence
- To explore the applications of soft computing
- To understand the need of optimization

Course Outcomes:

On completion of the course, student will be able to–

- Apply soft computing methodologies, including artificial neural networks, fuzzy sets, fuzzy logic, fuzzy inference systems and genetic algorithms
- Design and development of certain scientific and commercial application using computational neural network models, fuzzy models, fuzzy clustering applications and genetic algorithms in specified applications.

Course Contents

Unit I	Introduction	08 Hours

Introduction, soft computing vs. hard computing, various types of soft computing techniques, and applications of soft computing. Basic tools of soft computing – Fuzzy logic, neural network, evolutionary computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, and hybrid systems.

Unit II	Fuzzy Sets and Logic	08 Hours

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications.

Unit III	Fuzzy Systems	08 Hours

Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules, decomposition of compound rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference system, fuzzy expert systems.

Unit IV	Evolutionary Computing	08 Hours

Home

Basic Evolutionary Processes, EV : A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size.

Unit V	Genetic Algorithm	08 Hours

Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Traditional algorithm vs genetic algorithm, simple GA, general genetic algorithm, schema theorem, Classification of genetic algorithm, Holland classifier systems, genetic programming, applications of genetic algorithm, Convergence of GA. Applications and advances in GA, Differences and similarities between GA and other traditional method, applications.

Unit VI	Swarm Intelligence	08 Hours

Swarm intelligence , Particle Swarm Optimization (PSO) Algorithm- Formulations, Pseudo-code, parameters, premature convergence, topology, biases, Real valued and binary PSO, Ant colony optimization (ACO)- Formulations, Pseudo-code. Applications of PSO and ACO.

Books:

Text:

1. S.N. Sivanandam- "Principles of Soft Computing", Wiley India- ISBN- 9788126527410
2. S. Rajsekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" , Prentice Hall of India, ISBN: 0451211243
3. J S R Jang, CT Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing" , PHI PVT LTD, ISBN 0-13-261066-*3*.
4. De Jong , "Evolutionary Computation: A Unified Approach", Cambridge (Massachusetts): MIT Press. ISBN: 0-262-04194-4. 2006
5. Maurice Clerc, "Particle Swarm Optimization", ISTE, Print ISBN:9781905209040 |Online ISBN:9780470612163 |DOI:10.1002/9780470612163

References:

1. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
2. N.P.Padhy, "Artificial Intelligence and Intelligent Systems" Oxford University Press, ISBN 10: 0195671546
3. Siman Haykin, "Neural Networks", Prentice Hall of India, ISBN: 0-7923-9475-5
4. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" , Wiley India, ISBN: 978-0-470-74376-8
5. Eiben and Smith, "Introduction to Evolutionary Computation", Springer, ISBN-10: 3642072852

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(A): Software Defined Networks

Home

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245-Computer Networks

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand the challenges of the traditional networks and evolution of next generation networks.
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Center.
- To understand role of Open Flow protocol and SDN Controllers.
- To study industrial deployment use-cases of SDN
- To Understand the Network Functions Virtualization and SDN.

Course Outcomes:

On completion of the course, student will be able to–

- Interpret the need of Software Defined Networking solutions.
- Analyze different methodologies for sustainable Software Defined Networking solutions.
- Select best practices for design, deploy and troubleshoot of next generation networks.
- Develop programmability of network elements.
- Demonstrate virtualization and SDN Controllers using OpenFlow protocol

Course Contents

Unit I	Introduction to Software Defined Networking (SDN)	08 Hours

Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Planes, Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separation, Simplified Device and Centralized control, Network Automation and Virtualization, and Openness), SDN Operation/Architecture, SDN API's (Northbound API's, Southbound API's, East/West API's), ONF, SDN Devices and SDN Applications.

Unit II	Open Flow	08 Hours

Home

OpenFlow Overview, The OpenFlow Switch, The OpenFlow Controller, ,OpenFlow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, OpenFlow Protocol, Proactive and Reactive Flow, Timers, OpenFlow Limitations, OpenFlow Advantages and Disadvantages, Open v Switch Features

Unit III	SDN Controllers	08 Hours

SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu and Open Daylight, Applicability of OpenFlow protocol in SDN Controllers, Mininet, and implementing software-defined network (SDN) based firewall.

Unit IV	SDN in Data Centre	08 Hours

Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and Path Efficiency), Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays, and APIs, Real-World Data Center Implementations.

Unit V	Network Functions Virtualization (NFV)	08 Hours

Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.

Unit VI	SDN Use Cases	08 Hours

Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.

Books:

Text:

1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844.
2. Siamak Azodolmolky, “Software Defined Networking with Open Flow, Packt Publishing, 2013, ISBN: 9781849698726
3. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, 2013, ISBN : 10:1-4493-4230-2, 978-1-4493-4230-2

References:

1. Vivek Tiwari, “SDN and OpenFlow for Beginners”, Digital Services, 2013, ISBN: 10: 1-940686-00-8, 13: 978-1-940686-00-4
2. Fei Hu, “Network Innovation through OpenFlow and SDN: Principles and Design”, CRC Press, 2014, ISBN: 10: 1466572094
3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(B): Human Computer Interface

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 210251-Computer Graphics

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To design, implement and evaluate effective and usable Human Computer Interfaces.
- To describe and apply core theories, models and methodologies from the field of HCI.
- Learn a variety of methods for evaluating the quality of a user interface
- To implement simple graphical user interfaces based on principles of HCI.

Course Outcomes:

On completion of the course, student will be able to–

- Evaluate the basics of human and computational abilities and limitations.
- Inculcate basic theory, tools and techniques in HCI.
- Apply the fundamental aspects of designing and evaluating interfaces.
- Apply appropriate HCI techniques to design systems that are usable by people

Course Contents

Unit I	Foundations of Human–Computer Interaction	08 Hours

What is HCI – design, models, evaluation, Need to understand people, computers and methods. Basic human abilities - vision, hearing, touch, memory.

Computers – speed, interfaces, widgets, and effects on interaction. Humans – Memory, Attention Span, Visual Perception, psychology, ergonomics. Understanding Users.

Methods for evaluation of interfaces with users: goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method.

Unit II	The Design Process	08 Hours

Interaction Design Basics, Interaction Styles. HCI in the Software Process. HCI design principles and rules: design principles, principles to support usability, golden rules and heuristics, HCI patterns, design rules, HCI design standards. Direct Manipulation - Overview, Scope, Applications. Universal Design, User-centered design, task analysis/GOMS, Graphic Design

Unit III	Implementation	08 Hours

Home

Implementation Tools, Technology and change designing for the Web, designing for portable devices. Handling errors and Designing Help. Prototyping and UI Software.

Unit IV	Evaluation and User Support	08 Hours

Evaluation of User Interfaces. Web Browsers - Fonts, Color Palette, Color Depth, Resolution, Layout, Size, Orientation. Mobile devices issues – design, limitations, what next. User Support.

Unit V	Users Models	08 Hours

Predictive Models, Cognitive Models. Interaction with Natural Languages, Next Generation Interface. Socio-organizational Issues and Stakeholder Requirements. Heuristic Evaluation, Evaluation with Cognitive Models, Evaluation with Users.

Unit VI	Task Models and Dialogs	08 Hours

Task Analysis, DOET (Design of Everyday Things). Design Dialogs Notations, Warnings, and Error messages. Model-based Evaluation. User Testing, Usability Testing, User Acceptance Testing.

Books:

Text:

1. Alan J, Dix. Janet Finlay, Rusell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9
2. Jenny Preece, Rogers, Sharp, “Interaction Design-beyond human-computer interaction”, WILEY-INDIA, ISBN 81-265-0393-9

References:

3. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904.
4. Mary Beth Rosson and John M. Carroll, “Usability Engineering: Scenario-Based Development of Human-Computer Interaction”, Morgan Kaufmann, 2001, ISBN-13: 978-1558607125

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(C): Cloud Computing

Home

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245 Computer Networks

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand cloud computing concepts;
- To study various platforms for cloud computing
- To explore the applications based on cloud computing

Course Outcomes:

On completion of the course, student will be able to–

- To install cloud computing environments.
- To develop any one type of cloud
- To explore future trends of cloud computing

Course Contents

Unit I	Basics of Cloud Computing	08 Hours

Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of Paas Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a Service (IDaaS).

Unit II	Data Storage and Security in Cloud	08 Hours

Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. [Anthony T. Velte]3 Securing the Cloud- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.

Unit III	Virtualization	08 Hours

Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP),Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.

Unit IV	Amazon Web Services	08 Hours

Home

Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shotting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.

Unit V	Ubiquitous Clouds and the Internet of Things	08 Hours

Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking.

Unit VI	Future of Cloud Computing	08 Hours

How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing. Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

Text:

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, " Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more" , Wiley Publications, ISBN: 978-0-470-97389-9
3. Gautam Shrof, "ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, *ISBN*: 9780511778476

References:

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication, ISBN10: 8126536039
2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0,
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Pearson, 1st Edition, ISBN :978 9332535923, 9332535922
4. Tim Mather, Subra K, Shahid L.,Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(D): Open Elective

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Companion Course: 410255-Laboratory Practice IV

The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time.

Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons.

With this idea learner opts for the course without any boundaries to choose the approved by academic council and Board of Studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410254:Laboratory Practice III

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Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 50 Marks

Companion Courses: 410250 and 410251

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice III is for practical hands on for core courses Machine Learning and Information & Cyber Security.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

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Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising boost to the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments& Mini Projects

(any 04 assignments Machine Learning and Information & Cyber Security AND Mini-project per course)

410250: Machine Learning

1. Assignment on Linear Regression:
The following table shows the results of a recently conducted study on the correlation of the number of hours spent driving with the risk of developing acute backache. Find the equation of the best fit line for this data.

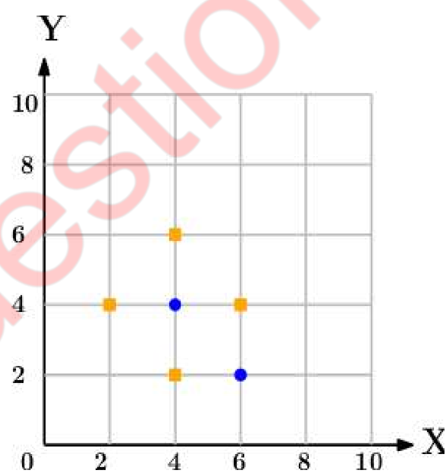
Number of hours spent driving (x)	Risk score on a scale of 0-100 (y)
10	95
9	80
2	10
15	50
10	45
16	98
11	38
16	93

2. Assignment on Decision Tree Classifier:
A dataset collected in a cosmetics shop showing details of customers and whether or not they responded to a special offer to buy a new lip-stick is shown in table below. Use this dataset to

build a decision tree, with Buys as the target variable, to help in buying lip-sticks in the future. Find the root node of decision tree. According to the decision tree you have made from previous training data set, what is the decision for the test data: [Age < 21, Income = Low, Gender = Female, Marital Status = Married]?

ID	Age	Income	Gender	Marital Status	Buys
1	< 21	High	Male	Single	No
2	< 21	High	Male	Married	No
3	21-35	High	Male	Single	Yes
4	>35	Medium	Male	Single	Yes
5	>35	Low	Female	Single	Yes
6	>35	Low	Female	Married	No
7	21-35	Low	Female	Married	Yes
8	< 21	Medium	Male	Single	No
9	<21	Low	Female	Married	Yes
10	> 35	Medium	Female	Single	Yes
11	< 21	Medium	Female	Married	Yes
12	21-35	Medium	Male	Married	Yes
13	21-35	High	Female	Single	Yes
14	> 35	Medium	Male	Married	No

3. **Assignment on k-NN Classification:**
In the following diagram let blue circles indicate positive examples and orange squares indicate negative examples. We want to use k-NN algorithm for classifying the points. If k=3, find the class of the point (6,6). Extend the same example for Distance-Weighted k-NN and Locally weighted Averaging



4. **Assignment on K-Means Clustering:**
We have given a collection of 8 points. P1=[0.1,0.6] P2=[0.15,0.71] P3=[0.08,0.9] P4=[0.16, 0.85] P5=[0.2,0.3] P6=[0.25,0.5] P7=[0.24,0.1] P8=[0.3,0.2]. Perform the k-mean clustering with initial centroids as m1=P1 =Cluster#1=C1 and m2=P8=cluster#2=C2. Answer the following
1] Which cluster does P6 belongs to?
2] What is the population of cluster around m2?
3] What is updated value of m1 and m2?

5. **Mini-Project 1** on Genetic Algorithm:
Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository.
For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset

6.	**Mini-Project 2** on SVM: Apply the Support vector machine for classification on a dataset obtained from UCI ML repository. For Example: Fruits Classification or Soil Classification or Leaf Disease Classification
7.	**Mini-Project 3** on PCA: Apply the Principal Component Analysis for feature reduction on any Company Stock Market Dataset
410251:: : Information and Cyber Security	
1.	Implementation of S-DES
2.	Implementation of S-AES
3.	Implementation of Diffie-Hellman key exchange
4.	Implementation of RSA.
5.	Implementation of ECC algorithm.
6.	**Mini Project 1:** SQL Injection attacks and Cross -Site Scripting attacks are the two most common attacks on web application. Develop a new policy based Proxy Agent, which classifies the request as a scripted request or query based request, and then, detects the respective type of attack, if any in the request. It should detect both SQL injection attack as well as the Cross-Site Scripting attacks.
7.	**Mini Project 2:**This task is to demonstrate insecure and secured website. Develop a web site and demonstrate how the contents of the site can be changed by the attackers if it is http based and not secured. You can also add payment gateway and demonstrate how money transactions can be hacked by the hackers. Then support your website having https with SSL and demonstrate how secured website is.

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410255:Laboratory Practice IV

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Presentation: 50 Marks

Companion Courses: 410252 and 410253

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the elective courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course III and elective course IV.

Guidelines for Laboratory Conduction

- **List of recommended programming assignments and sample mini-projects is provided for reference.**
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MongoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of digital storage media/DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab

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assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project(s) Demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- Encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and as ready reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction and Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, references among others.

Suggested List of Laboratory Assignments & Mini Projects

Recommended / Sample set of assignments and mini projects for reference for four courses offered for Elective I and for four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

410252: Elective III

410252 (A) Advanced Digital Signal Processing

Use -
A] MATLAB or other equivalent software working with speech and image signals/files and for analysis purpose.
B] C++ or JAVA for working with sampled data (n – point data samples of DT/Digital signal)
C] JAVA or other for image processing assignments

1.	Apply 1-D DFT to observe spectral leakage and frequency analysis of different window sequences, plot the frequency spectrums.
2.	Adaptive FIR and IIR filter design: A] Steepest descent and Newton method, LMS method, B] Adaptive IIR Filter design: Pade Approximation, Least square design
3.	Power spectrum estimation and analysis: Take a speech signal and perform A] Non parametric method: DFT and window sequences B] Parametric methods: AR model parameters
4.	Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion A] Take a speech signal with specified sampling frequency. Decimate by factor D(e.g. factor B] Take a speech signal with specified sampling frequency. Interpolate by factor I(e.g. factor)

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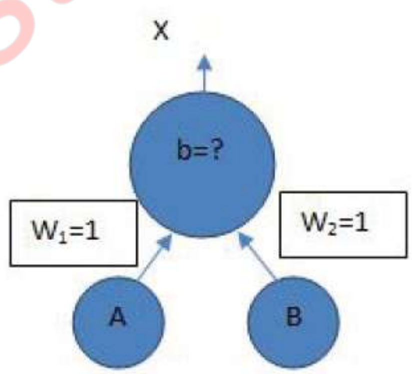
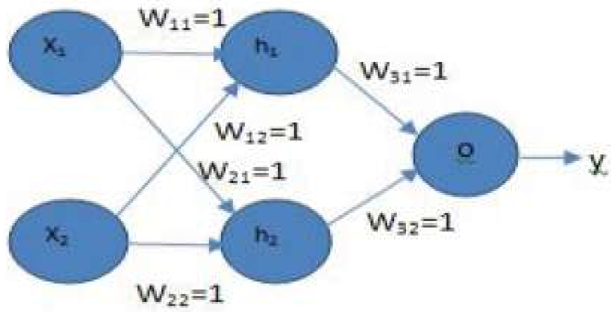
	C] Sampling rate conversion by factor of I/D
5.	Write a program to calculate LPC coefficients, reflection coefficients using Levinson Durbin algorithm
6.	Feature Extraction of speech signal A] Using LPC and other methods B] Apply different coding methods: harmonic coding, vector quantization
7.	**Mini-Project 1:** Discrete Cosine Transform (DCT) A] To find DCT of NxN image block B] To plot spectrum of the speech signal using DCT and find the correlation of DCT transformed signal C] Image filtering using DCT : LPF, edge detection D] Image compression using DCT, Image resizing
8.	**Mini-Project 2:** Wavelet Transform (WT) A] To get compression using wavelet decomposition of a signal B] Denoising using wavelet decomposition C] To get compression using wavelet decomposition of a signal (Harr Wavelet) D] To get low-pass filtered and high pass filtered speech signal using Haar wavelet E] Image filtering using WT
9.	**Mini-Project 3:** Image Processing A] Histogram and Equalization B] Image Enhancement Techniques C] Image Filtering: LPF, HPF, Sobel/Prewitt Masks D] Image Smoothing with special filters: Median, Weiner, Homomorphic filters
Course: 410252 (B) Compiler Construction	
1.	Implement a Lexical Analyzer using LEX for a subset of C. Cross check your output with Stanford LEX.
2.	Implement a parser for an expression grammar using YACC and LEX for the subset of C. Cross check your output with Stanford LEX and YACC.
3.	Generate and populate appropriate Symbol Table.
4.	Implementation of Semantic Analysis Operations (like type checking, verification of function parameters, variable declarations and coercions) possibly using an Attributed Translation Grammar.
5.	Implement the front end of a compiler that generates the three address code for a simple language.
6.	A Register Allocation algorithm that translates the given code into one with a fixed number of registers.
7.	Implementation of Instruction Scheduling Algorithm.
8.	Implement Local and Global Code Optimizations such as Common Sub-expression Elimination, Copy Propagation, Dead-Code Elimination, Loop and Basic-Block Optimizations. (Optional)
9.	**Mini-Project 1:** Implement POS tagging for simple sentences written Hindi or any Indian Language
Course: 410252 (C) Embedded and Real Time Operating Systems	
1.	Simulation/ Design, planning and modeling of a Real-Time / Embedded System for- (any one) • Alarm system for elderly people (Fall detection, Heart attack) • Medication machine for patients in ICU • Smart traffic control • Autonomous car • Smart home (sound system, temperature, light)

	• Control of an autonomous quadrocopter (e.g. for surveillance tasks) • Control of a rail station • Video conference system • Washing machine
Course: 410252 (D) Soft Computing and Optimization Algorithms	
1.	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
2.	Implement genetic algorithm for benchmark function (eg. Square, Rosenbrock function etc) Initialize the population from the Standard Normal Distribution. Evaluate the fitness of all its individuals. Then you will do multiple generation of a genetic algorithm. A generation consists of applying selection, crossover, mutation, and replacement. Use: • Tournament selection without replacement with tournament size s • One point crossover with probability Pc • bit-flip mutation with probability Pm • use full replacement strategy
3.	Implement Particle swarm optimization for benchmark function (eg. Square, Rosenbrock function). Initialize the population from the Standard Normal Distribution. Evaluate fitness of all particles. Use : • c1=c2 = 2 • Inertia weight is linearly varied between 0.9 to 0.4. • Global best variation
4.	Implement basic logic gates using Mc-Culoch-Pitts or Hebbnet neural networks
5.	Write a program to find the Boolean function to implement following single layer perceptron. Assume all activation functions to be the threshold function which is 1 for all input values greater than zero and 0, otherwise. 
6.	Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
7.	The figure shows a single hidden layer neural network. The weights are initialized to 1's as shown in the diagram and all biases are initialized to 0's. Assume all the neurons have linear activation functions. The neural network is to be trained with stochastic (online) gradient descent. The first training example is [x1=1, x2=0] and the desired output is 1. Design the back-propagation algorithm to find the updated value for W11 after backpropagation. Choose the value that is the closest to the options given below: [learning rate =0.1]



8.	**Mini-Project 1** on Genetic Algorithm: Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository. For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset
9.	Apply the Particle swarm optimization for Travelling Salesman Problem
10.	**Mini-Project 2** on Fuzzy Logic: Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox or Octave or Python.
11.	**Mini-Project 3** on Fuzzy Logic: Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox or Octave or Python.
	410253: Elective III
	Course: 410253 (A) Software Defined Networks
1.	Phase I:Set up Mininet network emulation environment using Virtual Box and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology (Simple, Linear, and Tree).View flow tables.
2.	Phase II:Study open source POX and Floodlight controller. Install controller and run custom topology using remote controller like POX and floodlight controller. Identify inserted flows by the controllers.
3.	Phase III:Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller. Ref:https://github.com/mininet/openflow-tutorial/wiki/Create- Firewall
4.	Phase IV:Build your own Internet Router using Mininet as an Emulator and POX controller. Write a simple router with a static routing table. The router will receive raw Ethernet frames. It will process the packets just like a real router, and then forward them to the correct outgoing interface. Make sure you receive the Ethernet frame and create the forwarding logic so packets go to the correct interface. Ref:https://github.com/mininet/mininet/wiki/Simple-Router
5.	Phase V: Emulate a Data Center and manage it via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center. Your second task is to implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management. Ref: https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf
	Course:410253 (B) Human Computer Interface
1.	Identify specialized users and related facilities for a selected product / system and make necessary suggestions for its improved accessibility design.

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2.	Design user persona for the users of selected product / system.
3.	Conduct a contextual inquiry for selected product / system.
4.	Design an interface prototype for selected product / system.
5.	Evaluate an interface using usability evaluation technique.
Course: 410253 (C) Cloud Computing	
1.	1. Installation and configuration of own Cloud 2. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System. 3. Study and implementation of infrastructure as Service using Open Stack. 4. Write a program for Web feed using PHP and HTML. 5. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features. 6. Case study on Amazon EC2 to learn about Amazon EC2,Amazon Elastic Compute Cloud is a central part of Amazon.com's cloud computing platform, Amazon Web Services. How EC2 allows users torrent virtual computers on which to run their own computer applications. 7. Case study on Microsoft azure to learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, forbuilding, deploying and managing applications and services through a global network of Microsoft-managed datacenters. How it work, different services provided by it. 8. Design and develop custom Application (Mini Project) using Salesforce Cloud. 9. Assignment to install and configure Google App Engine. 10. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store. 11. Creating an Application in SalesForce.com using Apex programming Language. **12.** Design an Assignment based on Working with Mangrasoft Aneka Software.
2.	**Mini-Project 1:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies **without HDFS**. Implement the basic operations may be like to upload and download file on/from cloud in encrypted form.
3.	**Mini-Project 2:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies to implement **with HDFS**. Implement the basic operations may be like to divide the file in segments/blocks and upload/ download file on/from cloud in encrypted form.
Course: 410253 (D) Open Elective	
Suitable set of programming assignments/Mini-projects for open elective Opted.	

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Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410256:Project Work Stage II

Teaching Scheme:	Credit	Examination Scheme:
Practical : 06 Hours/Week	06	Term Work: 100 Marks Presentation: 50 Marks

Course Objectives:

- To follow SDLC meticulously and meet the objectives of proposed work
- To test rigorously before deployment of system
- To validate the work undertaken
- To consolidate the work as furnished report.

Course Outcomes:

On completion of the course, student will be able to–

- Show evidence of independent investigation
- Critically analyze the results and their interpretation.
- Report and present the original results in an orderly way and placing the open questions in the right perspective.
- Link techniques and results from literature as well as actual research and future research lines with the research.
- Appreciate practical implications and constraints of the specialist subject

Guidelines

In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6

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In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor‘s degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment(Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC6- I	Business Intelligence
AC6-II	Gamification
AC6-III	Quantum Computing
AC6-IV	Usability Engineering
AC6-V	Conversational Interfaces
AC6-VI	MOOC- Learn New Skills (Refer Page 48)

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier
http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – I: Business Intelligence

The course aims at examining Business Intelligence (BI) as a broad category of applications and technologies for gathering, storing, analyzing, sharing and providing access to data to help enterprise users make better managerial decisions.

Course Objectives:

- To understand the concept of Business Intelligence
- To know the details of Decision Support System
- To inculcate the concepts of Data Warehousing
- To understand the basics of design and management of BI systems

Course Outcome:

On completion of the course, learner will be able to–

- Apply the concepts of Business Intelligence in real world applications
- Explore and use the data warehousing wherever necessary
- Design and manage practical BI systems

Course Contents:

1. **Concepts with Mathematical treatment :** Introduction to data, Information and knowledge, Decision Support System, Theory of Operational data and informational data, Introduction to Business Intelligence, Determining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Benefits of BI. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization
2. **Decision Making Concepts :** Concepts of Decision Making, Techniques of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS.
3. **Data-Warehouse :** Introduction: Data warehouse Modeling, data warehouse design, data-warehouse technology, Distributed data warehouse, and materialized view
4. **Data Pre-processing and outliers:** Data Analytics life cycle, Discovery, Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization, and concept hierarchy generation, Model Planning, Model building, Communicating Results and Findings, Operationalizing, Introduction to OLAP. Real-world Applications, types of outliers, outlier challenges, Outlier detection Methods, Proximity-Based Outlier analysis, Clustering Based Outlier analysis.
5. **Designing and managing BI systems :** Determining infrastructure requirements, planning for scalability and availability, managing and maintenance of BI systems, managing BI operations or business continuity

Books:

1. R. Sharda, D. Delen, and E. Turban, Business Intelligence and Analytics. Systems for Decision Support,10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;

2. Business Process Automation, Sanjay Mohapatra, PHI.

3. Introduction to business Intelligence and data warehousing, IBM, PHI, ISBN: 9788120339279

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – II: Gamification

Gamification is the application of game-design elements and game principles in non-game contexts. Gamification commonly employs game design elements to improve user engagement, organizational productivity, flow, crowd sourcing, employee recruitment and evaluation, ease of use, usefulness of systems, exercise, traffic violations, voter apathy, and more.

Course Objectives:

- To develop problem solving abilities using gamification
- To apply gamifications for Web Applications
- To apply gamifications for Mobile Applications

Course Outcome:

On completion of the course, learner will be able to–

- To write survey on the gamification paradigms.
- To write programs to solve problems using gamification and open source tools.
- To solve problems for multi-core or distributed, concurrent/Parallel environments

Course Contents:

1. **Gaming Foundations:** Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.
2. **Developing Thinking:** Re-framing Context, Player Motivation, Case studies for Thinking: Tower of Hanoi.
3. **Opponent Moves in Gamification:** Reclaiming Opposition, Gamed Agencies, Remodeling design, Game Mechanics, Case study of Maze Problem.
4. **Game Design:** Game Mechanics and Dynamics: Feedback and Re-enforcement, Game Mechanics in depth, putting it together, Case study of 8 queens problem.
5. **Advanced tools, techniques and applications:** Gamification case Studies, Coding basic game Mechanics, Instant Gamification Platforms, Mambo.io(Ref:http://mambi.io), Installation and use of BigDoor (Open Source http://bigdoor.com),ngageoint/gamification-server (ref: https://github.com/ngageoint/gamification-server

Books:

1. Mathias Fuchs, Sonia Fizek,Paolo Ruffino, Niklas Schrape, Rethinking Gamification, Meson Press, ISBN (Print): 978-3-95796-000-9 , http://projects.digital-cultures.net/meson-press/files/2014/06/9783957960016-rethinking-gamification.pdf, ISBN (PDF): 978-3-95796-001-6,
2. , Gabe Zechermann, Christopher Cunningham, Gamification Design, Oreilly, ISBN: 978-1-449-39767-8, ftp://ftp.ivacuum.ru/i/WooLF/%B2011%5D%20Gamification%20by%20Design.pdf
3. http://press.etc.cmu.edu/files/MobileMediaLearning-DikkersMartinCoulter-web.pdf

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – III: Quantum Computing

Quantum computation and quantum information is the study of the information processing tasks that can be accomplished using quantum mechanical systems. Sounds pretty simple and obvious, doesn't it? Like many simple but profound ideas it was a long time before anybody thought of doing information processing using quantum mechanical sys- tems. To see why this is the case, we must go back in time and look in turn at each of the fields which have contributed fundamental ideas to quantum computation and quantum information -quantum mechanics, computer science, information theory, and cryptography.

Course Objectives:

- To understand basic concepts of quantum computing
- To learn quantum search algorithms
- To apply quantum information for solving real world problem

Course Outcome:

On completion of the course, learner will be able to–

- design efficient quantum algorithms
- apply quantum algorithms for several basic promise problems
- learn the hidden subgroup problems and their role in quantum computing

Course Contents:

1. **Fundamental concepts:** Introduction and overview, Quantum computation, quantum algorithm, Introduction to quantum mechanics, The postulates of quantum mechanics
2. **Quantum computation:** Quantum circuits, The quantum Fourier transform and its applications, Quantum search algorithms, Quantum computers: physical realization
3. **Quantum information:** Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, mEntropy and information, Quantum information theory

Books:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, ISBN: 9780521635035.
2. Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008.
3. N. David Mermin, "Quantum Computer Science", Cambridge 2007

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – IV: Usability Engineering

In this course you will have a hands-on experience with usability evaluation and user-centered design. This course will not help to learn how to implement user interfaces, but rather how to design based on the needs of users, which you will determine, and learn how toevaluate your designs rigorously. This help in knowing more about the usability; human computer interaction, the psychological aspects of computing, evaluation.

Course Objectives:

- To understand the human centered design process and usability engineering process and their roles in system design and development.
- To know usability design guidelines, their foundations, assumptions, advantages, and weaknesses
- Understand the user interface based on analysis of human needs and prepare a prototype system

Course Outcome:

On completion of the course, learner will be able to–

- Describe the human centered design process and usability engineering process and their roles in system design and development.
- Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
- Design a user interface based on analysis of human needs and prepare a prototype system.
- Assess user interfaces using different usability engineering techniques.
- Present the design decisions

Course Contents:

1. Introduction: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences
2. Usability in Software Development : The Emergence of Usability, Human Computer Interaction, Usability Engineering
3. The usability Engineering Lifecycle: Requirement Analysis, Design, Testing, Development
4. Usability Assessment Methods beyond Testing
5. International User Interfaces

Books:

1. Mary Beth Rosson, John Millar Carroll, “Usability Engineering: Scenario- based Development of Human- Computer Interaction”
2. Jakob Nielsen, “Usability Engineering”
1. Deborah J. Mayhew, “ The usability engineering lifecycle”

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Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – V: Conversational Interfaces

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

- To understand the basics of conversation
- To know the interactive environments for conversational skills
- To acquaint with the speech to text and text to speech techniques

Course Outcome:

On completion of the course, learner will be able to–

- Develop an effective interface for conversation
- Explore advanced concepts in user interface

Course Contents:

1. **Introduction to Conversational Interface:** Preliminaries, Developing a speech based Conversational Interface, Conversational Interface and devices.
2. **A technology of Conversation:** Introduction, Conversation as Action, The structure of Conversation, The language of Conversation.
3. **Developing a Speech-Based Conversational Interface:** Implementing Text to Speech: Text Analysis, Wave Synthesis, Implementing Speech Recognition: Language Model, Acoustic Model, Decoding. Speech Synthesis Markup Language.
4. **Advanced voice user interface design**

Books:

1. Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences"
2. Michael McTear, ZoraidaCallejas, David Griol, " The Conversational Interface: Talking to Smart Devices"
3. Martin Mitrevski, "Developing Conversational Interfaces for iOS: Add Responsive Voice Control"
4. SriniJanarthanam, " Hands-On Chatbots and Conversational UI Development: Build chatbots"

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Savitribai Phule Pune University
Bachelor of Computer Engineering (2015 Course)
(Total 190 Credit)

First Year		Second Year		Third Year		Forth Year	
Credit =50		**Credit =50**		**Credit =46**		**Credit =44**	
Semester I							
Course Code	**Course**	**Course Code**	**Course**	**Course Code**	**Course**	**Course Code**	**Course**
107001	Engineering Mathematics I	210241	Discrete Mathematics	310241	Theory of Computation	410241	High Performance Computing
107002 / 107009	Engineering Physics / Engineering Chemistry	210242	Digital Electronics and Logic Design	310242	Database Management Systems (DBMS)	410242	Artificial Intelligence and Robotics
102006	Engineering Graphics I	210243	Data Structures and Algorithms	310243	Software Engineering & Project Management	410243	Data Analytics
103004 / 104012	Basic Electrical Engineering /Basic Electronics Engineering	210244	Computer Organization and Architecture	310244	Information Systems & Engineering Economics	410244	Elective I • Digital Signal Processing • Software Architecture and Design • Pervasive and Ubiquitous Computing • Data Mining and Warehousing
101005	Basic Civil and Environmental Engineering	210245	Object Oriented Programming	310245	Computer Networks (CN)	410245	Elective II • Distributed Systems • Software Testing and Quality Assurance • Operations Research • Mobile Communication
110003	Fundamentals of Programming Languages I	210246	Digital Electronics Lab	310246	Skills Development Lab	410246	Laboratory Practice I
111007	Workshop Practice	210247	Data Structures Lab	310247	DBMS Lab	410247	Laboratory Practice II
		210248	Object Oriented Programming Lab	310248	CN Lab	410248	Project Work Stage I
		210249	Soft Skills	310249	Audit Course 3	410249	Audit Course 3
		210250	Audit Course 1				

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Semester II							
Course Code	**Course**	**Course Code**	**Course**	**Course Code**	**Course**	**Course Code**	**Course**
107008	Engineering Mathematics II	207003	Engineering Mathematics III	310250	Design & Analysis of Algorithms	410250	Machine Learning
107009 / 107002	Engineering Chemistry / Engineering Physics	210251	Computer Graphics	310251	Systems Programming & Operating System (SP & OS)	410251	Information and Cyber Security
102013	Basic Mechanical Engineering	210252	Advanced Data Structures	310252	Embedded Systems & Internet of Things (ES & IoT)	410252	Elective III Advanced Digital Signal Processing Compilers Embedded and Real Time Operating Systems Soft Computing and Optimization Algorithms
101011	Engineering Mechanics	210253	Microprocessor	310253	Software Modeling and Design	410253	Elective IV Software Defined Networks Human Computer Interface Cloud Computing Open Elective
104012 / 103004	Basic Electronics Engineering / Basic Electrical Engineering	210254	Principles of Programming Languages	310254	Web Technology	410254	Laboratory Practice III
110010	Fundamentals of Programming Languages II	210255	Computer Graphics Lab	310255	Seminar & Technical Communication	410255	Laboratory Practice IV
102014	Engineering Graphics II	210256	Advanced Data Structures Lab	310256	Web Technology Lab	410256	Project Work Stage II
		210257	Microprocessor Lab	310257	SP & OS Lab	410257	Audit Course 3
		210258	Audit Course 2	310258	ES & IoT Lab		
				310259	Audit Course 4		

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SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS FOR

B.E. ELECTRICAL ENGINEERING

(2015 course)

WITH EFFECT FROM YEAR 2018-2019

Savitribai Phule Pune University

FACULTY OF ENGINEERING

B.E. Electrical Engineering (2015 Course)
(w.e.f. 2018-2019)

SEMESTER-I

Sr No	Subject Code	Subject Title	Teaching Scheme (Hrs/Week)			Examination Scheme (Marks)					Total Marks	Credit	
			TH	PR	TU	PP In Sem	PP End Sem	TW	PR	OR		TH / TU	PR + OR
1	403141	Power System Operation and Control	03	02	--	30	70	25	--	25	150	03	01
2	403142	PLC and SCADA Applications	04	02	--	30	70	25	50	--	175	04	01
3	403143	Elective I	03	02	--	30	70	25	--	--	125	03	01
4	403144	Elective II	03	--	--	30	70	--	--	--	100	03	--
5	403145	Control System II	03	02	--	30	70	25	--	25	150	03	01
6	403146	Project I	--	--	02	--	--	--	--	50	50	02	--
	403152	Audit Course V											
		TOTAL	16	08	02	150	350	100	50	100	750	18	04

SEMESTER-II

Sr No	Subject Code	Subject Title	Teaching Scheme (Hrs/Week)			Examination Scheme (Marks)					Total Marks	Credit	
			TH	PR	TU	PP In Sem	PP End Sem	TW	PR	OR		TH / TU	PR + OR
1	403147	Switchgear and Protection	03	02	--	30	70	50	--	25	175	03	01
2	403148	Power Electronic Controlled Drives	04	02	--	30	70	25	50	--	175	04	01
3	403149	Elective III	03	02	--	30	70	25	--	25	150	03	01
4	403150	Elective IV	03	--	--	30	70	--	--	--	100	03	--
5	403151	Project II	--	--	06	--	--	50	--	100	150	06	--
	403153	Audit Course VI											
TOTAL			13	06	06	120	280	150	50	150	750	19	03

TH	**Theory lectures hours/week**	**TW**	**Term work**
PR	**Practical hours/week**	**OR**	**Oral**
TU	**Tutorial hours/week**	**PP**	**Paper- In semester and End Semester**

Elective I (403143)	**Elective II (403144)**
A) Fundamentals of Microcontroller MSP430 and its Applications [Open Elective] **B) Power Quality** **C) Renewable Energy Systems** **D) Digital Signal Processing**	**A) Restructuring and Deregulation** **B) Electromagnetic Fields** **C) EHVAC Transmission** **D) Electric and Hybrid Vehicles** **E) Special Purpose Machines**
Elective III (403149)	**Elective IV (403150)**
A) High Voltage Engineering **B) HVDC and FACTS** **C) Digital Control System** **D) Intelligent Systems and Applications in Electrical Engineering** **E) Analog Electronics and Sensing Technology [Open Elective]**	**A) Smart Grid** **B) Robotics and Automation** **C) Illumination Engineering** **D) VLSI Design[Open Elective]**

Audit Course

- Audit Course: Optional for 1st and 2nd term of BE Electrical Engineering
- 'Audit Courses' means a Course in which the student shall be awarded Pass or Fail only. It is left to the discretion of the respective affiliated institute to offer such courses to the students. Evaluation of audit course will be done at institute level itself.
- Teaching-learning process for these subjects is decided by concern faculty/industry experts appointed by the affiliated Engineering College based on the syllabus and guidelines given.
- Marks obtained by student for audit course will not be taken into consideration of SGPA or CGPA.

Audit Course V 403152	**(A) Hydro Energy Systems** **(B) Foreign Language – German**
Audit Course VI 403153	**Energy Storage Systems**

403141: Power System Operation and Control

Teaching Scheme		Credits	Examination Scheme [150 Marks]		
Theory	: 03 Hr/Week	03	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			Oral	:	25 Marks
			Term work	:	25 Marks

Prerequisite:
Basics of Power System

Course Objective: The course aims:-

- To develop ability to analyze and use various methods to improve stability of power systems
- To understand the need for generation and control of reactive power
- To impart knowledge about various advanced controllers such as FACTs controllers with its evolution, principle of operation, circuit diagram and applications
- To illustrate the automatic frequency and voltage control strategies for single and two area case and analyze the effects, knowing the necessity of generation control.
- To understand formulation of unit commitment and economic load dispatch tasks and solve it using optimization techniques
- To illustrate various ways of interchange of power between interconnected utilities and discuss planning, reliability aspects at all stages of power system.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Identify and analyze the dynamics of power system and suggest means to improve stability of system.
2. Comprehend the effect of reactive power on Power system and suggest the suitable means of reactive power management.
3. Selection of appropriate FACTs devices
4. Analyze the generation-load balance in real time operation and its effect on frequency and develop automatic control strategies with mathematical relations.
5. Formulate objective functions for optimization tasks such as unit commitment and economic load dispatch and get solution using computational techniques.
6. Evaluate reliability indices of Power system

Unit 01 : Power System Stability (06 Hrs)

Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and reclosure), solution of swing equation by point by point method, methods to improve steady state and transient stability, numerical based on equal area criteria.

Unit 02 : Reactive Power management (06 Hrs)

Necessity of reactive power control, reactive power generation by a synchronous machine, effect of excitation, loading capability curve of a generator, compensation in power system: series and shunt compensation using capacitors and reactors, Problems with Series Compensation, synchronous condenser.

Unit 03 : FACTs Technology (06 Hrs)

Problems of AC transmission system, evolution of FACTs technology, Working principle, circuit diagram, VI characteristics, applications, advantages and limitations of SVC, TCSC, STATCOM and UPFC.

Unit 04 : Automatic Generation and Control (AGC) (06 Hrs)

Concept of AGC, complete block diagram representation of load-frequency control of an isolated power system, steady state and dynamic response, control area concept, two area load frequency control. Schematic and block diagram of alternator voltage regulator scheme.

Unit 05 : Economic Load Dispatch and Unit Commitment (06 Hrs)

A. **Economic load dispatch:** Introduction, revision of cost curve of thermal and hydropower plant, plant scheduling method, equal incremental cost method, method of Lagrange multiplier (neglecting transmission losses), B_{mn} coefficient, economic scheduling of thermal plant considering effect of transmission losses, penalty factor, procedure of load dispatch at state level load dispatch center, Regional Load Dispatch Center, numerical on penalty factor, exact coordination equation.

B. **Unit commitment:** Concept of unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic programming, Numerical on priority list method.

Unit 06 : Energy Control and Planning and Reliability of Power Systems (06 Hrs)

A. **Energy Control:** Interchange of power between interconnected utilities, economy interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools.

B. **Planning and Reliability of Power Systems:** Need of short term planning and long term planning in generation, transmission, distribution expansion. Definition of reliability of power system, Hierarchical levels for reliability study, Reliability evaluation of generation system, loss of load probability (LOLP), loss of load expectation (LOLE), Expected Energy Not Supplied (EENS), generation model, load model, risk model, composite system reliability evaluation, Distribution system reliability evaluation for radial and parallel system, customer oriented and energy based reliability indices.

Guidelines for Instructor's Manual

Practical Sessions:-

Instructor's Manual should contain following things related to every experiment-

- Specify prerequisite and objective(s) of experiment.
- List out equipment required to perform the experiment with their ratings (for hardware experiments).
- Include circuit diagram with specifications (for hardware experiments).
- Related theory of the experiment must be included.
- The circuit diagram of the experiment should be drawn at the beginning.
- For simulation experiments using MATLAB, the Simulink diagram with proper details must be included in write up. For programming, take printout of program and result.
- Conclusion based on calculations, result and graph (if any) should be written. Provide space for same.

Guidelines for Student's Lab Journal

- Students should write the journal in own hand writing particularly results, diagram, conclusion, question answers etc.
- Circuit / Connection diagram or construction diagram must be drawn either manually using or using software on graph paper.
- Hand writing and figures must be neat and clean.

Guidelines for Laboratory / TW Assessment

- Continuous assessment is to be carried out. The experiment performed in a particular week must be checked in the next turn in next week.
- After assessment, teacher should put the remark by writing word "Complete" and not simply "C". Put the signature along with date at the end of experiment and in the index.

List of Experiments

[Perform experiment 1 or 2 and any seven from 3 to 11 using any simulation software]

1. To determine Steady state Stability of synchronous motor (performance).
2. To determine Steady state stability of medium transmission line (performance).
3. To plot swing curve by Point by Point method for transient stability analysis.
4. To apply equal area criteria for analysis stability under sudden rise in mechanical power input.
5. To apply equal area criteria for stability analysis under fault condition.
6. To study reactive power compensation using any device.
7. To study Lagrange multiplier technique for economic load dispatch.
8. To develop and execute dynamic programming method for unit commitment.
9. To study load frequency control using approximate and exact model.
10. To study load frequency control with integral control.
11. To study the two area load frequency control.

Industrial Visit:

Industrial visit is mandatory to Load Dispatch Center / Power Station Control Room.

Text Books:

[T1] I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Co. Ltd. (Edition 2)

[T2] Hadi Saadat, "Power System Analysis", Tata McGraw Hill

[T3] P. S. R. Murthy, "Power System Operation and Control", Tata McGraw Hill Publishing Co. Ltd.

[T4] P. S. R. Murthy, "Operation and Control in Power System", B. S. Publication.

[T5] R. Mohan Mathur, Rajiv K. Varma, "Thyristor based FACTs controller for Electrical transmission system", John Wiley and Sons Inc.

[T6] Abhijit Chakrabarti, Sunita Halder, "Power System Analysis Operation and Control", Prentice Hall of India.

[T7] Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS", IEEE Press.

Reference Books:

[R1] Allen J. Wood, Bruce F. Wollenberg, "Power Generation, Operation, and Control", Wiley India Edition.

[R2] "Electrical Power System Handbook", IEEE Press.

[R3] Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTs Concepts and Technology of Flexible AC Transmission Systems," IEEE Press.

[R4] Olle I. Elgerd, "Electrical Energy System Theory", 2nd Edition, Tata McGraw Hill. Publishing Co. Ltd.

[R5] Prabha Kundur, "Power System Stability and Control", Tata McGraw Hill.

Websites:

1. http://www.mahasldc.in/
2. http://cercind.gov.in/
3. http://www.srldc.org/
4. https://nrldc.in/
5. http://www.mercindia.org.in/
6. http://www.erldc.org/
7. http://nptel.ac.in/courses/108101040/ (PSOC webcourse)
8. http://www.powergridindia.com/

Unit	Text Books	Reference Books
1	T1, T2, T6	R1, R2, R5
2	T3	R5
3	T5,T7	R3
4	T1	R1
5	T2,T4	R1, R4, websites
6	T1	R1

403142: PLC and SCADA Applications

Teaching Scheme		Credits	Examination Scheme [175 Marks]		
Theory	: 04 Hr/Week	04	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			PR	:	50 Marks
			Term work	:	25 Marks

Prerequisite:
Logic gates operations, Boolean algebra, Relay logic

Course Objective: The course aims:-

- To understand the generic architecture and constituent components of a Programmable Logic Controller.
- To develop architecture of SCADA explaining each unit in detail.
- To develop a software program using modern engineering tools and technique for PLC and SCADA.
- To apply knowledge gained about PLCs and SCADA systems to real-life industrial applications.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Develop block diagram of PLC and explain the working.
2. Classify input and output interfacing devices with PLC.
3. Develop architecture of SCADA and explain the importance of SCADA in critical infrastructure.
4. Execute, debug and test the programs developed for digital and analog operations.
5. Describe various SCADA protocols along with their architecture.
6. Observe development of various industrial applications using PLC and SCADA.

Unit 01 : Introduction to PLC (08 Hrs)

Role of automation in Industries, benefits of automation, Necessity of PLC, History and evolution of PLC, Definition as per NEEMA (National Electrical Engineering Manufacturers' Association), types – fixed/modular/dedicated, Overall PLC system, PLC Input and output modules (along with Interfaces), CPU, programmers and monitors, power supplies, selection criterion, advantages and disadvantages, specifications, comparison of various PLCs manufactured by Allen Bradley, Siemens, ABB, Mitsubishi, GE, Fanuc and Schneider.

Unit 02 : Interfacing of PLC with I/O devices (08 Hrs)

Input ON/OFF switching devices, Input analog devices, Output ON/OFF devices, Output analog devices Sensors-temperature, pressure, flow, level Actuators-Electrical, pneumatic, hydraulic Encoders-Incremental, Absolute Transducers, Limit switches, proximity sensors Control Elements- Mechanical, Electrical, Fluid valves

Unit 03 : Programming of PLC (09 Hrs)

Programming languages for PLC, Ladder diagram fundamentals, Rules for proper construction of ladder diagram Timer and counter- types along with timing diagrams, Reset instruction, latch instruction MCR (master control relay) and control zones Developing ladder logic for Sequencing of motors, ON OFF Tank level control, ON OFF temperature control, elevator, bottle filling plant, car parking, traffic light controller.

Unit 04 : Advance function and Applications of PLC (08 Hrs)

Analog PLC operation and PLC analog signal processing, PID principles, Typical continuous process control curves, simple closed loop systems, closed loop system using Proportional, Integral and Derivative (PID), PID modules, PID tuning, tuning methods including "Adjust and observe" method.

Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

PLC Applications in developing systems- Tank level controller using analog signals, temperature controller using RTD, speed control of electric motor.

Unit 05 : SCADA Systems (08 Hrs)

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, important definitions HMI, MTU, RTU, communication means, Desirable Properties of SCADA system, advantages, disadvantages and applications of SCADA.

SCADA generations (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Functions and features of SCADA systems, Automatic substation control, Energy management systems (EMS), System operating states, SCADA system in critical infrastructure: Petroleum Refining Process, Conventional electric power generation, Water Purification System, Chemical Plant.

Unit 06 : SCADA Protocols (07 Hrs)

Open systems interconnection (OSI) Model, TCP/IP protocol, Modbus model, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus).

Guidelines for Instructor's Manual

- Specify objective(s) of the experiment.
- Include ladder diagram.
- Related theory of the experiment must be included.
- Include step by step procedure to perform the experiment.
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable.
- Provide space to write conclusion.

Guidelines for Student's Lab Journal

➢ Students are expected to write the journal in the following sequence:
- Aim –
- Ladder diagram –
- Theory –
- Conclusion.

➢ Students are expected to draw the ladder diagrams on 1mm graph paper.
➢ They should attach print out or draw SCADA HMI.
➢ Students should write conclusion.
➢ Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Laboratory conduction

- Give the safety instructions to students.
- Allow 4-5 students per group for performing the experiment.
- Explain theory related to the experiment to be conducted.
- Introduce PLC and SCADA in detail with specifications to students.
- Explain the ladder diagram of the experiment.
- Ladder diagram should be completed by the students.
- Perform the experiment in the presence of instructor.
- Verify the results obtained.

List of Experiments:

Minimum 11 experiments should be conducted. 6 experiments should be on PLC and 5 experiments should be on SCADA.

a) Experiments No. 1 to 5 are compulsory.
b) Any 1 experiment should be conducted from experiment number 6 to 9.
c) Experiments No. 10 to 13 are compulsory.
d) Any 1 experiment should be conducted from experiment number 14 to 17.

1. Interfacing of lamp and button with PLC for ON and OFF operation. Verify all logic gates.
2. Set / Reset operation: one push button for ON and other push button for OFF operation.
3. Delayed operation of lamp by using push button.
4. UP/DOWN counter with RESET instruction.
5. Combination of counter and timer for lamp ON/OFF operation.
6. DOL starter and star delta starter operation by using PLC.
7. PLC based thermal ON/OFF control.
8. Interfacing of Encoder with PLC
9. PLC based speed, position, flow, level, pressure measurement system.
10. PLC interfaced with SCADA and status read/command transfer operation.
11. Parameter reading of PLC in SCADA.
12. Alarm annunciation using SCADA.
13. Reporting and trending in SCADA system.
14. Tank level control by using SCADA.
15. Temperature monitoring by using SCADA.
16. Speed control of Machine by using SCADA.
17. Pressure control by using SCADA.

Industrial Visit: Compulsory visit to SCADA and PLC based automation industry.

Text Books:

[T1] John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Application”, PHI Learning, New Delhi, 5th Edition

[T2] John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications”, PHI Publishers

[T3] Ronald L. Kurtz, “Securing SCADA System”, Wiley Publishing

[T4] Stuart A Boyer, “SCADA supervisory control and data acquisition”, ISA, 4th Revised edition

[T5] Sunil S. Rao, “Switchgear and Protection”, Khanna Publication

[T6] Curtis Johnson, “Process Control Instrumentation Technology”, Prentice Hall of India

[T7] Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson, 2nd Edition

Reference Books:

[R1] Gordan Clark, Deem Reynders, “Practical Modern SCADA Protocols”, ELSEVIER
[R2] Batten G. L., “Programmable Controllers”, McGraw Hill Inc., Second Edition
[R3] Bennett Stuart, “Real Time Computer Control”, Prentice Hall, 1988
[R4] Krishna Kant, “Computer Based Industrial Control”, PHI
[R5] P. K. Srivstava, “Programmable Logic Controllers with Applications”, BPB Publications

Unit	Text Books	Reference Books
1	T1	R2
2	T1, T2, T6	R3, R4
3	T1, T7	R5
4	T1, T2, T6	R2, R5
5	T3, T4, T5	R1
6	T3	R1

Elective I : 403143 (A) : Fundamentals of Microcontroller MSP430 and its Applications [Open Elective]

Teaching Scheme		Credits	Examination Scheme [125 Marks]		
Theory	:03 Hr/Week	03	In Sem	:	30 Marks
Practical	:02 Hr/Week	01	End Sem	:	70 Marks
			Term work	:	25 Marks

Prerequisite:

Basic knowledge of Number system.
Knowledge of basic logic components.
Programming skills in C Language.

Course Objective: The course aims to:-

- Provide understanding of architecture of MSP430 microcontroller
- Develop ability to write and interpret C language programs for MSP430
- Use advance features in PWM for MSP430
- Interface various devices with MSP430
- Understand use of MSP 430 for IoT applications

Course Outcome: Upon successful completion of this course, the students will be able to:-

1. Explain architecture of MSP430 microcontroller, its instructions and the addressing modes.
2. Develop and debug program in C language for specific applications.
3. Use of Code Composer Studio IDE for simulating the functionalities of MSP430 microcontroller
4. Interface microcontroller MSP430 to various sensing devices.
5. Develop IoT based application using MSP430.

Unit 01 : Overview of MSP430 (06 Hrs)

Basics of Embedded Systems, Introduction to MSP430, RISC Architecture / Functional Block Diagram of MSP430G2553, Pin Diagram, Memory Organization, CPU, On-Chip-Peripherals. Overview of MSP430G2 Launchpad and its Features.

Unit 02 : Digital I/O, Interrupts and basic of programming (06 Hrs)

GPIO programming and I/O multiplexing; Interrupts and interrupt programming, Issues associated with interrupts, Capacitive touch I/O pin interface.

Software and hardware tools for development of MSP430 based system such as assembler, compiler, IDE, Emulators, debugger, programmer.

Unit 03 : Timers, PWM Control and RTC (06 Hrs)

Watchdog timer, Timers, Measurement in Capture Mode, PWM control – Edge-Aligned PWM, Centred PWM and Sine-PWM, Real Time Clock (RTC).

Unit 04 : ADC and Operating Modes (06 Hrs)

Analog-to-Digital Conversion: General Issues, Successive Approximation. Basic Operation of ADC10, Advanced Operation of ADC10, ADC10 Successive Approximation, Digital to Analog Conversion.

Low Power aspects of MSP430: Operating Modes, low power modes, Active vs Standby current consumption, FRAM vs Flash for low power; reliability.

Unit 05 : Communication (06 Hrs)

Serial communication basics, USCI, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C), UART protocol, I2C protocol, SPI protocol, Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.

Unit 06 : IoT Basics and Applications of MSP430 (06 Hrs)

IoT overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee and Bluetooth.

Real world application: MSP430 based Embedded Networking Application: "Implementing Wi-Fi or Bluetooth Connectivity in a Smart Electric Meter".

Guidelines for Instructor's Manual

Instructor's Manual shall have

- Brief relevant theory.
- Equipment with specifications.
- Connection diagram/ methodology.
- Format of observation table and sample results.

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

1. Theory related to the experiment.
2. Apparatus with their detailed specifications.
3. Connection diagram /circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two reading.
6. Result table.
7. Graph and Conclusions.
8. Few short questions related to the experiment.

Guidelines for Laboratory conduction

Lab Requirement:MSP430F2553 Launch Pad, Desktop/ Laptop with Windows7/8 operating system, System with installed circuit CCS software, Breadboard, Single strand and jumper wires, MSP430 Capacitive Touch Booster-Pack, CC3100 Wi -Fi Booster Pack.

List of Experiments

Minimum 8 experiments are to be performed from the following list:

1) Digital I/O: Learn and understand how to configureMSP-EXP430G2553 / MSP-EXP430F5529 digital I/O pins. Write a C program for configuration of GPIO ports for MSP430 (blinking LEDs, push buttons interface).

   Exercises: a) modify the code to make the green and red LEDs blink: Together and alternatively

   b) Modify the delay with which the LED blinks: Together and alternatively

   c) Modify the code to make the green LED blink: Together and alternatively

2) Timer/Interrupt: Learn and understand GPIO based Interrupt programming in MSP-EXP430G2553 / MSP-EXP430F5529. Write a C program and associated GPIO ISR using interrupt programming technique.

   Exercises:

   a) Write the code to enable a timer interrupt for the pin.
   b) Write the code to turn on interrupts globally.
   c) LED Blink using timer instead of software delay.

3) PWM: Implement Pulse Width Modulation to control the brightness of the on-board, green LED. Exercises:

   a) Observe the PWM waveform using CRO / DSO.
   b) What is the maximum resolution of PWM circuitry in MSP-EXP430G2553 / MSP-EXP430F5529?
   c) Change the above code to create a PWM signal of 75% duty cycle on PWM pin.

4) PWM (Continued): Implement Advanced Pulse Width Modulation techniques

   Exercises:

   a) Edge-Aligned and Center Aligned PWM.
   b) Sine-PWM generation.

5) ADC: Learn and understand how to configure the ADC module to control the brightness of LED.

   Exercises:

   a) Read ADC value and observe in Watch window
   b) Change PWM duty cycle based on ADC value and control brightness of LED using a pot connected to ADC pin.

6) Configure of Universal Serial Communication Interface (USCI) module ofMSP-EXP430G2553 / MSP430F5529 for UART based serial communication. The main objective of this experiment is to use UART of the MSP-EXP430G2553 / MSP430F5529 to communicate with the computer.

   Exercise:

   a) Modify the above code to transmit the set of strings to the serial terminal via UART as shown below:

      char str1[]="MSP-EXP430G2553 / MSP430F5529 MCU"
      char str2[]= "Ultra low power mixed signal processing applications"

7) Capacitive I/O interface: Understand and interface a Capacitive Booster pack with MSP430.
   Exercise:
   a) Implementing Capacitive Booster Pack Demo

8) On chip temperature Sensor and ADC interface demo: To implement the on-chip temperature sensor demo.
   Exercise:
   a) Implementing Temperature Sensor and ADC interface Demo

9) Bluetooth Interface: Transmit Data wirelessly over Bluetooth for any chosen IoT application
   Examples:
   a) Temperature Sensor
   b) Humidity Sensor
   c) Position Sensor
   d) Proximity Sensor
   e) Current Sensor
   f) Voltage Sensor
   g) Pressure Sensor
   h) Or any other sensor interfaced with MSP430.

10) Closed loop temperature/speed control system using MSP430.

Lab Manual:

1) www.ti.com/lab-maunals

Embedded System Design using MSP430 Launchpad Development Kit – Lab Manual

Text Books:

[T1] Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880

[T2] MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN- 13: 978-0750682763

Other References:

[R1] http://www.ti.com/lit/ds/symlink/msp430g2553.pdf

[R2] http://www.ti.com/lit/ug/tidu520/tidu520.pdf

[R3] http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode

Unit	Text Books	Reference Books
1	T1	R1
2	T2	R1, R3
3	T2	R1
4	T2	R1
5	T2	R1
6	-	R2

Elective I: 403143 (B) : Power Quality

Teaching Scheme		Credits	Examination Scheme [125 Marks]		
Theory	: 03 Hr/Week	03	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			Term work	:	25 Marks

Prerequisite:
Fundamentals of Power system and Power electronics.

Course Objective: The course aims to:-

- Develop ability to identify various power quality issues, its sources and effects on various equipments.
- Monitor and analyze various power quality problems
- Describe and selection of cost effective power quality mitigation solutions.
- Explain use of power quality standards

Course Outcome: Upon successful completion of this course, the students will be able to:-

1. Identify importance of various power quality issues.
2. Carry out power quality monitoring
3. List and explain various causes and effects of power quality problems
4. Analyze power quality parameters and carry out power quality analysis
5. Select cost effective mitigation technique for various power quality problems
6. Use IEEE 519-2014 power quality standard for harmonic compliance

Unit 01 : Basics of power quality (06 Hrs)
Introduction and importance of power quality, symptoms of poor power quality. Classification of power quality events, power quality definition as per IEEE 1159.Grounding of sensitive electronic equipments and guidelines of IEEE std 1100.Long duration RMS voltage variations, its sources, effects and solutions.

Unit 02 : Voltage Sag (06 Hrs)
Sources of voltage sags, classification of voltage sags, factors governing severity of voltage sag. Area of vulnerability, critical distance. Voltage sag characteristics. Classification of equipments based on its sensitivity to various characteristics of voltage sag. Effect of voltage sag on various equipments. Voltage tolerance curve, ITIC and SEMI F47 curve, investigation of sensitivity of equipments to voltage sags. Voltage sag mitigation techniques at equipment level, LT power entrance and medium voltage. Voltage sag indices. Study of important provisions in IEEE Std 1346.

Unit 03 : Transient Overvoltage and Flicker (06 Hrs)
Sources of transient over voltages, Impulsive and oscillatory transients. Magnification of capacitor switching transients, pre insertion reactors to control capacitor switching transients, ferroresonance, principle of over voltage protection. Devices for over voltage protection. Voltage flicker, its sources. Factors governing severity of flicker. Flicker measurement, Pst and Plt. Flicker mitigation solutions.

Unit 04 : Fundamentals of Harmonics (06 Hrs)
Waveform Distortion, Harmonics, Harmonic phase sequences. Classification of harmonics harmonic, Voltage Verses Current distortion, AC quantities under non-sinusoidal conditions, Voltage and current harmonic indices, Sources of harmonics, General and special Effects of Harmonics on Electrical Equipments, cables, switchgears, Meters and Communications.

Unit 05 : Harmonic Mitigation Techniques (06 Hrs)

System behaviour to harmonics, location of harmonic sources, Series and parallel resonance, Harmonic mitigation, passive tuned and detuned filters, design of tuned filters, Active Filter, Sizing and location of active filters, Advantages of active filters over passive filters, Hybrid filters. IEEE 519-2014 standard.

Unit 06 : Power Quality Monitoring (06 Hrs)

Objectives of Power quality monitoring. Types of power quality monitoring, Power quality monitoring equipments, Power quality analyser specification requirement as per EN50160 Standard. Selection of power quality equipments for cost effective power quality monitoring, selection of voltage and current transducers. Power quality indices. IEEE 1159 standard and important provision related with power quality monitoring. Computer Tools for analysis of power quality.

Guidelines for Instructor's Manual

Instructor's Manual shall have

- Brief relevant theory.
- Equipment with specifications.
- Connection diagram/ methodology.
- Format of observation table and sample results.

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

9. Theory related to the experiment.
10. Apparatus with their detailed specifications.
11. Connection diagram /circuit diagram.
12. Observation table/ simulation waveforms.
13. Sample calculations for one/two reading.
14. Result table.
15. Graph and Conclusions.
16. Few short questions related to the experiment.

Guidelines for Laboratory conduction

- Read and understand power quality analyzer manual completely.
- Make sure that connections of power analyzer are done as per manual.
- Follow safety protocols while doing power quality audit.

List of Experiments

Minimum 8 experiments are to be performed from the following list:

Compulsory experiments:

1. Study of power quality analyzer and measurement of voltage, current, power and power factor using it.
2. Measurement of harmonic distortion of various Equipments such as UPS /AC/DC drive
3. Harmonic compliance of institute as per IEEE 519-2014 standard and sizing of active filter.
4. Power quality audit of institute or department.

Any 4 experiments from following list:

1. Harmonic analysis of transformer for various conditions (no load, inrush, full load etc.)
2. Analysis of performance of induction motor/transformer operated with sinusoidal supply and under distorted supply conditions supplied by 3 phase inverter.
3. Measurement of voltage sag magnitude and duration by using digital storage oscilloscope/ power quality analyzer.
4. Design of 7% detuned Passive Filter
5. Simulation study of transient and/or flicker measurement.
6. Simulation studies of harmonic generation sources such as VFD, SVC, STATCOM and FACTS devices and harmonic measurement (THD) by using professional software like MATLAB.
7. Harmonic load flow analysis by using professional software such as ETAP, PSCAD, ATP etc.

Text Books:

[T1] R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, 2nd Edition, McGraw Hill Publication.

[T2] M. H. J. Bollen, “Understanding Power Quality Problems, Voltage Sag and Interruptions”, New York: IEEE Press, 2000, Series on Power Engineering.

[T3] C.Sankaran “Power quality”, CRC Press

[T4] Arrillaga, M. R. Watson, S. Chan, “Power System Quality Assessment”, John Wiley and Sons.

Reference Books:

[R1] Enriques Acha, Manuel Madrigal, “Power System Harmonics: Computer Modeling and Analysis”, John Wiley and Sons Ltd.

[R2] Ewald F. Fuchs, Mohammad A. S. Masoum, “Power Quality in Power Systems and Electrical Machines” Elsevier Publication.

[R3] G. J. Heydt, “Electric Power Quality”, Stars in Circle Publications

[R4] EN50160and IEEE 1100, 1346,519 and 1159 standards

[R5] Arrillaga, M. R. Watson, “Power System Harmonics”, John Wiley and Sons

Unit	Text Books	Reference Books
1	T1,T2, T3	R3, R4
2	T1,T2,T3	R2, R3, R4
3	T1,T2,T3	R2, R3
4	T1,T3,T4	R1, R4, R5
5	T1,T3,T4	R1, R4, R5
6	T1,T3	R1, R4

403143 (C) : Renewable Energy Systems

Teaching Scheme		Credits	Examination Scheme [125 Marks]		
Theory	: 03 Hr/Week	03	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			Term work	:	25 Marks

Prerequisite: Knowledge of basic renewable technologies like solar, wind, biogas, fuel cell, Knowledge of conventional grid

Course Objective: The course aims:-

- To develop fundamental understanding about Solar Thermal and Solar Photovoltaic systems.
- To provide knowledge about development of Wind Power plant and various operational as well as performance parameter/characteristics.
- To explain the contribution of Biomass Energy System in power generation.
- To describe different Storage systems, Integration and Economics of Renewable Energy System.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Describe various renewable energy sources such as Solar Photovoltaic, Biomass, Wind, Fuel cell and Solar thermal.
2. Explain different renewable energy sources as an alternate for conventional power sources in any application of energy.
3. Identify and locate the use of renewable energy sources as per the requirement of the location.
4. Analyze, assess and design renewable energy systems such as solar and wind sources.
5. Compare the various storage sources for electrical energy.
6. Describe the standards for renewable energy source integration and evaluate economics related to these sources.

Unit 01 : Solar Thermal (06 Hrs)

Solar radiation at the Earth's surface, solar constant, spectral distribution, Extra-terrestrial radiation, solar terrestrial radiation, solar radiation geometry, Introduction to the concept of monthly average daily and hourly global and diffuse radiation, beam and diffuse radiation under cloudless skies, solar radiation on tilted surfaces: a) beam radiation, b) diffuse radiation, c) reflected radiation, d) flux on tilted surface.

Instruments for measuring solar radiation, Basics of flat plate collector, concepts of solar water heating system and space heating system, solar dryer, introduction to Concentrating Solar Power (CSP) plants using technologies like a) parabolic troughs b) linear Fresnel reflector c) paraboloid dish

Unit 02 : Solar PV (06 Hrs)

Introduction to various solar PV technologies, Single c-Si, Poly c-Si, thin film PV Cell, Module and Array, factors influencing the electrical design of the solar system: a) Sun Intensity b) Sun Angle c) Shadow Effect d) Temperature Effect e) Effect of Climate f) Electrical Load Matching g) Sun Tracking; Peak Power Point Operation, Electrical characteristics of Silicon PV Cells and Modules, PV System Components, Efficiency of PV system.

Design of typical solar PV system with and without battery backup for applications such as homes, commercial complex, agriculture etc.

Unit 03 : Wind Energy System (06 Hrs)

Types of wind turbine, Site selection, Power Contained in Wind, Aerodynamics of Wind Energy, Efficiency Limit for Wind Energy Conversion, Maximum Energy obtained for a Thrust-operated converter (Efficiency limit), Introduction to the Design of Wind Turbine Rotor, Power-Speed Characteristics, Wind Turbine Control Systems: a) Pitch Angle Control b) Stall Control c) Power Electronics Control d) Yaw Control; Control Strategy, Introduction to Offshore Wind Energy System and its comparison with on grid Wind Energy System

Unit 04 : Biomass Energy System (06 Hrs)

Biomass Classification, Biomass Resources and their Energy Potential, Biomass Conversion Technologies: Anaerobic Digestion, Ethanol Fermentation, Biomass Gasification: Gasifiers, Fluidized Bed Gasifier, Biogas Technologies and their factor affecting Biogas Production, Biogas Plants: Floating and Fixed Dome type, Introduction to other bio-reactors such as CSTR and UASB, designing of biogas plant. Power Generation from Municipal Solid Waste (MSW), Land Fill Gas, Liquid Waste. Introduction to organic fertilizers from digest state.

Unit 05 : Fuel cell and Storage Systems (06 Hrs)

a) Fuel Cells: Introduction to Fuel Cell Technology; type of fuel cells, Operating principles of Fuel Cell, Fuel and Oxidant Consumption, Fuel Cell System Characteristics, application and limits.

b) Energy Storage systems: Hydrogen storage: Hydrogen production, relevant properties, Hydrogen as an Engine Fuel, methods of Hydrogen storage.

Batteries: Introduction to Batteries, Elements of Electro Chemical Cell, Battery classification, Battery Parameters, Factors affecting battery performance.

Grid scale storage, various options available (pumped storage, SMES, compressed air storage, fly wheels, etc.), requirements, future trends, Introduction to the concepts of round trip efficiency and cost of storage.

Unit 06 : Integration and Economics of Renewable Energy Systems (06 Hrs)

a) Integration of RES with grid, standards., Introduction to hybrid systems

b) Economics of RES: Simple payback, Internal Rate of Return (IRR), time value, Net present value (NPV), Life cycle costing, Effect of fuel cost Escalation, Annualized and levelized cost of energy

Guidelines for Instructor's Manual

Manual must have assignment related to theory of each experiment.

Guidelines for Student's Lab Journal

A separate notebook/file is required for experiments. Top of the page must have experiment number, title of experiment, date of experiment. It is to be followed by observations, calculations and results. The laboratory notebook must be checked by the staff in-charge of the experiment. Journal must have observations and conclusions written neatly. The experiments must be assessed by the proper authority before submission.

Guidelines for Laboratory conduction

Minimum 08 experiments should be conducted from the list given below:

List of Experiments

1. To identify and measure the parameters of a Solar PV Module with Series and/or Parallel combination.
2. To plot I-V and P-V characteristics with series and parallel combination of Solar PV Modules for different Insolation and temperature effects.
3. To evaluate effect of Shading and Tilt Angle on I-V and PV characteristics of Solar Module.
4. To estimate effect of sun tracking on energy generation by Solar PV Module.
5. To estimate efficiency of standalone Solar PV Module.
6. To evaluate performance of Solar flat plate collector.
7. To plot characteristics of lead-acid battery for various source and load condition.
8. To analyze effect of blade angles on performance of wind turbine.
9. To evaluate performance of horizontal axis wind turbine.
10. To evaluate performance evolution of vertical axis wind turbine.
11. To study synchronization of wind electric generator.
12. Wind generation analysis using Matlab for variable wind speeds.
13. To evaluate efficiency of DFIG System (Hardware setup only).

Industrial Visit: Field visit to Renewable Energy Sources locations or Manufacturing Industry

Text Books:

[T1] S.P. Sukhatme, “Solar Energy,” Tata McGraw Hill

[T2] Mukund R. Patel, “Wind and Power Solar System”, CRC Press

[T3] Chetan Singh Solanki, “Solar Photovoltaics-Fundamentals, Technologies and Applications”, PHI Second Edition

[T4] H. P. Garg, J. Prakash, “Solar Energy-Fundamentals and Applications”, Tata McGraw hill Publishing Co.ltd., First Revised Edition

[T5] Tony Burton, Nick Jenkins, David Sharpe, “Wind Energy Hand Book-Second Edition”, John Wiley & Sons, Ltd., Publication

[T6] Godfrey Boyle, “Renewable Energy”, Third edition, Oxford University Press

[T7] S. Rao, Dr. B. B. Parulekar, “Energy Technology – Non Conventional, Renewable and Conventional”, Khanna Publication

Reference Books:

[R1] D. P. Kothari, K. C. Singal, Rakesh Rajan, “Renewable Energy Sources and Emerging Technologies”, PHI Second Edition

[R2] Donald L.Klass, “Biomass for Renewable Energy, Fuels, and Chemicals, Elsevier, Academic Press

[R3] B T.Nijaguna, “Biogas Technology”, New Age International Publishers

[R4] Tapan Bhattacharya, “Terrestrial Solar Photovoltaics”, Narosa Publishing House

[R5] Thomas Ackermann, “Wind Power in Power Systems”, Wiley Publications

Unit	Text Books	Reference Books
1	T1, T4	R4
2	T2, T3	R1
3	T5	R5
4	T7	R2,R3
5	T3,T6	R1
6	T6, T7	R1

Elective I: 403143 (D): Digital Signal Processing

Teaching Scheme		Credits	Examination Scheme [125 Marks]		
Theory	: 03 Hr/Week	03	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			Term work	:	25 Marks

Prerequisite:
Knowledge of basic signals and systems

Course Objective: The course aims:-

- To elaborate Sampling theorem
- To classify discrete signals and systems
- To analyze DT signals with Z transform, inverse Z transform and DTFT
- To describe Frequency response of LTI system
- To introduce Digital filters and analyze the response
- To demonstrate DSP Applications in electrical engineering

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Sample and reconstruct any analog signal
2. Construct frequency response of LTI system
3. Evaluate Fourier Transform of discrete signals
4. Design IIR filter and its implementation
5. Design FIR filter and implementation
6. Develop block diagram for DSP applications to electrical engineering

Unit 01 : Classification of Signals: (06 Hrs)
Analog, Discrete-time and Digital signals, Basic sequences and sequence operations, Discrete-time systems, Properties of D. T. Systems and Classification, Linear Time Invariant Systems, impulse response, linear convolution and its properties, properties of LTI systems: stability, causality, parallel and cascade connection, Linear constant coefficient difference equations, Periodic Sampling, Sampling Theorem, Frequency Domain representation of sampling, reconstruction of a band limited Signal, A to D conversion Process: Sampling, quantization and encoding.

Unit 02 : Z-transform, Inverse Z-transform and its properties: (06 Hrs)
Unilateral Z-transform, Z transform properties: Linearity, time shifting, multiplication by exponential sequence, differentiation, conjugation, time reversal, convolution, initial value theorem, Inverse z transform by inspection, partial fraction, power series expansion and complex inversion, solution of difference equation

Unit 03 : Discrete Time Fourier Transform (06 Hrs)
Representation of Sequences by Fourier Transform, Symmetry properties of D. T., F. T. theorems: Linearity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, Frequency response analysis of first and second order system, steady state and transient response

Unit 04 : Discrete Fourier Transform (06 Hrs)
Sampling theorem in frequency domain. The Discrete Fourier Transform, Relation with z transform Properties of DFT: Linearity, circular shift, duality, symmetry, Circular Convolution, Linear Convolution using DFT, Effective computation of DFT and FFT, DIT FFT, DIF FFT, Inverse DFT using FFT

Unit 05 : Frequency Response of LTI Systems: (06 Hrs)

Ideal frequency selective filters, Concept of filtering, specifications of filter, IIR filter design from continuous time filters: Characteristics of Butterworth, and Cheybyshev low pass filter, impulse invariant and bilinear transformation techniques, Design examples, Basic structures for IIR Systems: direct form, cascade form

Unit 06 : FIR filter design using windows: (06 Hrs)

specifications of properties of commonly used windows, Design Examples using rectangular, and hanning windows. Basic Structures for FIR Systems: direct form. Comparison of IIR and FIR Filters Applications: Measurement of magnitude and phase of voltage, current, power, frequency and power factor correction, harmonic Analysis and measurement, applications to machine control, DSP based protective relaying.

Guidelines for Instructor's Manual

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment.
- Basic MATLAB instructions for DSP/ Simulink basics.
- Observation table/ Expected simulation results.
- Sample calculations for one/two reading.
- Result table

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment
- Circuit diagram/Simulink diagram/MATLAB program
- Simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Few short questions related to the experiment

Guidelines for Laboratory conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results.
- Understanding fundamentals and objective of experiment, timely submission of journal.

List of Experiments: :

[Minimum eight experiments are to be performed]

Note: Perform the practical using C language or any other professional software for group A and B

GROUP-A (Any Three)

1. Plotting of discrete time waveforms (a) Sin, (b) Unit Step, (c) Exponential.
2. Find Linear convolution
3. Plot frequency response of given system function (Magnitude and Phase)
4. Verification of Z-transform properties (any two)

GROUP-B (Any Four)

1. Find DFT and IDFT of sequence
2. Find Circular convolution Using DFT IDFT method and linear convolution using Circular convolution.

3 DIT- FFT or DIF-FFT algorithm

4. Design of IIR filter (Butterworth method).
5. Design of FIR filter (window (any one) method).

Group-C (Any one)
1. Study of DSP starter kit and generation of Sine wave.
2. Discrete implementation of FIR Filter using PIC18F/DSP kit.
3. Discrete implementation of IIR Filter using PIC18F/DSP kit.
4. Harmonic analysis of any non-sinusoidal signal using DSP.

Text Books:

[T1] Proakis J., Manolakis D., "Digital signal processing", 3rd Edition, Prentice Hall, ISBN 81- 203-0720-8
[T2] P. Ramesh Babu, "Digital Signal Processing", 4th Edition Scitech Publication
[T3] Dr.S. D. Apte,"Digital Signal Processing",2nd Edition Wiley India Pvt. Ltd ISBN: 978-81-265-2142-5
[T4] W.Rebizant, J.Szafran, A.Wiszniewski, "Digital Signal Processing in Power system Protection and Control", Springer 2011 ISBN 978-0-85729-801-0

Reference Books:

[R1] Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
[R2] A.V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete Time Signal Processing", 2nd Edition Prentice Hall, ISBN 978-81-317-0492-9
[R3] Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists",1st Edition Elsevier, **ISBN:** 9780750674447

Unit	Text Books	Reference Books
1	T1,T2	R1,R2,R3
2	T1,T2	R2,R3
3	T1,T2	R2,R3
4	T1,T2	R2,R3
5	T1,T2,T3	R1,R2,R3
6	T4	R3

Elective II : 403144 (A) : Restructuring and Deregulation

Teaching Scheme	Credits	Examination Scheme [100Marks]		
Theory : 03 Hr/Week	03	In Sem	:	30 Marks
		End Sem	:	70 Marks

Prerequisites: Knowledge in power system analysis and power system generation, transmission and distribution.

Course Objective: The course aims:-

- To educate students about the process and operation of restructuring of power system.
- To familiarize students about the various power system restructuring models.
- To elaborate students pricing of electricity.
- To explain fundamental concept of congestion, its management and transmission pricing.

Course Outcome: Upon successful completion of this course, the students will be able to: -

1. Enlist the functions of various key entities in India and explain the implications of various policies and acts on restructuring and deregulation.
2. Describe the regulatory process in India along with various methods of regulations.
3. List the components involved in tariff determination.
4. Explain different power sector restructuring models
5. Explain different types of electricity markets.
6. State different transmission pricing methods and discuss congestion management

Unit 01 : Power Sector Reforms in India (06 Hrs)

Need of Regulation. Institutional structure before reforms and after reforms. Roles of various key entities like Ministry of Power, CEA, Planning Commission, CERC and SERC in India. Electricity Act 2003 and 2010 and its implications for Restructuring and Deregulation. National Energy policy. Critical issues and challenges before the Indian power sector.

Unit 02 : Power Sector Regulation (06 Hrs)

Regulatory process in India, Principles of Tariff setting, Phases of Tariff determination, types and methods of Regulation, cost plus, performance-based regulation, price cap, revenue cap, rate of return regulation, benchmarking or yardstick regulation. Considerations of socio economic aspects in regulation.

Unit 03 : Power Sector Economics (06 Hrs)

Introduction to various concepts such as capital cost, debt and equity, depreciation, fixed and variable costs, working capital. Typical cost components of utilities such as return in equity, depreciation, interest and finance charges, O and M expenses etc. Key Indices for assessment of utility performances (Generation, transmission and distribution). Financial tools to compare investment options.

Unit 04 : Power Sector Restructuring Models and Introduction to energy Markets (06 Hrs)

Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades. ISO models. Introduction to Energy Exchange, Day ahead market (DAM) and Term ahead market (TAM) procedure adopted in Energy exchanges and trading of Renewable Energy Credits and Carbon Credits.

Unit 05 : Electricity Markets (06 Hrs)

Rules that govern electricity markets, peculiarity of electricity as a commodity. Various electricity markets such as spot markets, forward contracts and forward markets, future contracts and future markets, day ahead market, reserve market, ancillary services market, market for differences, Options contracts. Market operation- settlement process, Market Clearing Price (MCP), Market efficiency, Market power.

Unit 06 : Transmission Pricing and Transmission Congestion issues (06 Hrs)

Cost components of transmission system, Cost allocation of Transmission system, Transmission pricing methods, physical transmission rights, Open Access, Role of Load Dispatch centers (SLDC, RLDC and NLDC). Congestion in power network, reasons for congestion, congestion management.

Text Books:

[T1] Know Your Power: A citizen Primer on the electricity Sector, Prayas Energy Group, Pune

[T2] Daniel S. Kirschen, Goran Strbac, "Power System Economics" John Wiely and Sons Publication Ltd. August 2006.

[T3] Mohammad Shahidehpour, Muwaffaq Alomoush, "Restructured Electrical Power Systems: Operation Trading and Volatility" CRC Press, 06-Jun-2001

Reference Books:

[R1] Steven Stoft, "Power System Economics: Designing Markets for Electricity", John Wiley and Sons, 2002

[R2] Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc

[R3] Geoffrey Rothwell, Tomas Gomez, "Electricity Economics Regulation and Deregulation" A John Wiley and Sons Publication 2003

[R4] Mohammad Shahidehpour, Hatim Yamin, Zuyi Li, "Market operations in Electric Power System" A John Wiley and Sons Publication.

[R5] Deregulation in Power Industry – A course under continuing Education Program, Department of Electrical Engineering , IIT , Bombay

Websites:

1 http://www.cercind.gov.in/Function.html
2 www.cercind.gov.in/serc.html
3 http://www.power.gov.ng/index.php/about-us/our-functions
4 http://www.cea.nic.in/functions.html
5 http://planningcommission.nic.in/reports/genrep/arep9920/ar9920role.htm

Unit	Text Books	Reference Books
1	T1	Websites 1-5
2	T1	R3
3	T1	R1
4	T2	R5
5	T2	R5, R2, R4
6	T3	R1

Elective II : 403144 (B) : Electromagnetic Fields

Teaching Scheme	Credits	Examination Scheme [100 Marks]
Theory : 03 Hr/Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite: Coordinate system, Vector algebra, Electric field intensity, Magnetic field intensity, Fundamental relations for electrostatic and magnetostatic fields

Course Objective: The course aims:-

- To impart knowledge on the basics of electric and magnetic fields and their applications for utilization in the development of the theory for power transmission lines and electrical machines.
- To describe how materials affect electric and magnetic fields
- To discuss the boundary conditions
- To analyze the relation between the fields under time varying situations
- To give insight to Maxwell's equations in different form and media

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Describe time varying Maxwell's equations and their applications in electromagnetic problems
2. Interpret electric and magnetic field with the help of associated laws
3. Solve simple electrostatic and magnetic boundary conditions
4. Determine the relationship between time varying electric and magnetic fields and electromotive force
5. Solve electromagnetic problems with the help of mathematical tools

Unit 01 : Introduction (06 Hrs)

Sources and effects of Electro-Magnetic Fields, Scalar and vector, Unit vector, Mathematical operations of Vector, Scalar and vector fields, Different Co-ordinate System, Operator Del, Physical interpretation of gradient, divergence and curl, Conversion between coordinate system, Expression for gradient, divergence and curl in three coordinate system.

Unit 02 : Basic Electrostatics (06 Hrs)

Coulomb's law, Electric field, Electric Field Intensity (EFI), EFI due to - point charge, line charge, surface charge and volume charge, Electric displacement, Electric flux density, Gauss's law (scalar and vector form), Applications of Gauss law, Electric field due to – point charge, infinite long straight conductor and infinite plane sheet of charge, Divergence theorem, Stoke's theorem.

Unit 03 : Applied Electrostatics (06 Hrs)

Electric Potential, Relationship between E and V, Equipotential surfaces, Electric dipole and flux lines, Electric field due to dipole, Energy density in electrostatic field, Energy stored in terms of D and E, Convection and Conduction currents, Current and current density, Continuity equation for current, Poisson's and Laplace's equations, Capacitor and its capacitance, Parallel plate capacitor, Capacitors with multiple dielectrics, Spherical capacitor, Coaxial capacitor.

Unit 04 : Magnetostatics and Applications (06 Hrs)

Magnetic flux density, Magnetic field intensity (MFI), Magnetic permeability, Biot-Savart's law, Applications of Biot-Savart's law, MFI due to - infinite long straight filament, finite length element, on the axis of circular loop, Ampere's Circuital law, Field due to – infinite line current, coaxial cable, uniform current sheet density, Magnetic flux density, Scalar magnetic potential, Vector magnetic potential, Poisson's Equations for Magnetostatic field, Derivations of Biot-Savart law and Ampere's law based on magnetic potential, Forces due to magnetic field, Magnetic dipole.

Unit 05 : Boundary Conditions and Analysis. (06 Hrs)

Conductors, Ohm's law employing mobility, Dielectrics, Polarization in Dielectrics, Dielectric constants and strength, Relaxation time, Boundary conditions : Dielectric-Dielectric boundary conditions, Conductor – Dielectric boundary conditions, Conductor – Free space boundary conditions, Boundary conditions for Magnetostatic fields

Unit 06 : Time Varying Fields and Maxwell's equations (06 Hrs)

Faraday's law, Transformer and motional EMFs – stationary loop in time varying B field, moving loop in static B field and moving loop in time varying field, Displacement current, Maxwell's equations in point form and integral form, Power and Poynting theorem, Time varying potentials, Time Harmonic Field, Maxwell's equations in point form and integral form for harmonic field, Concept of uniform plane wave.

Text Books:

[T1] W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", Tata McGraw Hill

[T2] Mathew Sadiku, "Elements of Electromagnetics", Oxford University Press

Reference Books:

[R1] R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill

[R2] Liang Chi Shen, Jin Au Kong, Amalendu Patnaik, "Engineering Electromagnetics", CENGAGE Learning

[R3] K. B. Madhu Sahu, "Electromagnetic Fields", SciTech Publication

[R4] N. N. Rao, " Elements of Engineering Electromagnetics", Pearson Education

[R5] Edminister J. A., " Electromagnetics", Tata McGraw Hill

Unit	Text Books	Reference Books
1	T2	R2, R3, R4
2	T1, T2	R1,R2, R3
3	T1, T2	R2, R3, R4, R5
4	T1, T2	R2, R3
5	T2	R1, R4, R5
6	T1, T2	R2, R3, R4

Elective II : 403144 (C) : EHV AC Transmission

Teaching Scheme	Credits	Examination Scheme [100Marks]		
Theory : 03 Hr/Week	03	In Sem	:	30 Marks
		End Sem	:	70 Marks

Prerequisite : Fundamental course in Power System

The course aims:-

- To explain the need of EHV and UHV systems.
- To describe the impact of such voltage levels on the environment
- To identify problems encountered with EHV and UHV transmissions
- To describe methods of governance on the line conductor design, line height and phase etc.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Highlight need for EHV ac transmission.
2. Calculate line and ground parameters.
3. Enlist problems encountered in EHV transmission.
4. Describe effect of electric and magnetic field on human being
5. Express issues related to UHV transmission discussed

Unit 01 : EHV ac transmission lines (06 Hrs)

Need for EHV transmission lines, Power handling capacity and line loss, Mechanical considerations in line performance, Vibrations.

Travelling wave equations, transmission reflection attenuation and distortion of travelling waves, transmission and reflection coefficients and examples.

Unit 02 : Calculation of line and ground parameters (06 Hrs)

Resistance of conductors, effect of temperature on overhead conductors, temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of current carrying single conductor, Inductance of EHV line configurations, Line capacitance calculations

Unit 03 : Voltage gradient of conductors (06 Hrs)

Electrostatic Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, charge potential relations for multi-conductor lines, Maximum charge condition on three phase line.

Surface voltage gradient on conductors-single conductor, two conductors and multi-conductor bundle, Maximum surface voltage gradient, Mangoldt formula, design of cylindrical cage for corona gradients

Unit 04 : Electrostatic and magnetic fields of EHV lines (06 Hrs)

Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level.

Electrostatic induction on un-energized circuit of a double circuit line. Insulated ground wire and induced voltage in insulated ground wires.

Magnetic field calculation of horizontal configuration of single circuit of three phase lines, Effects of power frequency magnetic fields on human health.

Unit 05 : Corona and its effects (06 Hrs)

Corona formation, corona inception voltage, visual corona voltage, critical field for corona inception and for visual corona under standard operating condition and conditions other than standard operating conditions.

Power loss due to corona, corona loss formulae, corona current waveform, charge-voltage diagram and corona loss. Audible noise operation and characteristics limits for audible noise, AN measurement and meters, microphone, weighting networks.

Unit 06 : (06 Hrs)

A) **Design of EHV line**

Design of EHV lines based upon steady state limits and transient over voltages, design factors under state. Design examples: steady state limits. Line insulation design based on transient over voltages

B) **Extra high voltage cable transmission**

Classification of cables, Electrical characteristics of EHV Cables, Properties of cable insulation materials.

Text Books:

[T1] Rakosh das Begamudre "Extra high voltage transmission", New Age International publishers

Reference Books:

[R1] S. Rao , "EHV AC and DC Transmission" Khanna publication.

Unit	Text Books	Reference Books
1	T1	R1
2	T1	--
3	T1	--
4	T1	R1
5	T1	R1
6	T1	R1

Elective II : 403144 (D) : Electric and Hybrid Vehicles

Teaching Scheme	Credits	Examination Scheme [100 Marks]
Theory : 03 Hr/Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite: Basic concept of Batteries, Electrical motors, Power electronic conversion

Course Objective: The course aims:-

- To make students aware the need and importance of Electric, Hybrid Electric Vehicles and Fuel cell vehicle.
- To differentiate and analyze the various energy storage devices and battery charging and management systems.
- To impart knowledge about architecture and performance of Electric and Hybrid Vehicles
- To classify the different drives and controls used in electric vehicles.

Course Outcome: Upon successful completion of this course, the students will be able to:-

1. Review history, Social and environmental importance of Hybrid and Electric vehicles.
2. Describe the performance and selection of energy storage systems and Analyze battery management system.
3. Distinguish between the performance and architecture of various drive trains.
4. Describe the different Instrumentation and Control used for electric vehicles.
5. Differentiate between Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid energy systems concepts.

Unit 01 : Introduction (05 Hrs)

Conventional Vehicle: Basic of Vehicle performance, vehicle power source characterization, transmission characterization. Need and importance of transportation development.
History of Electric Vehicle, Hybrid Electric Vehicle and Fuel cell Vehicle. Social and environmental importance of Hybrid and Electric vehicles. Impact of modern drive-trains on energy supplies.

Unit 02 : Energy Storage Systems (07 Hrs)

Introduction to energy storage requirements in Hybrid and Electric vehicles, battery-based energy storage and its analysis, Fuel cell based energy storage and its analysis, Ultra capacitor based energy storage and its analysis, flywheel based energy storage and its analysis.
Hybridization of energy sources for Hybrid and Electric vehicle: - Hybridization of drive trains in HEVs, Hybridization of energy storage in EVs.
Selection of energy storage technology.

Unit 03 : Battery charging and Management systems (06 Hrs)

Introduction, charging algorithm, balancing method for battery pack charging.
Battery management system representation: - battery module, measurement unit block, battery equalization balancing unit, MCU estimation unit, display unit, fault warning block.
SoC and SoH, estimation of SoC, battery balancing, Thermal monitoring of Battery unit.

Unit 04 : Hybrid and Electric vehicles (05 Hrs)

Electric vehicles: - Components, configuration, performance, tractive efforts in normal driving, Advantages and challenges in EV design.
Hybrid Electric vehicles: - Concept and architecture of HEV drive train (Series, parallel and series-parallel).Energy consumption of EV and HEV

Unit 05 : Drives and control systems (07 Hrs)

Drives: - Application of BLDC drives and Switched reluctance motor drive for HEV and EV, performance characteristics of drives.

Instrumentation and control system related to Hybrid and Electric vehicles, speed control, acceleration characteristics, Electric steering, motion control, braking mechanism, Vehicle tracking through GPS, over speed indicating systems, Auto-parking systems

Unit 06 : Vehicle to Home, Vehicle to Vehicle and Vehicle to Grid energy systems (06 Hrs)

Vehicle to Home(V2H): PHEV control Strategies to V2H applications, V2H with demand response.

Vehicle to Vehicle(V2V): - Concept and structure of EV aggregator, control method for EV aggregator for dispatching a fleet of EV.

Vehicle to Grid(V2G): - planning of V2G infrastructure in the smart grid, ancillary services provided by V2G, cost emission optimization.

Text Books:

[T1] James Larminie and John Lowry, "Electrical Vehicle", John Wiley and Sons, 2012.

[T2] Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles", SAE InternationalPublisher.

[T3] K T Chau, "Energy Systems for Electric and Hybrid Vehicles", The institution of Engineering and Technology Publication

[T4] D.A.J Rand, R Woods, R M Dell, "Batteries for Electric Vehicles", Research studies press Ltd, New York, John Willey and Sons

[T5] Electric and Hybrid Vehicles-Design Fundamentals, CRC press

[T6] Mark Warner, The Electric Vehicle Conversion handbook –HP Books, 2011.

Reference Books:

[R1] Mehrdad Ehsani, Yimin Gao and Ali Emadi, "Modern Electrical Hybrid Electric and Fuel Cell Vehicles: Fundamental, Theory and design", CRC Press, 2009.

[R2] Junwei Lu, Jahangir Hossain,"Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid", IET Digital Library.

[R3] "Automobile Electrical and Electronic systems", Tom Denton, SAE International publications.

[R4] "Automotive handbook 5th edition", Robert Bosch, SAE international publication.

Unit	Text Books	Reference Books
1	T1,T2,T3, T4, T5	R1
2	T1,T2,T3, T4, T5	R1, R3
3	T2,T3,T4	R1
4	T1,T2,T5	R1
5	T1,T2,T5	R1
6	T3	R2

Elective II : 403144 (E) : Special Purpose Machines

Teaching Scheme	Credits	Examination Scheme [100 Marks]		
Theory : 03Hr/Week	03	In Sem	:	30 Marks
		End Sem	:	70 Marks

Prerequisite:
- Basic concepts of different electric motors
- Laws related to energy conversion in electrical machines
- Knowhow of D-Q axis theory related to electrical machines

Course Objective: The course aims:-
1. To explain operation and performance of synchronous reluctance motors.
2. To describe operation and performance of stepping motors.
3. To elaborate operation and performance of switched reluctance motors.
4. To familiarize with operation and performance of permanent magnet brushless D.C. motors.
5. To illustrate operation and performance of permanent magnet synchronous motors.

Course Outcome: Upon successful completion of this course, the students will be able to :-
1. Reproduce fundamentals of magnetic circuits
2. Reproduce principal of operation of PMSM, Stepper motor, SRM, Switch reluctance and linear motors.
3. Derive basic transformations used in machine modeling and control
4. Develop torque speed and performance characteristics of above motors
5. Enlist application of above motors
6. Demonstrate various control strategies.

Unit 01 : Generalised Machine Theory (06 Hrs)
Energy in singly excited magnetic field systems, determination of magnetic force and torque from energy. Determination of magnetic force and torque from co-energy, Forces and torques in systems with permanent magnets. MMF of distributed winding, Magnetic fields production of EMFs in rotating machines.

Unit 02 : Permanent Magnet Synchronous and brushless D.C. Motor Drives (06 Hrs)
Synchronous machines with PMs, machine configurations. Types of PM synchronous machines Sinusoidal and Trapezoidal. EMF and torque equations Torque speed characteristics Concept of electronic commutation, Comparative analysis of sinusoidal and trapezoidal motor operations. Applications

Unit 03 : Control of PMSM Machine (06 Hrs)
abc-αβ and αβ-dq transformations, significance in machine modelling, Mathematical Model of PMSM (Sinusoidal), Basics of Field Oriented Control (FOC), Control Strategies: constant torque angle, unity power factor.

Unit 04 : Reluctance Motor (06 Hrs)
Principle of operation and construction of Switch Reluctance motor, Selection of poles and pole arcs, Static and dynamics Torque production, Power flow, effects of saturation, Performance, Torque speed characteristics, Synchronous Reluctance, Constructional features; axial and radial air gap motors; operating principle; reluctance torque; phasor diagram; motor characteristics Introduction to control of Reluctance Drive. Applications.

Unit 05 : Stepper Motor (06 Hrs)

Construction and operation of stepper motor, hybrid, Variable Reluctance and Permanent magnet, characteristics of stepper motor; Static and dynamics characteristics, theory of torque production, figures of merit; Concepts of lead angles , micro stepping , Applications selection of motor.

Unit 06 : Linear Electrical Machines (06 Hrs)

Introduction to linear electric machines. Types of linear induction motors, Constructional details of linear induction motor, Operation of linear induction motor. Performance specifications and characteristics Applications.

Text Books:

[T1] K. Venkatratnam, 'Special Electrical Machines', University Press

[T2] A.E. Fitzgerald Charles Kingsley, Stephen Umans, 'Electric Machinery', Tata McGraw Hill Publication

[T3] T.J.E. Miller, 'Brushless Permanent magnet and Reluctance Motor Drives' Clarendon Press, Oxford 1989.

[T4] V. V. Athani, 'Stepper Motors: Fundamentals, Applications and Design', New age International, 1997

Reference Books:

[R1] R Krishnan, 'Permanent Magnet Synchronous and Brushless D.C. Motor Drives' CRC Press.

[R2] Ion Boldea, 'Linear Electric Machines, Drives and maglevs' CRC press

[R3] Ion Boldea S. Nasar, 'Linear Electrical Actuators and Generators', Cambridge University Press.

Unit	Text Books	Reference Books
1	T2	--
2	T1,T3	R1
3	T1	--
4	T1	--
5	T1,T4	--
6	--	R2, R3

403145: Control System II

Teaching Scheme		Credits	Examination Scheme [150 Marks]		
Theory	: 03 Hr/Week	03	In Sem	:	30 Marks
Practical	: 02 Hr/Week	01	End Sem	:	70 Marks
			Oral	:	25 Marks
			Term work	:	25 Marks

Prerequisite: Basic concepts of Control System, Transfer Function, Pole zero plot.

Course Objective: The course aims to:-

- Explain the basic digital control system and the concept of sampling and reconstruction.
- Elaborate the concept of state and to be able to represent a system in the state space format.
- Solve the state equation and familiarize with STM and its properties.
- Design a control system using state space techniques including state feedback control and full order observer.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Recognize the importance of digital control system.
2. Derive pulse transfer function.
3. Analyze digital controllers.
4. Convert system in state space format.
5. Solve state equation.
6. Design observer for system.

Unit 01 : Digital Control System (06 Hrs)

Introduction, Configuration of the basic digital control system. Advantages and limitations of digital control; data conversion and quantization, Sampling and Reconstruction processes, Shannon's Sampling theorem, practical aspects of choice of sampling rate. Zero order hold (ZOH) and it's transfer function, Basic concepts and transfer function of first order hold.

Unit 02 : Z-transform and Pulse-transfer-function (06 Hrs)

Review of z-transform, Inverse z-transform, difference equations and solution using z transform method. Pulse transfer function and Z-transfer function, General procedure for obtaining Pulse-transfer-function, pulse transfer function of ZOH.

Unit 03 : Stability Analysis (06 Hrs)

Sampled data closed loop systems, characteristic equation, causality and physical realizability of discrete data system, realization of digital controller by digital programming, direct digital programming, cascade digital programming, parallel digital programming. Mapping between S-plane and Z-plane, stability analysis of closed loop system in z-plane using Jury's test, Bilinear Transformation.

Unit 04 : Introduction to state space analysis (06 Hrs)

Important definitions – state, state variable, state vector, state space, state equation, output equation. State space representation for electrical and mechanical system, n^{th} order differential equation and transfer function. Conversion of transfer function to state model and vice versa. State model of armature control DC motor

Unit 05 : Solution of state equations (06 Hrs)

Concept of diagonalization, eigen values, eigenvectors, diagonalization of system matrices with distinct and repeated eigen values, Vandermonde matrix.

Solution of homogeneous and non-homogeneous state equation in standard form, state transition matrix, its properties, Evaluation of STM using Laplace transform method and infinite series method Cayley Hamilton theorem.

Unit 06 : Design of Control System Using State Space Technique: (06 Hrs)

Concept of controllability and observability, controllability and observability Tests, condition for controllability and observability from the system matrices in Canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability and observability of the system, duality property. Pole placement design by state variable feedback. Necessity of an observer, design of full order observer.

Guidelines for Instructor's Manual

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment.
- Connection diagram /circuit diagram.
- Basic MATLAB instructions for control system/ Simulink basics.
- Observation table/ Expected simulation results.
- Sample calculations for one/two reading.
- Result table.

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Circuit diagram/Simulink diagram/MATLAB program.
- Observation table/ simulation results.
- Sample calculations for one/two reading.
- Result table, Conclusion.
- Few short questions related to the experiment.

Guidelines for Laboratory Conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results.
- Understanding fundamentals and objective of experiment, timely submission of journal.

List of Experiments

Any 8 experiments out of the list given below:

1. Plotting of discrete time wave forms a) sin, b)Unit step c) Exponential
2. Effect of sampling and verification of sampling theorem
3. Software programming for determination of STM of Discrete Time system.
4. Design and analysis of digital position control system.
5. Software programming for determination of state space representation for given transfer function and vice versa.
6. Check for observability and controllability in MATLAB
7. Verify State Feedback control using pole placement.
8. Convert a continuous time system to digital control system and check response using software.
9. Design state observer and validate it by software.
10. Software programming for determination of STM.

Text Books:

[T1] K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009
[T2] Benjamin C. Kuo "Digital Control System", Prentice Hall of India Pvt. Ltd.
[T3] J. Nagrath, M. Gopal "Control System Engineering", 5th Edition. New Age International Publishers
[T4] R.Anandanatarajan and P.Ramesh Babu "Control System Engineering",4th Edition, SCITECH Publications, India Pvt. Ltd.

Reference Books:

[R1] K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
[R2] M. Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill.
[R3] M. N. Bandyopadhyay, "Control Engineering – Theory and Practice", Prentice Hall of India Ltd. Delhi.

Unit	Text Books	Reference Books
1	T1,T2	R1,R2
2	T1,T2	R2,R3
3	T1,T2	R2
4	T3, T4	R1, R3
5	T3, T4	R1, R3
6	T3, T4	R1, R3

403146 : Project I

Teaching Scheme	Credits	Examination Scheme [50 Marks]
Tutorial : 02 Hr/Week	02	Oral : 50 Marks

The student shall take up a project in the field closely related to Electrical Engineering. Preferably, group of 3/4 students should be formed for project work.

The project work should be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project work in this semester is an integral part of the complete project. In this, the student shall complete the partial work of the project which will consists of problem statement, literature review, project overview and scheme of implementation. As a part of the progress report of project work, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic.

Guidelines for VIIth Semester for Project work:

1. To identify the problems in industry and society.
2. Perform Literature survey on the specific chosen topic through research papers, Journals, books etc. and market survey if required.
3. To narrow down the area taking into consideration his/her strength and interest. The nature of project can be analytical, simulation, experimentation, design and validation.
4. Define problem, objectives, scope and its outcomes.
5. Design scheme of implementation of project.
6. Data collection, simulation, design, hardware if any, needs to be completed.
7. Presentation based on partially completed work.
8. Submission of report based on the work carried out.
9. Student should maintain Project Work Book.

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Audit Course V (A) : 403152: Hydro Energy Systems

Teaching Scheme
Theory : 02 Hr/Week
Field visit : 1 Day

Examination Schemes: Audit (P/F)
Written / MCQ / Term paper

Course Objectives:
- To elaborate various hydro electric generators
- To be familiar with basic operation and various elements of hydro electric systems

Course Outcomes:

On completion of the course, students will be able to:-
- Explain and differentiate various types of hydro electric generators; pico, micro and small hydro

Description:
The following topics may be broadly covered in the classroom. The course will introduce the basics of: hydro energy, availability, introduction to hydraulic machines, turbines, basics of design of hydro electric generators, pico, micro and small hydro, grid interaction, advantages and limitations of the technology, environmental impact, and introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The site visit will be organized to understand the basic operation and system elements.

Details:
- Energy in water
- Basic hydro energy conversion
- Types of turbines and their applications
- Decentralized hydroelectric plants
- Pico, Micro, small and large hydroelectric power plants
- Energy conversion calculations
- Hydro turbine basics and design
- Generator designs for hydro power
- Controllers for hydroelectric power
- Site requirements for hydro power
- Grid integration of micro-hydro
- Operation and maintenance of hydro power plants
- Financial modeling of hydro power
- Software tools for simulation, validation and economics of hydro power
- Environmental impact of various capacity hydroelectric plants
- Manufacturing and assembly
- Quality assurance and standards
- Standards and certification for hydroelectric power plants

Field Trip:
- Visit to Pico, Micro or Small hydroelectric plant

Audit Course V (B) : 403152
Foreign language- German

Teaching Scheme
Theory : 02 Hr/Week

Examination Schemes: Audit (P/F)
Written / MCQ / Term paper

Course Objectives:

- To meet the needs of ever growing industry with respect to language support
- To get introduced to German society and culture through language

Course Outcomes:

On completion of the course, students will be able to:-

- Comprehend everyday expressions and very simple sentences
- Read, write, listen and grasp German Language
- Develop interest to pursue professional German language

Description:

On a professional level, speaking and understanding another language opens many career opportunities. Knowing more than one language enhances employment opportunities in business, teaching, technology, communications, social service, etc.

In an increasingly globalized world, knowledge of German gives students access to the language, culture, and marketplace of few leading nations.

Speaking German gives significant advantages in the world of business since many companies nowadays would choose a competent German speaker over an equally qualified candidate for a job. A proficiency in German prepares you to function productively on behalf of a multinational employer who wants to capitalize on business.

Course Contents:

- Introduction to alphabets, numbers, months, days of the week and time of the day
- Pronouns, Modal and normal verbs, W/V questions
- Bestimmt, Unbestimmt Artikel, Akkusative and Akkusative prepositions
- Hobbies and Freizeit activities, Perfekt tense, basic adjectives and conjunctions.

References:

- Netzwerk Deutsch als Fremdsprache A1, Langenscheidt, First Indian Edition 2015
- www.dw.de

403147: Switchgear and Protection

Teaching Scheme		Credits	Examination Scheme [175Marks]	
Theory	: 3 Hrs./Week	03	In Sem	: 30 Marks
Practical	: 2 Hrs./Week	01	End Sem	: 70 Marks
			Oral	: 25 Marks
			Term work	: 50 Marks

Prerequisite:

- Different type of faults in power system
- Various switchgears and their use in substation
- Principle and working of rotating machines and transformer with vector groups

Course Objective: The course aims to:-

1. Acquaint about construction and working principle of different types of HVCBs
2. Elaborate the Need of protective Relaying and operating principles of different types of relays.
3. Explain different type of faults in transformer, alternator and 3 phase Induction motor and various protective schemes related to them.
4. Impart knowledge about transmission line protection schemes and characteristics of different types of distance relays

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Describe arc interruption methods in circuit breaker.
2. Derive expression for restriking voltage and RRRV in circuit breaker
3. Explain construction and working of different high voltage circuit breakers such as ABCB, SF_6 CB, and VCB.
4. Classify and Describe different type of relays such as over current relay, Reverse power relay, directional over current relay, Differential relay, Distance relay, Static relay and numerical relay
5. Describe various protection schemes used for transformer, alternator and busbar
6. Describe transmission line protection schemes.

Unit 01 : Fundamentals of protective relaying (08 Hrs)

Need for protective system, nature and causes of fault, types of faults, effects of faults, evolution of protective relaying, classification of relays, zones of protection, primary and backup protection, essential qualities of protective relaying. Trip circuit of circuit breaker, zone of protection. Various basic operating principles of protection- over current, (current graded and time graded), directional over current, differential, distance, induction type relay, torque equation in induction type relay, current and time setting in induction relay, Numericals on TSM , PSM and operating time of relay

Unit 02 : Fundamentals of arc interruption (06 Hrs)

Ionization of gases, deionization, Electric arc formation , Current interruption in AC circuit breaker, high and low resistance principles, arc interruption theories, arc voltage, recovery voltage, derivation and definition of restriking voltage and RRRV, current chopping, interruption of capacitive current, resistance switching, Numerical on RRRV, current chopping and resistance switching.

Unit 03 : Circuit Breaker (05 Hrs)

Different ratings of circuit breaker (like rated voltage, rated current, rated frequency, rated breaking capacity – symmetrical and unsymmetrical breaking, making capacity, rated interrupting duties, rated operating sequence, short time rating). Classification of high voltage circuit breaker. Working and constructional features of ACB, SF_6 VCB- advantages, disadvantages and applications. Auto reclosing.

Unit 04 : (05 Hrs)

A) Static and Digital Relaying

Overview of Static relay, block diagram, operating principal, merits and demerits of static relay. Numerical Relays :-Introduction and block diagram of numerical relay, Sampling theorem, Anti –Aliasing Filter, Block diagram of PMU

B) 3 Phase Induction Motor Protection

Abnormal conditions and causes of failures in 3 phase Induction motor, single phasing protection, Overload protection, Short circuit protection.

Unit 05 : (06 Hrs)

A) Transformer Protection

Types of faults in transformer, Percentage differential protection in transformers, Restricted E/F protection, incipient faults, Buchholz relay, protection against over fluxing, protection against inrush current,

B) Alternator Protection

Various faults in Alternator, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.

Unit 06 : Transmission line protection (06 Hrs)

Over current protection for feeder using directional and non directional over current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay and Quadrilateral Relays, Introduction to PLCC, block diagram, advantages, disadvantages, three stepped distance protection, Effect of arc resistance, and power swing on performance of distance relay. Realization of distance relays(impedance, reactance, and mho relay) using numerical relaying algorithm(flowchart, block diagram), Introduction to Wide Area Measurement (WAM) system.

Guidelines for Instructor's Manual

Prepare 3/4 sets of standard experiments. It must contain title of the experiment, Aim, Apparatus

- **Theory:** Brief theory explaining the experiment
- **Circuit / connection diagram** or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
- **Procedure:** Write down step by step procedure to perform the experiment.
- **Specifications of Switchgear:**
- **Observation table:**
- **Graph:**
- **Detailed constructional diagram with nomenclature:**
- **Conclusion:**

Guidelines for Student's Lab Journal

- Students should write the journal in his own hand writing using A4 size both side ruled paper.
- Circuit / Connection diagram or construction diagram must be drawn either manually or using software. [Do not use Photo copy of standard journal] on A4 size blank/graph paper.
- Hand writing must be neat and clean.
- Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
- Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
- (Use black or blue ink pen for writing.)

Guidelines for Laboratory conduction

- Check whether the MCB / main switch is off.
- Make connections as per circuit diagram. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
- Perform the experiment only in presence of teacher or Lab Assistant.
- After completion of experiment, switch off the MCB / main switch.
- Write the experiment in the journal and get it checked within a week

List of Experiments :

A) Compulsory Experiments

1. Study of switchgear testing kit.
2. Study of bus-bar protection schemes.

B) Minimum 6 Experiments to be performed from the following list:

1. Study of Fuse, MCB and MCCB
2. Testing of MCB and MCCB.
3. Study and testing of contactors.
4. Study and testing of ACB.
5. Study and testing of thermal overload relay for Induction Motor protection.
6. Study and plot Characteristics of IDMT type Induction over current relay
7. Study and plot Characteristics of digital over current relay
8. Percentage differential protection of transformer.
9. Protection of alternator.
10. Protection of Transmission line using Impedance relay
11. Study of various LT switchgears like RCCB, timers.

Industrial Visit:

A compulsory industrial visit to switchgear training centre /or switchgear/relay manufacturing unit/ or 220 kV substation visit and report to be submitted as a part of term-work.

Assignments:

Minimum 3 assignments (at least 4 to 6 questions in each) to be submitted as a part of term-work.

Text Books:

[T1] S. Rao, "Switchgear Protection and Power Systems", Khanna Publications

[T2] Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India

[T3] Bhavesh Bhalja,R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.

[T4] J.B.Gupta " Switchgear and Protection", S.K. Kataria and Sons.

Reference Books:

[R1] Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill Publishing Co. Ltd.

[R2] J Lewis Blackburn , "Protective Relaying- Principles and Applications", Dekker Publications.

[R3] Prof. Dr S.A. Soman, IIT Mumbai, A Web course on "Digital Protection of power System" http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html

[R4] A.G. Phadke, J.S. Thorp ,Computer relaying for Power System , Research Studies Press LTD, England.(John Willy and Sons Inc New York)

[R5] Mason C.R., "Art and Science of Protective Relaying", Wiley Eastern Limited.

[R6] Arun Ingole, "Switchgear and Protection", Pearson.

Unit	Text Books	Reference Books
1	T1,T2,T4	R1, R2, R6
2	T1,T3,T4	R1, R6
3	T1,T4	R1
4	T2,T3,T4	R3, R4, R6
5	T1	R5
6	T1,T4	R2, R5

403148: Power Electronic Controlled Drives

Teaching Scheme		Credits	Examination Scheme [175 Marks]	
Theory	: 4 Hrs./Week	04	In Sem	: 30 Marks
Practical	: 2 Hrs./Week	01	End Sem	: 70 Marks
			PR	: 50 Marks
			Term work	: 25 Marks

Prerequisite:
1. Construction, working and characteristic of different electrical motors and soft starting methods.
2. Power Electronic Applications such as converter, inverter, chopper etc.
3. Basic concept of control system

Course Objective: The course aims to
- To understand motor load dynamics.
- To analyze the operation of the converter fed and chopper fed dc drives.
- To elaborate braking methods of D.C. and Induction motor drive.
- To explain vector control of induction motor.
- To differentiate synchronous and BLDC motor drive.
- To identify classes and duty of motor.
- To describe the modes of operation of drive in various applications.

Course Outcome: Upon successful completion of this course, the students will be able to

1. Explain motor load dynamics and multi quadrant operation of drives
2. Analyze operation of converter fed and chopper fed DC drives.
3. Describe braking methods of D.C. and induction motor drive.
4. Explain vector control for induction motor drives
5. Describe synchronous motor drive.
6. Identify classes and duty cycles of motor and applications of drives in industries.

Unit 01 : Electrical Drives (08 Hrs)

A. Definition, Advantages of electrical drives, Components of Electric drive system, Types of Electrical Drives (DC and AC).
B. Motor-Load Dynamics, Speed Torque conventions and multi quadrant operation, Equivalent values of drive parameters. Load Torque Components, Nature and classification of Load. Constant Power operation of a Drive. Steady state stability, Numerical based on motor load dynamics.

Unit 02 : DC Motor Drives (08 Hrs)

A. Braking methods: Rheostatic, Plugging, and Regenerative. Closed loop control of drives: current limit control, torque control and speed control.
B. Single phase and three phase fully controlled converter drives and performance of converter fed separately excited DC Motor for speed control operations.
Chopper controlled drives for separately excited and series DC Motor operations.
Numerical based on above. Closed loop speed control of DC motor below and above base speed.

Unit 03 : Induction motor Drives I (08 Hrs)

Braking methods: DC Dynamic Braking, AC Rheostatic braking, Plugging, Regenerative Braking, V/f control and comparison with stator voltage control, voltage source inverter (VSI) control, Steady State Analysis. Current source inverter (CSI) control-open and closed loop, Regenerative braking and multiquadrant operation of Induction motor drives, relative merits and demerits of VSI and CSI for induction motor drives, Numerical on VSI and CSI fed I.M. drives

Unit 04 : Induction Motor Drives II (08 Hrs)

A. Principle of vector control, Block diagram of Vector control of induction motor. Servo mechanism in drives and block diagram for position control (Descriptive treatment only).
B. Thermal model of motor for heating and cooling, classes of motor duty, types of enclosures for motor.

Unit 05 : Synchronous motor Drives (08 Hrs)

Types of motor, cylindrical rotor wound field motor, equivalent circuit, speed torque characteristics and effect of power factor, salient pole wound field motor, phasor diagram, simple numerical based on above, closed loop speed control of self controlled synchronous motor drives fed from VSI and CSI.
BLDC drives, block diagram and speed torque characteristics.

Unit 06 : Industrial application (08 Hrs)

A. Specific requirement and choice of drives for following applications.
1. Machine tools
2. Textile mills
3. Steel rolling mills
3. Sugar mills
4. Traction drives
5. Crane and hoist drives
6. Solar and battery powered drives

Guidelines for Instructor's Manual

- Title and circuit diagram of power electronic controlled drives/ electrical machine circuit.
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit used to control the electric motor.
- Procedure to carry out the experiment

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit and expected machine performance with speed torque characteristics.
- Equipments along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.
- Analyse and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory conduction

- Each group in the lab should have not more than three students.
- All the students in the group must do the connections and perform the practical under the guidance of the staff member.
- Staff member has to check the result of all the groups.

List of Experiments: Minimum eight experiments are to be performed out of the list mentioned as below:

GROUP A: Any FIVE Experiment (Hardware)

1. Study of Electrical braking of D.C. Shunt motor (Rheostatic, Plugging).
2. Study speed control characteristics of single phase fully converter fed separately excited D.C. motor
3. Study speed control characteristics of 3-ph fully converter fed separately excited D.C. motor
4. Study of Chopper fed D.C. series/separately motor speed control characteristics.
5. Study of electrical braking of 3 phases Induction Motor (DC Dynamic Braking, Plugging).
6. Study of VSI fed 3 phase Induction motor (using V/f control PWM inverter) speed control characteristics.
7. Study of Solid state stator voltage control of 3 phase Induction motor (Using AC voltage Regulator).
8. Study of constant torque and constant power characteristic of induction motor.

GROUP B: Any THREE Experiment (Software)

1. Simulation of starting characteristics of D.C. motor.
2. Simulation of starting characteristics of 3 phase Induction motor.
3. Study of Closed loop speed control of separately excited D.C. motor/ Induction Motor.
4. Simulation of an electric drive system for steady state and transient analysis.
5. Simulation of closed loop control of synchronous motor
6. Simulation of chopper controlled DC series motor.

Industrial Visit:

Minimum one industrial visit must be organized for drives application in industry such as railways, sugar mill, machine shop, textile mill, paper mill etc.

Text Books:

[T1] G. K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House

[T2] N. K. De, P. K. Sen, "Electric Drives", Prentice Hall of India Eastern Economy Edition

[T3] S. K. Pillai, "Analysis of Thyristor Power Conditioned Motors", University Press

[T4] R. Krishnan, "Electric Motor Drives – Modeling Analysis and Control", PHI India

[T5] G.K. Dubey, "Power Semiconductor controlled drives", PHI publication

Reference Books:

[R1] B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education

[R2] Malcolm Barnes, "Practical Variable Speed Drives and Power Electronics", Elsevier Newnes Publications

[R3] V. Subrahmanyam, "Electric Drives: Concepts and Application", Tata Mc-Graw Hill (An imprint of Elsevier)

[R4] M.D. Singh and Khanchandani "Power Electronics", Tata Mc-Graw Hill

[R5] Austin Huges, "Electrical motor and drives: Fundamental, types and applications", Heinemann Newnes, London

[R6] Tyagi MATLAB for engineers oxford (Indian Edition)

Unit	Text Books	Reference Books
1	T1	R3
2	T1,T5	R2,R4
3	T1,T4	R1,R5
4	T1,T2,T5	R1,R2
5	T1,T3,T5	R1,R6
6	T1,T2	R3,R5

Elective –III : 403149 (A): High Voltage Engineering

Teaching Scheme	Credits	Examination Scheme [150 Marks]
Theory : 03 Hrs./Week	03	In Sem : 30 Marks
Practical : 02 Hrs./Week	01	End Sem : 70 Marks
		Oral : 25 Marks
		Term work : 25 Marks

Prerequisite: Atomic and molecular structure of gaseous and solid materials, basic properties of conductors and insulators, knowledge of material science.

Course Objective: The course aims to:-

- To enable students to know and compare the various processes of breakdown in solid, liquid and gaseous dielectric materials
- To enable students understand and apply various methods of generation and measurement of DC, AC, impulse voltage and current.
- To enable students to know the charge formation and separation phenomenon in clouds, causes of overvoltage and lightening phenomenon
- To develop ability among learners to execute testing on various high voltage equipments as per standards
- To introduce students to the design, layout, safety precautions, earthing, and shielding of HV laboratory.

Course Outcome: Upon successful completion of this course, the students will be able to

1. Identify, describe and analyze the breakdown theories of solid, liquid and gaseous materials
2. Describe as well as use different methods of generation of high AC, DC, impulse voltage and current.
3. Demonstrate and use different methods of measurement of high AC, DC, impulse voltage and current.
4. Identify the occurrence of overvoltage and to provide remedial solutions
5. Demonstrate an ability to carry out different tests on high voltage equipment and devices as well as ability to design the high voltage laboratory with all safety measures

Unit 01 : Breakdown in Gases (06 Hrs)

Ionization process in gas, Townsend's Theory, current growth equation in presence of primary and secondary ionization processes, Townsend's breakdown criterion, primary and secondary ionization coefficients, limitations of Townsend's theory, Streamer mechanism of breakdown, Paschen's Law and its limitations, Corona discharges for point plane electrode combination with positive and negative pulse application, time lag and factors on which time lag depends. (Numerical on Townsend's theory and Paschen's law).

Unit 02 : **(06 Hrs)**

1. **Breakdown in Liquid Dielectrics:** Pure and commercial liquids, Different breakdown theories: Breakdown in Pure liquid and breakdown in commercial liquids: Suspended Particle theory, Cavitations and bubble theory, Thermal mechanism of breakdown and Stressed Oil volume theory

2. Breakdown in Solid Dielectrics: Intrinsic breakdown: electronic breakdown, avalanche or streamer breakdown, electro-mechanical breakdown, thermal breakdown, treeing and tracking phenomenon, Chemical and electrochemical breakdown, Partial discharge(Internal discharge),Composite dielectric material, Properties of composite dielectrics, breakdown in composite dielectrics. (Numerical on theories of liquid and solid dielectric materials)

Unit 03 : Generation of High Voltages and Current **(06 Hrs)**

a)Generation of high ac voltages-Cascading of transformers, series and parallel resonance system, Tesla coil

b)Generation of impulse voltages and current-Impulse voltage definition, wave front and wave tail time, Multistage impulse generator, Modified Marx circuit, Tripping and control of impulse generators, Generation of high impulse current

Unit 04 : Measurement of High Voltage and HighCurrents: **(06 Hrs)**

Sphere gap voltmeter, electrostatic volt meter, generating voltmeter, peak reading voltmeter, resistive, capacitive and mixed potential divider , capacitance voltage transformer, cathode ray oscilloscope for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements. Measurement of high power frequency a.c. using current transformer with electro-optical signal converter, Radio interference measurements.

Unit 05 : Lightning and Switching Over Voltages **(06 Hrs)**

Causes of over voltages, lightning phenomenon, Different types of lightening strokes and mechanisms of lightening strokes, Charge separation theories, Wilson theory, Simpson theory, Reynolds and Mason theory, Over voltage due to switching surges and methods to minimize switching surges. Statistical approach of insulation coordination

Unit 06 : High Voltage Testing of Electrical Apparatus and H V Laboratories: **(06 Hrs)**

a)Testing of insulators and bushings, Power capacitors and cables testing, testing of surge arresters.

b) Design, planning and layout of High Voltage laboratory:-Classification and layouts, earthing and shielding of H.V. laboratories.

Guidelines for Instructor's Manual

The Instructor's Manual should contain following related to every experiment

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Students should be encouraged to visit industries/HV laboratories/HV installations.
- Students should be encouraged to use virtual labs.
- Few short questions related to each practical.

Assignments based on use of IS and IEC

Guidelines for Student's Lab Journal

The Students lab journal should contain:

- Brief theory related to the experiment.
- Circuit diagram and apparatus with their detail specification as per IS code.
- Observations, result tables and proper inferences/ conclusion from each experiment conducted.
- Reports on visit to industries/HV laboratories/HV installations.
- Simulations and print outs of use of virtual labs.
- Few short questions and answers related to each practical.
- Assignments based on use of IS and IEC.

Guidelines for Laboratory conduction

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

List of Experiments

1. To find the constants of breakdown equation of transformer oil.(Analytical and graphical method)
2. Measurement of unknown high a.c. voltage using sphere gap
3. To obtain breakdown strength of composite insulation system, and observe the effect of parameter like no. of layers, thickness of layer, effect of interfacing.
4. To find out the breakdown of air in uniform and non uniform field and compare it.
5. To study surface flashover on corrugated porcelain/polymeric insulation system.
6. To understand basic principle of corona and obtain audible and visible corona inception and extinction voltage under non uniform field.
7. To perform experiment on horn gap arrestor and understand arc quenching phenomenon.
8. To observe development of tracks and trees on polymeric insulation system.
9. Parametric analysis of Impulse current generator using virtual Laboratory.
10. To perform experiment on rod gap arrestor.
11. To Study effect of barrier on breakdown voltage of air/ transformer oil.
12. Simulation of lightening and switching impulse voltage generator using any simulation software.
13. To perform various HV insulation tests on cables as per IS.
14. Study of layout /earthing/safety of HV installation /lab in any industry by visit /virtual lab
15. Study of any IS for any power apparatus (Power Transformer/Induction Motor/ Alternator etc)

Industrial Visit: Industrial visit to high voltage equipment manufacturing industry/EHV substation/High Voltage Testing Unit.

Text Books:

[T1] M. S. Naidu, V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Publication Co. Ltd. New Delhi

[T2] C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers Ltd.

Reference Books:

[R1] E. Kuffel, W. S. Zaengl, J. Kuffel, “High Voltage Engineering Fundamentals”, Newnes Publication

[R2] Prof. D. V. Razevig Translated from Russian by Dr. M. P. Chourasia, “High Voltage Engineering”, Khanna Publishers, New Delhi

[R3] Ravindra Arora, Wolf Gang Mosch, “High Voltage Insulation Engineering”, New Age International

[R4] High Voltage Engineering Theory and Practice by M. Khalifa Marcel Dekker Inc. New York and Basel.

[R5] Subir Ray, “An Introduction to High voltage Engineering” PHI Pvt. Ltd. New Delhi

[R6] NPTEL lectures

[R7] IS 731-1971:Porcelain insulator for overhead power lines with nominal voltage > 1000 Volt

[R8] Bushings :IS2099-1986,specification for bushings for A.C. Voltages > 1000 Volts

[R9] Pollution test :IEC 60507-1991 on external and internal insulator

[R10] High voltage test techniques, general definitions and test requirements: IS 2071(part 1) 1993,IEC Pub 60-1(1989)

Unit	Text Books	Reference Books
1	T1,T2	R1,R2,R3,R6
2	T1,T2	R1,R2,R3,R5,R6
3	T1,T2	R1,R2,R3,R5,R6
4	T1,T2	R1,R2,R3,R4,R5,R6
5	T1,T2	R1,R2,R3,R4,R5,R6
6	T1,T2	R1,R2,R3,R7,R8,R9, R10

Elective –III : 403149 (B): HVDC and FACTS

Teaching Scheme	Credits	Examination Scheme [150 Marks]
Theory : 03Hrs./Week	03	In Sem : 30 Marks
Practical : 02Hrs./Week	01	End Sem : 70 Marks
		Oral : 25Marks
		Term work: : 25 Marks

Prerequisite:
1. Fundamental knowledge of Power Electronics and power controllers
2. Fundamentals of Power system Operation of three phase converters
3. Inverter topologies
3. Operation of VSI

Course Objective: The course aims to:-
- To provide students knowledge about modern trends in Power Transmission Technology
- To make students describe applications of power electronics in the control of power transmission.
- To educate students for utilization of software such as PSCAD, MATLAB for power transmission and control.

Course Outcome: Upon successful completion of this course, the students will be able to :-
1. Compare HVDC and EHV AC systems for various aspects
2. Reproduce the layout of HVDC system with various components including protective devices
3. Differentiate VSC HVDC and conventional HVDC system
4. Differentiate various types of Power Electronic Controllers
5. Analyze modeling of FACTs Controllers
6. Simulate various controllers and HVDC systems using softwares

Unit 01 : (06 Hrs)
EHVAC versus HVDC transmission, power flow through HVDC link, Graetz circuit, equation for HVDC power flow bridge connection, control of DC voltage and power flow, effects of angle of delay and angle of advance commutation, CIA, CC and CEA control.

Unit 02 : (06 Hrs)
Twelve pulse converter operation, Harmonics in HVDC systems. HVDC system layout and placement of components, HVDC protection, grounding, multi terminal HVDC systems, configurations and types.

Unit 03 : VSC HVDC Technology (06 Hrs)
Introduction to VSC transmission, power transfer characteristics, structure of VSC link, VSC DC system control, HVDC light technology. HVDC plus, introduction, construction, operation and applications to renewable energy sources

Unit 04 : Power Electronic Controllers (06 Hrs)
Basics, Challenges and needs, Review of rectifiers and inverters, back to back converter, dc link converter, static Power converter structures, AC controller based structures, DC link converter topologies, converter output and harmonic control, power converter control.

Unit 05 : Shunt and Series Compensation (06 Hrs)

Operation and control of SVC, STATCOM configuration and control, characteristics and applications of SVC and STATCOM, TCSC layout and modes of operation, layout, operation and characteristics of Static Synchronous Series Compensator (SSSC).

Unit 06 : Unified Power Flow Controller (06 Hrs)

UPFC configuration, steady state operation, control and characteristics, operational constraints of UPFC, Power flow studies in UPFC embedded systems.

Guidelines for Instructor's Manual

- Title and circuit diagram of experiment (block diagram) /power network.
- Working operation and output characteristics / output waveforms of power electronic Controllers/FACTS devices /converter circuit used to control.
- Procedure to carry out the experiment
- For simulation experiments print out of model and simulation results

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit and expected machine performance with speed torque characteristics.
- Equipment along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations if any.
- Analyse and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory conduction

- Minimum eight experiments are to be performed out of the list mentioned as below:
- Out of which at least two experiments shall be conducted on hardware setups.
- For simulation experiment ready models/demo models can be used. However study should simulate models for different conditions and attached prints of simulation models and test results.
- Term work should be assessed continuously.
- Term work marks are based on quality of work, initiative, timely submission

List of Experiments

Minimum eight experiments are to be performed out of the list mentioned as below:

A) Hardware experiments

1. Study effects of angle of delay and angle of advance commutation, CIA, CC and CEA control on single bridge converter
2. Study of Single Phase Thyristor Control Reactor(A) Study of Voltage and Current Waveforms with different delay angles (B) harmonic analysis (C) Basic control law (D) V-I characteristics
3. Single Phase TCR with fixed capacitor and filter.
4. Complete characteristics of a three phase voltage source converter, constant alpha and extinction angle control.

B) Simulation Experiments

1. Study and simulation of Three phase TCR with and without shunt capacitor
2. Study and simulation of resonance in electrical Power systems
3. Application study of SVC in Power System.
4. Application study of TCSC in Power System
5. Study and simulation of 6 pulse HVDC system
6. Study of 12 pulse or 24 pulse or 48 pulse inverter
7. Application study of DSTATCOM in Power System
8. Study and simulation of Power Flow control in a five bus system using any one of the following FACTS Controllers: (i) SVC (ii) STATCOM (iii) SSSC (iii) UPFC

Industrial Visit: Desirable visit to nearest HVDC substation

Text Books:

[T1] E. Acha, V.A. Agelidis, O.Anaya-lara and TJE Miller, "Power Electronic control in Electrical Systems" Newnes, Oxford.
[T2] J. Arrillaga, "High Voltage Direct Current Transmission" Peter Peregrinus Ltd., London, UK.
[T3] N.G. Hingorani and L.Gyugi, "Understanding FACTS" IEEE Press[Indian Edition], New York.
[T4] J. Arrillaga, Y.H.Liu and N.R.Watson, "Flexible Power Transmission The HVDC Options", John Wiley and sons Ltd., New York.
[T5] Erich Uhlmann, "Power Transmission by Direct Current" Springer International.

Reference Books:

[R1] Yong Hua Song and Allan T Johns, "Flexible ac transmission systems(FACTS), Published by The Institution of Electrical Engineers, London.
[R2] K.R.Padiyar, "FACTS controllers in transmission and Distribution" New Age Publications, New Delhi.
[R3] K.R.Padiyar , "HVDC Power Transmission Systems", New Age Publications, New Delhi, (2nd Edition)
[R4] M.H.Rashid , "Power Electronics Handbook", Academic Press.
[R5] PrabhaKundur, "Power System Stability and Control", McGraw Hill
[R6] S Kamakshaiah, V Kamaraju, "HVDC Transmission", McGraw Hill

Unit	Text Books	Reference Books
1	T2,T4,T5	R3,R6
2	T1, T3	R3, R4,R7
3	T1, T2	R1, R6
4	T2	R5, R8
5	T6	R2
6	T2, T3	R6

Elective –III : 403149 (C) : Digital Control Systems

Teaching Scheme	**Credits**	**Examination Scheme [150 Marks]**
Theory : 03 Hrs./Week	03	In Sem : 30 Marks
Practical : 02Hrs./Week	01	End Sem : 70 Marks
		Oral : 25Marks
		Term work : 25 Marks

Prerequisite : Z-Transform, Basics of discrete systems.

Course Objective: The course aims to:-

- Make students elaborate basic concepts of discrete signals and systems.
- Educate students to analyze the stability of discrete systems.
- Explain formulation of state space discrete model and design the digital controllers.
- Elaborate digitize analog controllers using various numerical methods.
- Explore application of the theory of digital control to practical problems.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Analyze digital control system and its stability.
2. Differentiate between various control systems
3. Present system in state space format.
4. Design observer for system.
5. Understand digital controllers
6. Elaborate applications such as digital temperature control and position control

Unit 01 : Discrete systems and Signals (06 Hrs)

Standard discrete test signals, Basic operations on signals. Classification of discrete systems. Detail analysis of frequency aliasing and quantization, Brief review of Sampling theorem, Ideal low pass filter. Transfer function of ZOH, Frequency domain characteristics of ZOH, First order hold, frequency domain characteristics of first order hold.

Unit 02 : State - Space analysis (06 Hrs)

Conversion of Pulse transfer functions to State space model and vice a versa. Solution of LTI Discrete –time state equation; State Transition Matrix (STM) and properties of STM; Computation of STM by Z-transform method, by power series expansion method, by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time state space equation.

Unit 03 : Design using state space (05 Hrs)

Controllability and observability of linear time invariant discrete-data system, Tests for Controllability and observability; Principal of Duality; Effect of pole- zero cancellation; Relationship between controllability, observability and stability. Pole placement design using linear state-feedback.

Unit 04 : Design of State Observers (06 Hrs)

Full order state observer, reduced order state observer, State estimation and full order observer design. Ackermann's formula. Compensator design by the separation principle, State feedback with integral control, State regulator design.

Unit 05 : State space model and digitising analog controllers (07 Hrs)

State space model of digital systems: Transformation of state-space model to various forms (controllable, observable, diagonal and Jordan canonical forms). Numerical approximation of differential equations, Eulers foreword and backward method, Trapezoidal method, Bilinear transformation with frequency warping. Numerical differentiation, Matching step and other response. Pole-zero matching.

Unit 06 : Digital control system applications (0 6 Hrs)
Hybrid system simulation, Computer program structure for simulation of discrete time control of continuous time plant. Digital temperature control, position control, Stepper motor control, Block diagram presentation and control algorithms.

List of Experiments Perform any eight experiments using MATLAB

1. Design and analysis of digital temperature control system
2. Design and analysis of digital position control system.
3. Software programming for determination of STM of DT system.
4. Software programming to design DT system by pole placement through state feedback.
5. Software programming for determination of controllability and observability of DT System.
6. Software programming to observe effect of sampling on response of the system
7. Software programming to observe effect of sampling on stability of DT system.
8. Solution of state equation of L.T.I. systems by the use of digital computer.
9. Digital computer aided difference equation solution.
10. Conversion of continuous time state space model to discrete time state space model

Text Books:

[T1] K. Ogata, "Discrete Time Control System", 2nd Edition, PHI Learning Pvt. Ltd. 2009
[T2] B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press
[T3] M. Gopal, "Digital Control Engineering", New Age International Publishers
[T4] M. Gopal, "Digital Control and State Variable Methods", 3rd Edition The McGraw Hill Co.

Reference Books:

[R1] Load D. Landau, Gianluca Zito, 'Digital Control Systems: design, Identification and Implementation' Springer.
[R2] Mohammed Santina, Allen Stubberud, Gene Hostetter 'Digital control System Design', Sanders College publishing
[R3] K.J. Astrom, B Wittenmark 'Computer Controlled Systems: Theory and Design' Prentice-Hall Inc New Jersey, 2011 Dover.

Unit	Text Books	Reference Books
1	T2,T3	R3
2	T2,	R3
3	T1,T2	R3
4	T1,T2	R1,R2
5	T1,T3	R1,R2
6	T2,T4	R3

Elective – III : 403149 (D): Intelligent Systems and Applications in Electrical Engineering

Teaching Scheme		Credits	Examination Scheme [150 Marks]	
Theory	: 03 Hrs./Week	03	In Sem	: 30 Marks
Practical	: 02 Hrs./Week	01	End Sem	: 70 Marks
			Oral	: 25 Marks
			TW	: 25 Marks

Prerequisite: Knowledge of MATLAB, C- Programming

Course Objective: The course aims to:-

- To enhance knowledge of intelligence system to carry out power system problems.
- To impart knowledge about Artificial neural network and fuzzy logic programming for electrical engineering applications like load dispatch and load shedding.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Classify neural networks
2. Compare various AI tools
3. Develop algorithms for AI tools
4. Apply AI tools for Applications in electrical engineering

Unit 01 : Introduction to Artificial Neural Network (06 Hrs)

Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures

Unit 02 : Classification Taxonomy of ANN (06 Hrs)

Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.
Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks

Unit 03 : Memory (06 Hrs)

Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).

Unit 04 : Introduction to Fuzzy Logic system (06 Hrs)

Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations.

Unit 05 : Fuzzy Control (06 Hrs)

Predicate logic (Interpretation of predicate logic formula, Inference in predicate logic), fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, defuzzification methods

Unit 06 : Introduction to other Intelligent tools (06 Hrs)

Introduction to Genetic Algorithm: biological background, GA operators, selection, encoding, crossover, mutation, chromosome.
Expert System: software architecture, rule base system

List of Experiments
Minimum eight experiments are to be performed out of the list mentioned as below:

[Matlab Programming based experiments.]

1. Write program to evaluate output of any given architecture of neural network with different transfer functions such as linear logsig tanh, threshold function.
2. Verify the fault tolerant nature of neural network by disconnecting few weight link for a given architecture
3. Write program for perceptron learning algorithm.
4. To study some basic neuron models and learning algorithms by using ANN tool
5. Power system failure analysis using ANN tool
6. Predict power factor of four bus system using neural network
7. Predict system analysis for measurements like rms voltage using ANN tool
8. Write supervised and unsupervised ANN program for Signal Frequency Separation using Perceptron
9. Temperature monitoring using fuzzy logic
10. Speed control of DC motor using fuzzy logic
11. Fuzzy logic based washing machine control
12. Fuzzy logic based air conditioner
13. Design of a Fuzzy Multi-Objective Power System Stabilizer via Linear Matrix Inequalities

Text Books:

[T1] Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Pearson Education

[T2] S. Rajsekaram, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and Applications", Practice Hall India

[T3] James A. Anderson, "An Introduction to Neural Networks", Practice Hall India Publication

[T4] Mohamed H. Hassoun, "Fundamentals of Artificial Neural Network", Practice Hall India

Reference Books:

[R1] Kelvin Waruicke, Arthur Ekwlle, Raj Agarwal, "AI Techniques in Power System", IEE London, U.K.

[R2] S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw Hill

[R3] Jacek Zurada, "Introduction to Artificial Neural Network", Jaico Publishing House India

Unit	Text Books	Reference Books
1	T1,T2	R1,R2
2	T1,T2	R1,R2
3	T1,T2	R1,R2
4	T2	R1
5	T2	R1
6	T1	R1,R2

Elective – III : 403149 (E): Analog Electronics and Sensing Technology [Open Elective]

Teaching Scheme		Credits	Examination Scheme [150 Marks]	
Theory	: 03 Hrs./Week	03	In Sem	: 30 Marks
Practical	: 02 Hrs./Week	01	End Sem	: 70 Marks
			Oral	: 25 Marks
			TW	: 25 Marks

Course Objective: The course aims to:-

- Study operational amplifiers for various analog operations.
- Understand different types of analog filters and waveform generation techniques.
- Study advance applications such as mux/demux and multipliers.
- Understand various analog sensors for various applications.

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Develop various analog circuits using operational amplifiers.
2. Design filters and waveform generators and various signal converter circuits.
3. Find characteristics of sensors used for system monitoring and protection.
4. Interface various position sensors to microcontrollers.
5. Find characteristics of sensors used for light and image sensing.

Unit 01 : Operational Amplifier & Applications (06 Hrs)

Study of Various types of Operational Amplifiers and their applications; Op-Amp: Block diagrams of LM741 and TL082, ideal and practical parameters, open loop and close loop configuration, Power supply configurations, DC and AC parameters.

Applications of Op- Amp- Comparator, zero crossing detectors, Voltage limiters, Integrator and Differentiator, V-I and I-V converters, V to f and f to V circuits using LM331, peak detector.

Unit 02 : Waveform generators, Filters & Regulators (06 Hrs)

Waveform generation using Op-amp - sine, square, saw tooth and triangular generator, Active filters-Its configuration with frequency response, Analysis of first order Butterworth low pass and high pass filters, bandpass and band-stop filters, notch filter, all pass filters, Universal Active filter design using UAF42.

OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Basic Switching Regulator and characteristics of standard regulator ICs –TPS40200 and Low Drop out (LDO) Regulators ICs- TPS7250.

Unit 03 : Advanced applications (06 Hrs)

Introduction to analog multiplier e.g.MPY634, Basic application of Analog multiplier: AM, FM, FSK; Typical application using op-AMP and analog multipliers: Voltage Controlled Oscillator, Phase Locked Loop and its applications, self-tuned filters.

Analog Switches and Multiplexers Overview, MUX507 Multiplexer, SN74LV4051A-Q1 8-Channel Analog Multiplexer/Demultiplexer

Unit 04 : System monitoring & protection sensing (06 Hrs)

Principle of operation and application of following sensors for Real-time system protection, feedback control and high-accuracy system monitoring: LM35 Temperature Sensor, INA240 current sense amplifier, DRV5053 Hall Effect based current sensor, HDC1080 / HDC1010 / HDC2010 Humidity Sensor.

Unit 05 : Position Sensing (06 Hrs)

Absolute and relative position sensing solutions including: angular, presence, proximity, distance, flow, level, and velocity basics, DRV 5032 Hall Effect Sensor, mmWave Sensor, AFE5805 Ultrasonic sensor, Encoder, Resolver, Inductive position sensor, Capacitive Position Sensor, LVDT.

Unit 06 : Light & image sensing (06 Hrs)

Sensors and sensing AFEs for capturing a broad range of wavelengths introduction, 3D Depth Sensor, Near Infrared spectroscopy, OPT3007 Light Sensor, Optical Isolators.

Guidelines for Instructor's Manual

Instructor's Manual shall have

- Brief relevant theory of all analog and sensing devices.
- Equipment with specifications.
- Connection diagram/ methodology.

Format of observation table, analog device characteristics and sample results.

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

1. Theory related to the experiment.
2. Apparatus with their detailed specifications.
3. Connection diagram /circuit diagram.
4. Observation table/ simulation waveforms.
5. Sample calculations for one/two reading.
6. Result table.
7. Graph and Conclusions.
8. Few short questions related to the experiment.

Guidelines for Laboratory conduction

Lab Requirement: LM741, TL082, LM331 operational amplifiers, ICs – TPS40200,TPS7250,TPS 7A4901, TPS7A8300, UAF42, MPY634, MUX507 and SN74LV4051A-Q1;LM35, INA240, DRV5053, HDC1080 modules; Angular, Presence, Proximity, Distance, Flow, level and other position sensor modules and OPT3007 light sensor module with relevant power supply and DSO/CRO and other metering equipment for characterization of all analog devices.

List of Experiments

Minimum eight experiments are to be performed out of the list mentioned as below:

1. LM741 based comparator circuit.
2. LM318 based zero crossing detector.
3. LM331 based V to f and f to V converter.
4. LM741 based triangular, square and sinusoidal waveform generation.
5. Universal Active filter design using UAF42.
6. Voltage Regulators using TPS40200 and TPS7250.
7. Analog multiplier using MPY634
8. Analog Multiplexer using MUX507
9. Study characteristics of LM35 based temperature sensor module
10. Study characteristics of HDC 1080 based Humidity sensor module
11. Hall Effect based position sensing / Ultrasonic based distance sensing.
12. Study characteristics of OPT 3007 light sensor module.

Text Books:

[T1] HANDBOOK OF OPERATIONAL AMPLIFIER APPLICATIONS, http://www.ti.com/lit/an/sboa092b/sboa092b.pdf

[T2] Thomas L. Floyd, "Electronics Devices", Pearson Education.

[T3] Mottershed, "Electronics Devices & Circuits", PHI New Delhi

[T4] Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd edition, PearsonEducation.

[T5] Linear Integrated Circuits and its Applications: https://www.ti.com/seclit/ml/ssqu016/ssqu016.pdf

[T6] http://www.ti.com/lit/ds/symlink/tps40200.pdf

[T7] www.ti.com/lit/ds/symlink/lm35.pdf

[T8] AIP Handbook of Modern Sensors: Physics, Design and Applications, Jacob Fraden, American Institute of Physics.

Reference Books:

[R1] K. R. Botkar, "Integrated Circuits", Khanna Publication, New Delhi.

[R2] James, "Operational Amplifier and Linear Integrated Circuits Theory and Application." P John Paul, "Electronics Devices and circuits", New Age international Publications.

[R3] P. S. Bimbhra, "Power Electronics", Khanna Publications

[R4] http://www.ti.com/lit/an/sboa092b/sboa092b.pdf

[R5] The Signal e-Book, Texas Instruments

[R6] http://www.ti.com/lit/ds/symlink/uaf42.pdf

[R7] https://www.ti.com/lit/ds/symlink/mpy634.pdf

[R8] www.ti.com/lit/ds/symlink/mux506.pdf

[R9] www.ti.com/lit/ds/symlink/hdc1080.pdf

[R10] The fundamentals of millimeter wave, Texas Instruments

[R11] www.ti.com/lit/ds/sbos864/sbos864.pdf

Unit	Text Books	Reference Books
1	T1, T2, T3	R1, R2, R6
2	T4, T5, T6	R3, R4, R5, R6, R7
3	-	R6, R8, R9
4	T7, T8	R6, R10
5	T8	R6, R11
6	T8	R6, R12

Elective –IV : 403150 (A): Smart Grid

Teaching Scheme	Credit	Examination Scheme [100 Marks]
Theory : 03 Hrs / Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite: Knowledge of power system and power electronics

Course Objective: The course aims:-

- To explain the concept of Smart Grid, compare with conventional grid, and identify its opportunities and barriers.
- To describe the concept of Smart Meter, Smart Appliances, Automatic Meter Reading, Outage Management System, Plug in Hybrid Electric Vehicles, Vehicle to Grid, Smart Sensors, Home and Building Automation, Phase Shifting Transformers.
- To elaborate the concept of Substation Automation, Feeder Automation. Intelligent Electronic Devices, Smart storage like Battery, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System, Phase Measurement Unit.
- To elaborate the concept of microgrid
- To acquaint Power Quality issues of Grid connected Renewable Energy Sources, Web based Power Quality monitoring, Power Quality Audit.

Course Outcome:

1. Apply the knowledge to differentiate between Conventional and Smart Grid.
2. Identify the need of Smart Grid, Smart metering, Smart storage, Hybrid Vehicles, Home Automation, Smart Communication, and GIS
3. Comprehend the issues of micro grid
4. Solve the Power Quality problems in smart grid
5. Apply the communication technology in smart grid

Unit 01 : Introduction to Smart Grid: (06 Hrs)

Concept of Smart Grid, Need of Smart Grid, Functions of Smart Grid, Opportunities and Barriers of Smart Grid, Drivers of SG in India, Functionalities and key components of smart grid, Difference between conventional and smart grid, Smart Grid Vision and Roadmap for India, Concept of Resilient and Self-Healing Grid, Present development and International policies in Smart Grid, Smart Cities, Pilot projects in India.

Unit 02 : Smart Grid Technologies (06 Hrs)

Remote Terminal Unit (RTU):Block diagram and function of each block, Intelligent Electronic Devices (IED), Phase Measurement Unit (PMU). Smart Substations, Substation and Feeder Automation, application for monitoring, protection and control, Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid(V2G), Grid to vehicles(G2V), Smart storage technologies and applications – Battery(flow and advanced), SMES, Super Capacitors, Compressed Air Energy Storage(CAES) and its comparison, Optimal location of PMUs for complete Observability.

Unit 03 : Smart Meters and Advance Metering Infrastructure: (06 Hrs)

Introduction to Smart Meters, Advanced Metering Infrastructure (AMI), Real Time Prizing, Automatic Meter Reading (AMR), Outage Management System (OMS) Smart Sensors, Smart Appliances, Home and Building Automation, Geographic Information System (GIS).

Unit 04 : Microgrids: (06 Hrs)

Concept of Microgrid, need and applications of Microgrid, Microgrid Architecture, DC Microgrid, Formation of Microgrid, Issues of interconnection, protection and control ofMicrogrid, Integration of renewable energy sources, Smart Microgrid, Microgrid and Smart Grid Comparison, Smart Microgrid Renewable Green Energy System, Cyber Controlled Smart Grid.

Unit 05 : Power Quality Management in Smart Grid (06 Hrs)

Power Quality and EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Unit 06 : Communication Technology for Smart Grid (06 Hrs)

Communication Architecture of SG, Wide Area Measurement System (WAMS), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN)., ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing and Cyber Security for Smart Grid, Broadband over Power line (BPL).

Text Books:

[T1] Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley

[T2] Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press

[T3] Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley Publications.

[T4] Stuart Borlase, "Smart Grids-Infrastructure, Technology and Solutions", CRC Press, Taylor and Francis group

[T5] James Momoh, "Smart Grid-Fundamentals of design and analysis", Wiley Publications.

Reference Books:

[R1] Nikos Ziargyriour, "Micro grid, Architecture and Control", IEEE Press, Wiley Publications.

[R2] Yang Xiao, "Communication and Networking in Smart Grids", CRC Press, Taylor and Francis group

[R3] Lars T. Berger and Krzysztof Iniewski, "Smart Grid-Applications, Communications and Security", Wiley Publications.

[R4] Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer Publications.

[R5] Smart grid handbook for regulators and policy makers November 2017,ISGF

Unit	Text Books	Reference Books
1	T1,T3,T5	R5
2	T1	R5
3	T1,T4	R4, R5
4	T1,T3	R5, R1
5	T5,T2	R5, R2
6	T4	R2, R3, R5

Elective – IV : 403150 (B): Robotics and Automation

Teaching Scheme	**Credits**	**Examination Scheme [100Marks]**	
Theory : 03 Hrs./Week	03	In Sem	: 30 Marks
		End Sem	: 70 Marks

Course Objective: The course aims to:-

- To know basic parts of a typical industrial robot system with its anatomy with human body.
- To analyze mathematically kinematic and dynamic modeling of a typical robot manipulator.
- To select an appropriate type of robot with given specifications for different industrial applications.
- To know the basics of actuators, sensors and control of an industrial robot for different applications

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Differentiate between types of robots based on configuration, method of control, types of drives, sensors used etc.
2. Choose a specific robot for specific application with given specifications.
3. Analyze the robot arm dynamics for calculation of torques and forces required for different joints of robots for control of robot arm.
4. Determine the D-H parameters for a robot configuration using concepts from robot arm kinematics which further leads to forward/inverse kinematics.
5. Calculate the Jacobian matrix for robot arm velocity and decide the singular positions.

Unit 01 : Introduction (06 Hrs)

Robot components, Degrees of freedom, Robot joints, Robot reference frames,Robot specifications: repeatability, spatial resolution, compliance, load carrying capacity, speed of response, work volume, work envelope, reach etc., end effectors (Wrist), concept of: yaw, pitch and roll. Robot classification: according to Co-ordinate system: Cartesian, cylindrical, spherical, SCARA, Articulated, Control Method: Servo controlled and non-servo controlled, their comparative study, formof motion: P-T-P (point to point), C-P (continuous path), pick and place etc. and their comparative study.

Unit 02 : Mathematical preliminaries (06 Hrs)

Homogeneous Coordinate, Translational Transformation, Rotational Transformation, coordinate reference frames, Effect of pre and post multiplication of transformation, Concept of Homogeneous transformation, Euler angles and singularities

Unit 03 : Forward Kinematics (06 Hrs)

Denavit-Hartenberg (D-H) representation of kinematic chains. Rules for establishing link co-ordinate frames. Forward solution of robotic manipulator for SCARA Robot and PUMA Robot. Forward solution for simple robot systems.

(06 Hrs)

Unit 04 :

Inverse Kinematics: Concept of Inverse Kinematics, general properties of inverse solution such as existence and uniqueness of solution, inverse solution by direct approach, Geometric approach, inverse solution for simple SCARA Robots, numericals for simple three axis robots based on direct approach.

Robot Dynamics: Lagrange's Equation, Kinetic and potential energy Equations, Euler-Lagrange analysis for a single prismatic joint working against gravity and single revolute joint. Equation of motion.

Unit 05 : Differential motion and Control **(06 Hrs)**

Manipulator Differential Motion: Concept of linear and angular velocity, Relationship between transformation matrix and angular velocity, manipulator Jacobian, Jacobian for prismatic and revolute joint, Jacobian Inverse, Singularities.

Control of Robot Arm: Modeling of DC motor and load, closed loop control in position servo, the effect of friction and gravity, control of a robotic joint, position velocity and acceleration profiles for trapezoidal velocity profile.

Control of Robot manipulator: joint position controls (JPC), resolved motion position controls (RMPC) and resolved motion rate control (RMRC).

Unit 06 : Actuators and Sensors **(06 Hrs)**

Drive Technology: Hydraulic, Pneumatic, Electric (stepper motor, D.C. servo motor, BLDC Motors) in detail with selection criteria. Sensors in servo control system: Resolver, rotary shaft encoders, potentiometers, tacho-generators.

Industrial Applications of Robots: Welding, Spray-painting, Grinding, Handling of rotary tools, Parts handling/transfer, Assembly operations, parts sorting, parts inspection, Potential applications in Nuclear and fossil fuel power plant etc. (Details for the above applications are selection criterion of robots, sensors used, selection of drives and actuators, methods of control, peripheral devices used etc).

Industrial Visit: At least one industrial visit should be arranged supporting the classroom teaching and student should submit a report on that industrial robot application including type of robot, method of control, type of application, sensor interface, method of programming etc.

Text Books:

[T1] Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Ashish Dutta, "Industrial Robotics:Technology, Programming and Applications", Tata- McGraw Hill Education Private Limited, New Delhi, 2012.

[T2] Richard D. Klafter, Thomas A. Chemielewski, Michael Neign, "Robotic Engineering – An IntegralApproach", Prentice Hall of India Pvt. Ltd., New Delhi. Eastern Economy Edition.

[T3] Robert J. Schilling, "Fundamentals of Robotics: Analysis and Control", Prentice Hall of India, New Delhi

Reference Books:

[R1] K. S. Fu, R. C. Gonzalez, C. S. G. Lee, "Robotics: Control Sensing, Vision and Intelligence", International Edition, McGraw Hill Book Co.

[R2] John J. Craig, "Introduction to Robotics: Mechanics and Control", Pearson Education

[R3] R. K. Mittal, I. J. Nagrath, "Robotics and Control", Tata McGraw Hill Publishing Company Ltd., New Delhi.

[R4] Saeed b. Niku, "Introduction to Robotics: Analysis, Control, Applications", Wiley Publication, 2011.

Unit	Text Books	Reference Books
1	T1,T2	R3
2	T1,T2,T3	R1, R2,R3,R4
3	T1,T2,T3	R1,R3,R4
4	T1,T2,T3	R1,R3,R4
5	T2, T3	R1,R2, R3
6	T2	R1

Elective IV :403150 (C): Illumination Engineering

Teaching Scheme	Credits	Examination Scheme [100Marks]
Theory : 03 Hr/Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite:
The working of the conventional lamps, generation of light and physics of light, techniques for natural and artificial lighting

Course Objective: The course aims :-

- To explain conventional and modern lamps and their accessories.
- To get detailed insight of indoor and outdoor illumination system components, control and design aspects.
- To know the requirements of energy efficient lighting.
- To introduce the modern trends in the lighting

Course Outcome: Upon successful completion of this course, the students will be able to :-

1. Define and reproduce various terms in illumination.
2. Identify various parameters for illumination system design.
3. Design indoor and outdoor lighting systems.
4. Enlist state of the art illumination systems.

Unit 01 : Importance of Lighting in Human Life (05 Hrs)
Optical systems of human eye, Dependence of human activities on light, performance characteristics of human visual system, External factors of vision-visual acuity, contrast, sensitivity, time illuminance, colour, visual perception, optical radiation hazards, Good and bad effects of lighting and perfect level of illumination, Artificial lighting as substitute to natural light, Ability to control natural light, Production of light, physics of generation of light, Properties of light, Quantification and Measurement of light.

Unit 02 : Light Sources and Electrical Control of Light Sources (08 Hrs)
(A) Light Sources- Lamp materials: Filament, glass, ceramics, gases, phosphors and other metals and non-metals. Discharge Lamps: Theory of gas Discharge phenomena, lamp design considerations, characteristics of low and high pressure mercury and Sodium vapour lamps, Low Vapour Pressure discharge lamps - Mercury Vapour lamp, Fluorescent Lamp, Compact Fluorescent Lamp (CFL)

High Vapour Pressure discharge lamps - Mercury Vapour lamp, Sodium Vapour lamp, Metal halide Lamps, Solid Sodium Argon Neon lamps, SOX lamps, Electro luminescent lamps, Induction lamps.

Ballast, ignitors and dimmers for different types of lamps

(B) Control of Light Sources
Photometric Control of Light Sources and their Quantification: Types of Luminaries, factors to be considered for designing luminaries Types of lighting fixtures.

Optical control schemes, design procedure of reflecting and refracting type of luminaries. Lighting Fixture types, use of reflectors and refractors, physical protection of lighting fixtures, types of lighting fixtures according to installation type, types of lighting fixtures according to photometric usages, luminaries standard (IEC-598-Part I).

Unit 03 : Design Considerations for illumination schemes (04 Hrs)

Zonal cavity method for general lighting design, determination for zonal cavities and different shaped ceilings using COU (coefficient of utilization), beam angles and polar diagrams. Factors to be considered for design of indoor illumination scheme

Unit 04 : Design of lighting schemes-I (06 Hrs)

Indoor illumination design for following installations-

Residential (Numerical)
Educational institute
Commercial installation
Hospitals
Industrial lighting
Special purpose lighting schemes
Decorative lighting
Theatre lighting
Aquarium, swimming pool lighting

Unit 05 : Design of lighting schemes-II (08 Hrs)

Factors to be considered for design of outdoor illumination scheme

Outdoor Lighting Design: Road classifications according to BIS, pole arrangement, terminology, lamp and luminaries' selection, different design procedures, beam lumen method, point by point method, isolux diagram, problems on point by point method.

Outdoor illumination design for following installations:

Road lighting (Numerical)
Flood lighting (Numerical)
Stadium and sports complex
Lighting for advertisement/hoardings

Unit 06 : Modern trends in illumination (05 Hrs)

LED luminary designs
Intelligent LED fixtures
Natural light conduiting
Organic lighting system
LASERS, characteristics, features and applications, non-lighting lamps
Optical fiber, its construction as a light guide, features and applications

Text Books:

[T1] H. S. Mamak, "Book on Lighting", Publisher International lighting Academy.
[T2] Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher -York, PA : Visions Communications
[T3] M. A. Cayless, A. M. Marsden, "Lamps and Lighting", Publisher-Butterworth-Heinemann(ISBN 978-0-415-50308-2)
[T4] Designing with light: Lighting Handbook., Anil Valia; Lighting System 2002

Reference Books:

[R1] "BIS, IEC Standards for Lamps, Lighting Fixtures and Lighting", Manak Bhavan, New Delhi.

[R2] D. C. Pritchard, "Lighting", 4th Edition, Longman Scientific and Technical, ISBN 0-582-23422-0.

[R3] "IES Lighting Handbook", (Reference Volume 1984), Illuminating Engineering Society of North America.

[R4] "IES Lighting Handbook", (Application Volume 1987), Illuminating Engineering Society of North America

[R5] IESNA lighting Handbook., Illuminating Engineering Society of North America 9th edition 2000

[R6] Applied Illumination Engineering, Jack L. Lindsey FIES (Author), Scott C. Dunning PHD PECEM (Author) ,ISBN-13: 978-0824748098 ISBN-10: 0824748093, 3rd Edition.

[R7] IS 3646: Part I: 1992, Code of practice for interior illumination.

[R8] Organic Light Emitting Diodes (OLEDs): Materials, Devices and Applications, Alastair Buckley, University of Sheffieid, UK, ISBN: 978-0-85709-425-4.

Unit	Text Books	Reference Books
1	T1,T4	R6
2	T3,T4	R1,R3,R4,R8
3	T2,T4	R2,R3,R7
4	T3,T4	R2,R3,R4,R5,R7
5	T3,T2,T4	R3,R4,R6,R7
6	T1,T2,T4	R8,R5,R3,R2

403150 (D) : VLSI Design [Open Elective]

Teaching Scheme	Credits	Examination Scheme [100 Marks]
Theory : 03 Hrs. /Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite : Concepts of Digital Electronics, Number systems, any programming language like C

Course Objective: The course aims to:-
- Develop Digital designing skills of Students
- Train the students for Hardware Description Language.
- Develop various applications using VHDL coding.

Course Outcome: Upon successful completion of this course, the students will be able to :-
1. To understand Modeling of Digital Systems Domains for different combinational and sequential circuits
2. To understand Levels of Modeling using Modeling Language VHDL.
3. To Understand Modeling and programming Concepts by Learning a New Language
4. To develop of logic design and programming skills in HDL language.
5. To study HDL based design approach.
6. To learn digital CMOS logic design

Unit 01 : Overview of Digital Logic Circuits and Introduction to VLSI (06 Hrs)
Combinational circuits: Decoders, Multiplexer, ALU. Sequential circuits: latch, flip flop – RS, JK, D,T., shift registers ,Counters, Moore, Mealy Machines. Introduction to VLSI: complete VLSI design flow (with reference to an EDA tool), IEEE Standards ,VHDL Terms Definitions – Entity, architecture, Schematic, Components, Configuration.

Unit 02 : VHDL Modeling (06 Hrs)
Data objects, Data types, Entity, Architecture and types of modeling: Behavioral, data flow, and Structural with the help of digital functions like multiplexer, Shift Register, counter. Sequential statements, Concurrent statements. VHDL Test bench. VHDL modeling of Combinational, Sequential logics.

Unit 03 : VHDL and Finite State Machines (06 Hrs)
Synthesizable and non synthesizable statements, functions, procedures, attributes, configurations, packages. Synchronous and asynchronous machines, Finite State Machines (FSM), metastability, state diagrams and VHDL codes for FSMs.

Unit 04 : Programmable Logic Devices (PLDs) (06 Hrs)
Need of PLDs. Comparison with ASIC, general purpose processor, DSP processor, microcontroller, memories etc. Features, specifications, detail architectures, application areas, limitations of Complex Programmable Logic Device (CPLD) and Field Programmable Logic Devices (FPGA).

Unit 05 : Digital CMOS Design (06 Hrs)
CMOS INVERTER, CMOS NAND and CMOS NOR, voltage transfer curve, body effect, hot electron effect, velocity saturation. Static and dynamic dissipations. Power delay product. Noise margin. Combinational logic design, comparison of CMOS and NMOS. Comparative study of TTL, ECL, CMOS.

Unit 06 : VLSI Design Applications (06 Hrs)

Barrel shifter, signed and unsigned comparators, Carry ripple and carry look, Ahead address, Fixed- point division, serial data receiver, parallel to serial converter, playing with a seven segment display and key board, signal generators, memory design, Vending - Machine controller.

Text Books:

[T1] Douglas Perry, "VHDL", Tata McGraw Hill.

[T2] John F. Wakerly, "Digital Design, Principles and Practices", Prentice Hall Publication

[T3] Wolf, "Modern VLSI Design", Pearson Education.

[T4] R.P.Jain, "Modern Digital electronics", 3rd edition, Tata McGraw-Hill.

[T5] Donald P. Leach, Albert Paul Malvino, "Digital Principles and Applications", Glencoe Publisher.

[T6] Neil H. Weste and Kamran, "Principles of CMOS VLSI Design", Pearson Publication.

Reference Books:

[R1] Charles H. Roth, "Digital System Design Using VHDL", PWS Publishing Company (Thomson Learning) 2.

[R2] Sung-Mo(Steve) Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata McGraw Hill Publication.

[R3] J. Bhaskar, "VHDL Primer", 3rd Edition, Addison Wesley Longman Singapore Pte Ltd.

[R4] Volner A. Dedroni, "Circuit Design with VHDL", PHI Publications

[R5] Xilinx Data Manual "The Programmable Logic Data Book".

[R6] LizyKurian John, "Principles of Digital Systems Design and VHDL" Paperback – 2008 .

[R7] Peter J. Ashenden (Author), Jim Lewis, " VHDL-2008: Just the New Stuff", (Systems on Silicon) Paperback – Import, 7 Dec 2007.

[R8] Data Sheets of PLDs.

Unit	Text Books	Reference Books
1	T2,T4,T5	R3, R6
2	T1,T3	R3, R4, R7
3	T2,T1	R1, R6
4	T2	R5, R8
5	T6	R2
6	T2,T3	R6

403151: Project II

Teaching Scheme	Credits	Examination Scheme [150 Marks]
Tutorial : 06 Hrs./Week	06	Oral : 50 Marks Term work : 100 Marks

Course Objectives:

- To explore and to acquire specified skill in areas related to Electrical Engineering
- To develop skills for carrying literature survey and organize the material in proper manner.
- To provide opportunity of designing and building complete system/subsystem based on their knowledge acquired during graduation.
- To understand the needs of society and based on it to contribute towards its betterment and to learn to work in a team.
- To ensure the completion of given project such as fabrication, conducting experimentation, analysis, validation with optimized cost.
- Present the data and results in report form
- Communicate findings of the completed work systematically.

Course outcomes: Students will be able to

- Work in team and ensure satisfactory completion of project in all respect.
- Handle different tools to complete the given task and to acquire specified knowledge in area of interest.
- Provide solution to the current issues faced by the society.
- Practice moral and ethical value while completing the given task.
- Communicate effectively findings in verbal and written forms.

Guidelines :

The student shall complete the remaining part of the project which is an extension of the work carried out in VIIth Semester. For exceptional cases, change of topic has to be approved by Internal Assessment Committee consisting of Guide, Project Coordinator and Head of Department.
Student should incorporate suggestions given by examiner in project I.
The student shall complete the remaining part of the project which consists of design, simulation, fabrication of set up required for the project, analysis and validation of results and conclusions.
The student shall prepare duly certified final report of the project work in the standard format in MS Word / LaTex.
Student should maintain Project Work Book.

Audit Course VI : 403153: Energy Storage Systems

Teaching Scheme
Theory : 02 Hrs. / Week
Field visit : 1 Day

Examination Schemes: Audit (P/F)
Written / MCQ / Term paper

Course Objectives:

- To elaborate various energy storage systems
- To be familiar with various aspects such as hybridization, selection and sizing of energy storage systems

Course Outcomes:

On completion of the course, students will be able to:-

- Explain and differentiate various types of energy storage systems

Energy Storage Systems:

1. Introduction to Energy Storage System: need, its types and applications.

a) Battery as an energy storage device, its types, Basic terms related to battery Energy Storage System such as Energy Density, Power Density, Cycle Life, C_{10} Rating, State of Charge (SOC), Depth of Discharge (DOD), its characteristics and analysis of various batteries.

b) Types of Batteries: Characteristics, construction, economics, development status, future trends in batteries such as advanced lead-acid, lithium ion, polymer, Ni-Cd, metal hydride, sodium, and various types of flow batteries (vanadium, zinc, manganese, etc.).

c) Fuel Cell as an energy storage device and its analysis.

d) Supercapacitor as an energy storage device and its analysis.

e) Superconducting Energy Storage as an energy storage device and its analysis.

f) Flywheel as an energy storage device and its analysis.

Hybridization of different energy storage devices.

Sizing and selecting the energy storage technology and its supporting subsystems.

2. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV) Introduction to energy management strategies used in hybrid and electric vehicles.

Experiments: There shall be a 3-4 exercises based on MATLAB and Simulink related to **Battery** energy storage, **Fuel Cell** energy storage and **Supercapacitor** energy storage.

Industrial Visit: Industrial visit to manufacturing industry of battery/ supercapacitor.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for Final Year of Mechanical Engineering

(Course 2015)

Savitribai Phule Pune University, Pune

BE (Mechanical Engineering) (2015 Course) Semester – VII

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits		
		Lect	Tut	Pract	In-Sem	End-Sem	TW	PR	OR		TH	TW	OR/ PR
402041	Hydraulics and Pneumatics	3	-	2	30	70	25	-	25	150	3	-	1
402042	CAD CAM Automation	3	-	2	30	70	25	50	-	175	3	-	1
402043	Dynamics of Machinery	4	-	2	30	70	25	-	25	150	4	-	1
402044	Elective-I	3	-	2	30	70	25	-	-	125	3	1	-
402045	Elective-II	3	-	-	30	70	-	-	-	100	3	-	-
402046	Project Stage-I	-	-	4	-	-	25	-	25	50	-	1	1
Total		16	-	12	150	350	125	50	75	750	16	2	4
											22		

B. E. (Mechanical Engineering) (2015 Course) Semester – VIII

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits		
		Lect	Tut	Pract	In-Sem	End-Sem	TW	PR	OR		TH	TW	OR/ PR
402047	Energy Engineering	3	-	2	30	70	25	-	25	150	3	-	1
402048	Mechanical System Design	4	-	2	30 (1.5 hrs)	70 (3 hrs)	25	-	50	175	4	-	1
402049	Elective-III	3	-	2	30	70	25	-	--	125	3	1	-
402050	Elective-IV	3	-	-	30	70	-	-	-	100	3	-	-
402051	Project Stage-II	-	-	12	-	-	100	-	100	200	-	3	3
Total		13	-	18	120	280	175	-	175	750	13	4	5
											22		

Elective – I		Elective – II	
Code	Subject	Code	Subject
402044 A	Finite Element Analysis	402045 A	Automobile Engineering
402044 B	Computational Fluid Dynamics	402045 B	Operation Research
402044 C	Heating Ventilation and Air Conditioning	402045 C	Energy Audit and Management
		402045 D	Open Elective**
Elective – III		**Elective – IV**	
402049 A	Tribology	402050 A	Advanced Manufacturing Processes
402049 B	Industrial Engineering	402050 B	Solar & Wind Energy
402049 C	Robotics	402050 C	Product Design and Development
		402050 D	Open Elective**

: Open Elective – Board of studies (BoS) – Mechanical and Automobile Engineering will declare the list of subjects, which can be taken under open electives or any other Electives that are being taught in the current semester, to the same level, as Elective – II and Elective -IV under engineering faculty in the individual college and Industry can define new elective subject with proper syllabus using defined framework of Elective II and Elective IV and ***get it approved from board of studies and other necessary statutory systems in the Savitribai Phule Pune University, Pune, before 30th November* of previous academic year in which the subject to be introduced . Without prior approval from University statutory system, no one can introduce the open elective in curriculum.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402041 **Course Name : Hydraulics and Pneumatics**

Teaching Scheme:		Credits		Examination Scheme:					
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem	: 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem	: 70	OR	: 25
							TW	: 25

Pre-requisites	: Fluid Mechanics, Manufacturing Processes and Machines, Mechatronics

Course Objectives:

- To study governing laws used in fluid power systems
- To study fluid power applications
- To study working principles of various components
- To study selection of different components
- To study how to design fluid power systems
- To study low cost automation

Course Outcomes:

On completion of the course, students will be able to -

- Understand working principle of components used in hydraulic & pneumatic systems
- Identify various applications of hydraulic & pneumatic systems
- Selection of appropriate components required for hydraulic and pneumatic systems
- Analyse hydraulic and pneumatic systems for industrial/mobile applications
- Design a system according to the requirements
- Develop and apply knowledge to various applications

Course Contents

Unit 1: Basics of Fluid Power and Pumps **6 Hrs**

Fluid power basics, advantages and limitations, fluid power distribution, standard symbols, energy loss in hydraulic systems.

Pumps - types, classification, principle of working and constructional details of vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, and characteristics curves.

Unit 2: Actuators and Power Unit **6 Hrs**

Linear and rotary actuators- types, construction and characteristics. Cylinder mountings, cushioning of cylinders.

Power units and accessories - types of power units, reservoir assembly, constructional details. Accumulators, Intensifiers, Pressure and Temperature switches /sensors, level sensors.

Unit 3: Fluid Power Control **6 Hrs**

Direction control valves - center positions, methods of actuation, two stage valves, Flow control valves - pressure and temperature compensated. Pressure control valves - pressure reducing valve, sequence valve, unloading valve, brake valve, back pressure valve, counter balance valve, check valves, prefill valve, servo valves, cartridge valves, proportional valves.

Unit 4: Hydraulic Circuits and Contamination Control **6 Hrs**

Hydraulic circuits: Simple reciprocating, regenerative, speed control (meter in, meter out and bleed off), sequencing, synchronization, traverse and feed, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, unloading circuit, motor breaking circuit etc.

Contamination control: Contamination, sources of contamination, suction strainer, filters, filtration, filter ratings.

Unit 5: Pneumatics – Components, Control Valves and Circuits **6 Hrs**

Compressors - Types, principle of working and constructional details. Comparison of pneumatic with hydraulic power transmissions. Types of filters, pressure regulators, lubricators, mufflers, dryers, direction control valves, pneumatic actuators, shuttle valve, two pressure valve, quick exhaust valve and time delay valves, electro-pneumatics. Speed regulating methods, pneumatic circuits, reciprocating, cascading time delay etc. Application of pneumatics in low cost automation and in industrial automation.

Unit 6: System Analysis and Design **6 Hrs**

Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads, design considerations for cylinders, Design of hydraulic/pneumatic circuits for practical application, selection of different components such as reservoir, control elements, actuators, accumulator, intensifier, filters, pumps. (Students are advised to refer manufacturers' catalogues for design and use simulation tool like Automation Studio for analysis).

Books

Text :

1. Esposito A, Fluid Power with application, Prentice Hall
2. Majumdar S.R, Oil Hydraulic system- Principle and maintenance ,Tata McGraw Hill
3. Majumdar S.R, Pneumatics Systems Principles and Maintenance ,Tata McGraw Hill
4. Stewart H. L, Hydraulics and Pneumatics , Taraporewala Publication

References :

1. Pipenger J.J, Industrial Hydraulics, McGraw Hill
2. Pinches, Industrial Fluid Power, Prentice Hall
3. Yeaple, Fluid Power Design Handbook
4. Andrew A. Parr, Hydraulics and Pneumatics, Elsevier Science and Technology Books
5. ISO - 1219, Fluid Systems and components, Graphic Symbols
6. Standard Manufacturer's Catalogues

Term Work shall consist of following experiments and assignments:

1. Test on Gear/Vane/Piston pump and plotting performance characteristics
2. Following experiments to be done on hydraulic trainer (any 3)
    a) Regenerative circuit
    b) Speed control circuit
    c) Sequencing circuit
    d) Traverse and feed circuit etc.
3. Following experiments to be done on pneumatic trainer (any 3)

a) Automatic reciprocating circuit
b) Speed control circuit
c) Pneumatic circuit involving Shuttle valve/ Quick exhaust valve / Two pressure valve
d) Electro pneumatic circuits

4. Test on pressure relief valve/flow control valve
5. Test on linear /rotary actuator
6. Design of simple hydraulic systems used in practice using manufacturers' catalogue and analysis using software.
7. Design of simple pneumatic systems used in practice using manufacturers' catalogue and analysis using software.
8. Industrial visit to study Hydraulic / Pneumatic based Automation systems
9. Assignment: Symbols for different components as per standards
10. Assignment: Trouble shooting procedures
11. Assignment: Standard specifications of hydraulic/ pneumatic components using manufacturer's catalogues.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402042 **Course Name : CAD CAM and Automation**

Teaching Scheme:		Credits		Examination Scheme:		
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR : 50
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR : --
						TW : 25

Pre-requisites	: Engineering Graphics, Engineering Mathematics, Numerical Methods & Optimization, Computer Aided Machine Drawing, Strength of Materials, Manufacturing Processes

Course Objectives:

- To apply homogeneous transformation matrix for geometrical transformations of 2D/3D CAD entities
- To model mathematically analytical and synthetic curves, surfaces
- To predict performance of simple mechanical components viz. beam, shafts, plates, trusses using FEA (Mathematical and Software treatment)
- To generate CNC program for appropriate manufacturing techniques viz. turning and milling
- To select and apply suitable Rapid Prototyping techniques for engineering applications
- To study role and components of different Automation strategies.

Course Outcomes:

On completion of the course, students will be able to -

- Apply homogeneous transformation matrix for geometrical transformations of 2D CAD entities for basic geometric transformations.
- Use analytical and synthetic curves and surfaces in part modeling.
- Do real times analysis of simple mechanical elements like beams, trusses, etc. and comment on safety of engineering components using analysis software.
- Generate CNC program for Turning / Milling and generate tool path using CAM software.
- Demonstrate understanding of various rapid manufacturing techniques and develop competency in designing and developing products using rapid manufacturing technology.
- Understand the robot systems and their applications in manufacturing industries.

Course Contents

Unit 1: Computer Graphics **6 Hrs**

Transformations (2D & 3D) : Introduction, Formulation, Translation, Shear, Rotation, Scaling and reflection, Homogeneous representation, Concatenated transformation, Mapping of geometric models, Inverse transformations, Introduction to 3D transformation (Theory + Numerical treatment only for 2D – Max 3 vertices)

Projections : Orthographic, Isometric, Perspective projections (Only theory)

Unit 2: Geometric Modeling **6 Hrs**

Curves – Introduction, Analytical curves (Line, circle, ellipse, parabola, hyperbola), Synthetic curves (Hermite Cubic Spline, Bezier, B-Spline Curve) [Numerical on Line, Circle, Ellipse, Hermite Cubic

Spline, Bezier] *Surfaces* – Introduction, Surface representation, Analytic surfaces, Synthetic Surfaces, Hermite bicubic, Bezier, B-Spline, Coons patch surface, Applications in freeform surfaces [only Theory] *Solids* - Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry (CSG), Boolean operation for CSG [only Theory]	
Unit 3: Finite Element Analysis (FEA)	**6 Hrs**
Introduction : Brief History of FEM, Finite Element Terminology (nodes, elements, domain, continuum, Degrees of freedom, loads and constraints), General FEM procedure, Applications of FEM in various fields, meshing, p and h formulation, Advantages and disadvantages of FEM [Only theory] *One Dimensional Problem*: Finite element modeling, coordinate and linear shape function, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Temperature Effects. [Theory + Numerical – composite shaft, spring elements in series and parallel] *Trusses* : Introduction, 2D Trusses, Assembly of Global Stiffness Matrix [Numerical limited to 4X4 matrix]	
Unit 4: Computer Aided Manufacturing (CAM)	**6 Hrs**
Introduction to Computer Aided Manufacturing (CAM), Coordinate system, Working principal of CNC Lathe, Turning Centers, Milling Machine, Steps in developing CNC part program, Tool and geometric compensations, subroutine and Do loop using canned cycle. [Only theory – 2 hrs] *CNC Lathe part programming (FANUC)* : Linear and circular interpolation, Canned cycles for facing, threading, grooving, etc. [Theory + Program] *CNC Milling part programming (FANUC)*: Linear and circular interpolation, Pocketing, contouring and drilling cycles. [Theory + Program]	
Unit 5: Advanced Manufacturing Method	**6 Hrs**
Product Life Cycle: Introduction, Need, Components/Elements of PLM, Collaborative Engineering. [Only theory] *Rapid Prototyping* : Introduction, classification of RP Processes (SLA, LOM, SLS, FDM, 3D printing), Working principle, features, models & specification of process, application, advantages and disadvantages, Rapid Tooling and STL format, Concept of 4D Rapid Prototyping. [Only theory]	
Unit 6: Automation	**6 Hrs**
Automation : Introduction, Automation strategies, Types of Automation - Hard and Soft Automation, Flexible Manufacturing System – Types, Advantages, Limitations, AGVs and AS/RS [Only theory] *Group Technology*: Introduction, Coding Methods, Concepts of Computer Integrated Manufacturing (CIM) and Computer Aided Process Planning (CAPP), Variant & Generative methods of CAPP, advantages of CAPP. [Only theory] *Robotics*: RIA definition of Robot, Laws of robotics, Classification of robots, robot anatomy, Point to point and continuous path robotic systems, Joints, End Effectors, Grippers - Mechanical, Magnetic and Pneumatic, Applications. [Only theory]	
Books	
Text : 1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill Publishing Co. 2009	

2. Chandrupatla T. R. and Belegunda A. D. -Introduction to Finite Elements in Engineering - Prentice Hall India.
3. Nitin S. Gokhale, Practical Finite Element Analysis, Finite To Infinite; First Edition edition, ISBN-10: 8190619500 ISBN-13: 978-8190619509
4. S. K. Sinha, CNC Programming using Fanuc Custom Macro B, McGraw-Hill Professional
5. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

References :

1. Ibraim Zeid, Mastering CAD/CAM – Tata McGraw Hill Publishing Co. 2000
2. Segerling L. J. - Applied Finite Elements Analysis, John Wiley and Sons
3. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010
4. Rao P. N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
5. B. S. Pabla, M. Adithan, CNC Machines, New Age International, 1994
6. Groover M.P.-Automation, production systems and computer integrated manufacturing' - Prentice Hall of India
7. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer
8. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight, Product Design for Manufacture and Assembly, Third Edition ,CRC Press
9. Antti Saaksvuori, Anselmi Immonen, Product Life Cycle Management -Springer, 1st Edition, 2003

Term Work shall consist of following experiments and assignments:

1. Demonstration of Application Programming Interface (API).
2. Stress and deflection analysis of Beam (FEA).
3. Stress and deflection analysis of 2D truss (FEA).
4. Stress and deflection analysis of any Mechanical Component using FEA software and validate the results by analytical methods (FEA).
5. Tool path generation and simulation for Turning – Grooving and Threading with help of suitable software.
6. Tool path generation and simulation for Milling – Facing, Pocketing, Contouring and drilling, etc. with help of suitable software.
7. Case study on Rapid Prototyping - Exporting STL files from 3D CAD models, structure of STL files, etc.
8. Case study based on modeling and analysis of structural system (Industry Based)
9. Manufacturing of machine component using additive manufacturing or Using CNC simulator software.
10. Assignment on Robot simulation
11. Industrial Visit Report on Automation and Robotics

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402043 **Course Name : Dynamics of Machinery**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 04 Hrs Per Week	TH	: 04	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: 25
						TW	: 25

Pre-requisites:	Strength of Materials, Engineering Mechanics, Engineering Mathematics and Numerical Methods,

Course Objectives:

- To conversant with balancing problems of machines.
- To understand fundamentals of free and forced vibrations.
- To develop competency in understanding of vibration and noise in Industry.
- To develop analytical competency in solving vibration problems.
- To understand the various techniques of measurement and control of vibration and noise.

Course Outcomes:

On completion of the course, students will be able to -

- Apply balancing technique for static and dynamic balancing of multi cylinder inline and radial engines.
- Estimate natural frequency for single DOF undamped & damped free vibratory systems.
- Determine response to forced vibrations due to harmonic excitation, base excitation and excitation due to unbalance forces.
- Estimate natural frequencies, mode shapes for 2 DOF undamped free longitudinal and torsional vibratory systems.
- Describe vibration measuring instruments for industrial / real life applications along with suitable method for vibration control.
- Explain noise, its measurement & noise reduction techniques for industry and day today life problems.

Course Contents

UNIT 1: Single Degree of Freedom Systems – Free Vibration **10 Hrs**

Fundamentals of Vibration : Elements of a vibratory system, vector representation of S.H.M., degrees of freedom, Introduction to Physical and Mathematical modeling of vibratory systems : Bicycle, Motor bike and Quarter Car. types of vibration, equivalent stiffness and damping, formulation of differential equation of motion (Newton, D'Alembert and energy method)

Undamped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems.

Damped free vibrations: Different types of damping, Viscous damping – over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, Dry friction or coulomb damping - frequency and rate of decay of oscillations.

UNIT 2: Single Degree of Freedom Systems - Forced Vibrations **8 Hrs**

Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to rotating and reciprocating unbalance, base excitation, magnification factor, Force and Motion transmissibility, Quality Factor. Half power bandwidth method, Critical speed of shaft having single rotor of undamped systems.

UNIT 3: Two Degree of Freedom Systems – Undamped Vibrations **8 Hrs**

Free vibration of spring coupled systems – longitudinal and torsional, torsionally equivalent shafts, natural frequency and mode shapes, Eigen value and Eigen vector by Matrix method, Combined rectilinear and angular motion, Vibrations of Geared systems.

UNIT 4: Balancing **8 Hrs**

Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V engines.

UNIT 5: Measurement and Control of Vibration **8 Hrs**

A) Measurement: Vibration Measuring Instruments, Accelerometers, Impact hammer, Vibration shakers, Vibration Analyzer, Vibration based condition monitoring, Analysis of Vibration Spectrum, Standards related to measurement of vibration, Human response to vibrations.

B) Control : Vibration control methods, passive, semi active (Introduction to Electro-Rheological & Magneto-Rheological dampers) and active vibration control, control of excitation at the source, control of natural frequency, Vibration isolators, Tuned Dynamic Vibration Absorbers, Introduction to Torsional Damper

UNIT 6: Introduction to Noise **6 Hrs**

Fundamentals of noise Sound concepts, Decibel Level, white noise, weighted sound pressure level, Logarithmic addition, subtraction and averaging, sound intensity, noise measurement, sound fields, octave band, sound reflection, absorption and transmission, acoustic material & its characteristics, Noise control at the Source, along the path and at the receiver, pass-by-noise, Reverberation chamber, Anechoic Chamber, Human Exposure to Noise and Noise standards.

Books

Text :

1. S. S. Rao, Mechanical Vibrations, Pearson Education Inc. New Delhi.
2. G. K. Grover, Mechanical Vibrations, New Chand and Bros.,Roorkee
3. Wiiliam J Palm III, Mechanical Vibration, Wiley India Pvt. Ltd, New Delhi
4. Uicker J. John, Jr, Pennock Gordon R, Shigley Joseph E., Theory of Machines and Mechanisms, International Version, OXFORD University Press, New Delhi.
5. M L Munjal, Noise and Vibration Control, Cambridge University Press India

References :

1. Weaver, Vibration Problems in Engineering, 5th Edition Wiley India Pvt. Ltd, New Delhi.
2. Bell, L. H. and Bell, D. H., Industrial Noise Control – Fundamentals and Applications‖, Marcel Dekker Inc.
3. Alok Sinha, Vibration of Mechanical System, Cambridge university Press , India
4. Debabrata Nag, Mechanical Vibrations, Wiley India Pvt. Ltd, New Delhi.
5. Kelly S. G., Mechanical Vibrations, Schaums outlines, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

6. Meirovitch, L., Elements of Mechanical Vibrations‖, McGraw Hill.
7. Ver, Noise and Vibration Control Engineering, Wiley India Pvt. Ltd, New Delhi.
8. Bies, D. and Hansen, C., Engineering Noise Control - Theory and Practice, Taylor and Francis.
9. Shrikant Bhave, Mechanical Vibrations Theory and Practice, Pearson, New Delhi

Term Work shall consist of following experiments and assignments:

A] Compulsory Experiments (Sr. No. 1 to 6)

1. Balancing of wheel / rotor on computerized balancing machine OR Experimental verification of dynamic balancing of rotating masses.
2. To determine the natural frequency of damped vibration of single degree freedom system and to find it‘s damping coefficient.
3. To obtain frequency response curves of single degree freedom system of vibration for different amount of damping.
4. To verify natural frequency of torsional vibration of two rotor system and position of node.
5. To determine natural frequency of transverse vibration of beam using vibration analyzer.
6. Noise measurement and analysis using vibration Analyzer.

B] Any Two Experiments from the following :

1. To determine critical speed of shaft with single rotor.
2. Experimental verification of principle of dynamic vibration absorber.
3. Experiment on shock absorbers and to plot its characteristic curve.
4. A case study (Industrial visit / In-house) based on Conditioning Monitoring and Fault Diagnosis.

C] List of Compulsory Assignment :

1. Simulation (using suitable software) of free response of SDOF damped system to demonstrate different damping conditions by solving differential equation numerically.

OR

2. Simulation (using suitable software) of total response of SDOF damped system to harmonic excitation by solving differential equation numerically.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402044 A | **Course Name : Elective – I Finite Element Analysis**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : --**
						TW : 25

Pre-requisites	: Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

- To understand the philosophy and general procedure of Finite Element Method as applied to solid mechanics and thermal analysis problems.
- To familiarize students with the displacement-based finite element method for displacement and stress analysis and to introduce related analytical and computer tools.
- It provides a bridge between hand calculations based on mechanics of materials and machine design and numerical solutions for more complex geometries and loading states.
- To study approximate nature of the finite element method and convergence of results are examined.
- It provides some experience with a commercial FEM code and some practical modeling exercises .

Course Outcomes:

On completion of the course, students will be able to -

- Understand the different techniques used to solve mechanical engineering problems.
- Derive and use 1-D and 2-D element stiffness matrices and load vectors from various methods to solve for displacements and stresses.
- Apply mechanics of materials and machine design topics to provide preliminary results used for testing the reasonableness of finite element results.
- Explain the inner workings of a finite element code for linear stress, displacement, temperature and modal analysis.
- Use commercial finite element analysis software to solve complex problems in solid mechanics and heat transfer.
- Interpret the results of finite element analyses and make an assessment of the results in terms of modeling (physics assumptions) errors, discretization (mesh density and refinement toward convergence) errors, and numerical (round-off) errors.

Course Contents

Unit 1: Fundamental Concepts of FEA **6 Hrs**

Introduction: Solution methodologies to solve engineering problems, governing equations, mathematical modelling of field problems in engineering, discrete and continuous models.

Brief history of FEM, Finite Element terminology (nodes, elements, domain, continuum, degrees of freedom, loads & constraints), general steps involved in FEM, applications of FEM in various fields, advantages and disadvantages of FEM, consistent units system, essential and natural boundary conditions, symmetric boundary conditions.

Introduction to different approaches used in FEA : Direct approach, Variational formulation- Principal of Minimum Potential Energy (PMPE), Galerkin weighted residual method, Principle of Virtual Work, Rayleigh-Ritz method, relation between FEM and Rayleigh-Ritz method

Types of Analysis (Introduction) : Linear static analysis, Non-linear analysis, Dynamic analysis, Linear buckling analysis, Thermal analysis, Fatigue analysis, Crash analysis.

Unit 2: 1D Elements **6 Hrs**

Types of 1D elements, displacement function, global and local coordinate systems, polynomial form of interpolation functions- linear, quadratic and cubic, properties of shape function, primary and secondary variables.

Formulation of elemental stiffness matrix and load vector for bar, truss and beam using any approach, Formulation of load vector due to uniform temperature change (only for bar).

Assembly of global stiffness matrix and load vector, properties of stiffness matrix, half bandwidth, treatment of boundary conditions- elimination approach, stress and reaction forces calculations

Unit 3: 2D Elements **6 Hrs**

Two-Dimensional Stress Analysis: Plane Stress/Strain problems in 2D elasticity, constitutive relations

Constant Strain Triangle(CST), Liner Strain Rectangle (LSR), displacement function, Pascal's triangle, compatibility and completeness requirement, geometric isotropy, convergence requirements, strain filed, stress filed, Formulation of element stiffness matrix and load vector for Plane Stress/Strain problems

Assembly of global stiffness matrix and load vector, Boundary conditions, solving for primary variables (displacement), stress calculations

Unit 4: Isoparametric Elements and Numerical Integration **6 Hrs**

Concept of isoparametric elements, Terms isoparametric, super parametric and subparametric.

Coordinate mapping : Natural coordinates, Area coordinates (for triangular elements), higher order triangular and quadrilateral elements (Lagrangean and serendipity elements), geometry associative mesh, quality checks, mesh refinement- p vs h refinements, Uniqueness of mapping - Jacobian matrix.

Numerical integration: Gauss Quadrature in one and two dimension, Order of Gauss integration, full and reduced integration, sub-modeling, substructuring.

Unit 5: 1D Steady State Heat Transfer Problems **6 Hrs**

Introduction, One dimensional steady-state heat transfer problem- Governing differential equation, Finite Element formulation using Galerkin's approach for composite wall and thin Fin , essential and natural boundary conditions and solving for temperature distribution

Unit 6: Dynamic Analysis **6 Hrs**

Types of dynamic analysis, general dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar, truss and beam element.

Undamped-free vibration: Eigenvalue problem, evaluation of eigenvalues and eigenvectors (characteristic polynomial technique).

Books

Text :

1. Daryl L, A First Course in the Finite Element Method,. Logan, 2007.
2. G Lakshmi Narasaiah, Finite Element Analysis, B S Publications, 2008.
3. Y.M.Desai, T.I.Eldho and A.H.Shah, Finite Element Method with Applications in Engineering, Pearson Education, 2011
4. Chandrupatla T. R. and Belegunda A. D., Introduction to Finite Elements in Engineering, Prentice Hall India, 2002.
5. P., Seshu, Text book of Finite Element Analysis, PHI Learning Private Ltd. , New Delhi, 2010.

References :

1. Bathe K. J., Finite Element Procedures Prentice, Hall of India (P) Ltd., New Delhi.
2. R. D. Cook, et al., Concepts and Applications of Finite Element Analysis. Wiley, India
3. Kwon Y. W., Bang H., Finite Element Method using MATLAB, CRC Press, 1997
4. Peter Kattan, MATLAB Guides to Finite Elements- An Interactive Approach, Springer, 2008.
5. S. Moaveni, Finite element analysis, theory and application with Ansys, Prentice Hall
6. Erdogan Madenci and Ibrahim Guven, "The Finite Element Method and Applications in Engineering Using Ansys", Springer, 2006.
7. David V. Hutton, Fundamental of Finite Element Analysis, Tata McGraw-Hill
8. Gokhale N. S., et al., Practical Finite Element Analysis, Finite to Infinite, Pune, 2008.

Term Work shall consist of following assignments:

Practical's to be performed: Minimum 7 including

- Any three practical's *from Practical No. 1 to 4** and
- Any three practical *from Practical No. 5 to 9***
- in Open source or Commercial Software

1. Computer program for stress analysis of 1D bar using linear and quadratic elements. Show the variation of stress and strain within the element for linear and quadratic bar element
2. Computer program for stress analysis of 2-D truss subjected to plane forces
3. Computer programs for (i) modal analysis and, (ii) stress analysis for 1-D beam (simply supported or cantilever beams)
4. Computer program for 1-D temperature analysis
5. Static stress concentration factor calculation for a plate with center hole subjected to axial loading in tension using FEA software
6. Modal analysis of any machine component using FEA software.
7. Stress and deflection analysis of any machine component consisting of 3-D elements using FEA software.
8. Elasto-plastic stress analysis of plate using FEA software
9. Coupled Thermal-Structural Analysis using FEA software

*1 Students can write the program in any of the programming language such as FORTRAN, C, C++, MATLAB, Python, VB.

*2 Minimum number of elements considered should be 10 or more.

*3 Validate results of the program with analytical method or commercial FEA software such as Abaqus, ANSYS, Msc-Nastran, Optistruct / Radioss, Comsol-Multiphysics, etc.

**1 Students should do convergence study for all assignment problems.
**2 Use different element types from element library,
**3 If possible use submodel / symmetry option.

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Course Code : 402044 B **Course Name : Elective – I Computational Fluid Dynamics**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: --
						TW	: 25

Pre-requisites	: Fluid Mechanics, Heat transfer, Numerical methods, Programming Languages.

Course Objectives:

- Students should be able to model fluid / heat transfer problems and apply fundamental conservation principles.
- Students should be able to do discretize the governing equations by Finite Difference Method and Finite volume Method.
- Students should be able to develop programming skills by in-house code development for conduction, convection and fluid dynamics problems.
- Students should be able to solve basic convection and diffusion equations and understands the role in fluid flow and heat transfer.
- To prepare the students for research leading to higher studies.
- To prepare the students for career in CAE industry using software tools.

Course Outcomes:

On completion of the course, students will be able to -

- Analyze and model fluid flow and heat transfer problems.
- Generate high quality grids and interpret the correctness of numerical results with physics.
- Conceptualize the programming skills.
- Use a CFD tool effectively for practical problems and research.

Course Contents

Unit 1: Introduction to CFD **6 Hrs**

Introduction to Computational Fluid Dynamics, Derivation and physical interpretation of governing equations (conservation of mass, momentum and energy) in differential form, Concept of substantial derivative, divergence and curl of velocity, Mathematical behavior of Governing Equations and boundary conditions.

Unit 2: Solution to Conduction Equation **6 Hrs**

Introduction to FEA, FDM and FVM, Solution of two dimensional steady and unsteady heat conduction equation using finite volume method (Implicit and Explicit) with Dirichlet, Neumann, Robbin boundary conditions, Stability Criteria.

Unit 3: Solution to Advection Equation **6 Hrs**

Solution of two dimensional steady and unsteady heat advection equation using finite volume method (Implicit and Explicit) with Dirichlet BC, Stability Criteria, Introduction to first order upwind, CD, second order upwind and QUICK convection schemes.

Unit 4: Solution to Convection-Diffusion Equation **6 Hrs**

Solution of two dimensional steady and unsteady heat convection-diffusion equation for slug flow using finite volume method (Implicit and Explicit), Stability Criteria, 1-D transient convection-diffusion system, Peclet Number

Unit 5: Solution to Navier – Stokes Equation **6 Hrs**

Solution of Navier-Stoke's equation for incompressible flow using SIMPLE algorithms for lid driven cavity flow problem, Introduction to external flow simulation.

Unit 6: Introduction to Turbulence Modeling **6 Hrs**

Introduction to turbulence models, Reynolds Averaged Navier-Stokes equations (RANS), One equation model (Derivation) and two equation model.

Books

Text :

1. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw-Hill
2. Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Wiley
3. Suhas V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation
4. A. W. Date, Introduction to Computational Fluid Dynamics, Cambridge Univ. Press, USA.
5. H. Versteeg, and W.Malalasekara, An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson.
6. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
7. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier.
8. H. Schlichting and K. Gersten, Boundary-Layer Theory, Springer.

References :

1. H. Tennekes and J. L. Lumley, A First Course in Turbulence, MIT Press.
2. David C. Wilcox, Turbulence Modeling for CFD, DCW Industries

Term Work shall consist of following assignments:

Practical's to be performed: Minimum 7 including

- Any three practical's with programming language (*from Practical No. 1 to 8*) and
- Any three practical in Open source or Commercial Software (*from Practical No. 9 to 16*)
- Mini project (*Practical No.16*) in Open source or Commercial Software tool

1. One-dimensional steady state conduction using finite volume method
2. One-dimensional unsteady state conduction using finite volume method
3. Two-dimensional steady state conduction using finite volume method
4. Two-dimensional unsteady state conduction using finite volume method
5. Two-dimensional advection using finite volume method
6. One-dimensional conduction convection problem using finite volume method
7. One-dimensional conduction convection problem using finite volume method
8. Solution of Navier Stokes equation using SIMPLE algorithm for Lid Driven Cavity flow

problem

9. Numerical simulation and analysis of boundary layer over a flat plate (Blausius Equation)
10. Numerical simulation and analysis of boundary layer for a
11. Developing flow through Pipe
12. Fully developed flow through a pipe
13. CFD Analysis of external flow: Circular Cylinder or Airfoil (NACA 0012)
14. CFD analysis of heat transfer in pin fin.
15. Numerical simulation and analysis of 2D square lid driven cavity. Effect of Reynolds number on the vorticity patterns.
16. Mini project on any practical application. Students should take a problem of their choice and verify the CFD solution with experimental data / research paper. (Mandatory)

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402044 C **Course Name : Elective – I**

Heating, Ventilation, Air Conditioning and Refrigeration Engineering

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR : --	
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR : --	
						TW : 25	

Pre-requisites:	Thermodynamics I and II, Refrigeration and Air Conditioning

Course Objectives:

- To understand the recent vapour compression cycle
- To provide the knowledge of analyze thermal design of refrigeration system components
- To understand practical aspects of vapour compression system
- To provide the knowledge of basic concepts of ventilation, infiltration and space distribution techniques
- To inculcate techniques of estimating building envelop load.
- To understand the working non-conventional air-conditioning systems.

Course Outcomes:

On completion of the course, students will be able to -

- Determine the performance parameters of trans-critical & ejector refrigeration systems
- Estimate thermal performance of compressor, evaporator, condenser and cooling tower.
- Describe refrigerant piping design, capacity & safety controls and balancing of vapour compressor system.
- Explain importance of indoor and outdoor design conditions, IAQ, ventilation and air distribution system.
- Estimate heat transmission through building walls using CLTD and decrement factor &time lag methods with energy-efficient and cost-effective measures for building envelope.
- Explain working of types of desiccant, evaporative, thermal storage, radiant cooling, clean room and heat pump air-conditioning systems.

Course Contents

Unit 1: Advanced Vapour Compression Cycles **4 Hrs**

Review of vapour compression cycle, Trans-critical cycle and their types retical treatment) Ejector refrigeration cycle and their types. Presentation of cycle on P-h and T-s chart.

Unit 2: Thermal Design of Refrigeration System Components **8 Hrs**

Compressor : Characteristic curves of reciprocating & Centrifugal compressors, sizing of reciprocating compressor

Evaporator : Standards & Codes, Performance analysis of Dx evaporator,

Condenser: Standards & Codes, air-cooled condenser, shell & tube condenser and evaporative condenser.

Expansion Devices : Standards & Codes, Operating Characteristics, Liquid Charge in the Sensing Bulb , Hunting of Thermostatic Expansion Valve

Cooling Tower: Types & design of cooling towers, cooling tower thermal performance, tower efficiency.

Unit 3: Practical Aspects of Vapour Compression System **6 Hrs**

Refrigerant Piping : Copper Tubing, Piping Design for Reciprocating Refrigeration Systems, Size of Copper Tube, Refrigeration Load, and Pressure Drop, Sizing Procedure, Suction Line, Discharge Line (Hot-Gas Line), Liquid Line

Capacity Controls : Capacity Controls of reciprocating, centrifugal and scroll compressors

Safety Controls: Low-Pressure and High-Pressure Controls. Low-Temperature Control, Frost Control, Oil Pressure Failure Control. Motor Overload Control.

Vapour compression system balance: Performance characteristics of the condensing unit & compressor-capillary tube.

Unit 4: Ventilation and Infiltration **6 Hrs**

Indoor Design Criteria and Thermal Comfort : Basic parameters, factors affecting thermal comforts, Comfort-Discomfort Diagrams, Indoor Temperature, Relative Humidity, and Air Velocity

Indoor Air Quality : Indoor Air Contaminants, Basic Strategies to Improve Indoor Air Quality,

Outdoor Design Conditions : Outdoor Air Requirements for Occupants, The Use of Outdoor Weather Data in Design, Outdoor Weather Characteristics and Their Influence

Ventilation for cooling : Natural ventilation, mechanical ventilation

Space air distribution: Design of air distribution systems, Types of air distribution devices: Airflow patterns inside conditioned space: Stratified mixing flow: Cold air distribution: Displacement flow: *Spot cooling / heating*: Selection of supply air outlets.

Unit 5: Heat Load Estimation in Building Structures **6 Hrs**

Solar radiation, Heat gain through fenestrations, Space load characteristics, cooling load and coil load calculations, Overall heat transmission coefficient, air spaces, sol-air temperature, Decrement factor & time lag method,, Cooling load Temperature Difference method (CLTD) or Equivalent Temperature Differential (ETD), detailed calculation procedure using CLTD method, Total heat balance.

Energy-efficient and cost-effective measures for building envelope**,** Concept of ECBC

Unit 6: Advanced Air-conditioning Systems **6 Hrs**

Desiccant-Based Air Conditioning Systems : Introduction, Sorbents & Desiccants, Dehumidification, Liquid Spray Tower, Solid Packed Tower, Rotary Desiccant Dehumidifiers, Hybrid Cycles, Solid Desiccant Air-Conditioning (Theoretical treatment)

Evaporative-Cooling Air Conditioning Systems, Thermal Storage Air Conditioning Systems, Clean-Room Air Conditioning Systems, Radiant cooling. (Theoretical treatment)

Heat Pump Systems: Heat Pump Cycle, different heats pump Circuits.

Books

Text :

1. Arora R.C., Refrigeration and Air Conditioning, PHI, India
2. Dossat Ray J., Principal of Refrigeration, Pearson, India
3. Arora C P, Refrigeration and Air Conditioning, Tata McGraw Hill

4. Manohar Prasad, Refrigeration and Air-conditioning, Wiley Eastern Limited, 1983

References :

1. Threlkeld J.L., Thermal Environmental Engineering, Prentice Hall Inc. New Delhi
2. ASHRAE Handbook (HVAC Equipments)
3. Stocker W.F. and Jones J.W., Refrigeration and Air-conditioning, McGraw Hill International editions 1982.
4. Roger Legg, Air conditioning systems: Design, Commissioning and maintenance
5. Shan Wang, Handbook of Refrigeration and Air Conditioning, McGrawHill Publications
6. Wilbert Stocker, Industrial Refrigeration, McGrawHill Publications
7. Keith Harold, Absorption chillers and Heat Pumps, McGrawHill publications
8. ASHRAE, Air Conditioning System Design Manual, IInd edition, ASHRAE.

Term Work shall consist of following assignments:

1. Performance Simulation of Central Air-conditioning plant using Newton Raphson Method.
2. Performance analysis of Counter flow or cross flow cooling tower
3. Building heat load simulation using suitable software (Trace 700, Energy plus etc.)
4. Design of cold storage with process layout.

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Course Code : 402045 A | **Course Name : Elective – II Automobile Engineering**

Teaching Scheme:		**Credits**		**Examination Scheme:**			
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR**	**: --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR**	**: --**
						TW	**: --**

Pre-requisites	: I. C. Engines, Theory of Machines, Basics of Electrical and Electronics

Course Objectives:

- To make the student conversant with fundamentals of automobile systems.
- To develop competencies in performance analysis of vehicles.
- To make the student conversant with automobile safety, electrical system and vehicle maintenance.
- To understand the emerging trends of electric vehicles, hybrid electric vehicles and solar vehicles. .

Course Outcomes:

On completion of the course, students will be able to -

- To compare and select the proper automotive system for the vehicle.
- To analyse the performance of the vehicle.
- To diagnose the faults of automobile vehicles.
- To apply the knowledge of EVs, HEVs and solar vehicles

Course Contents

Unit 1: Introduction and Drive Train **6 Hrs**

Introduction: Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames: Types of chassis layout with reference to power plant locations and drive, various types of frames, constructional details.

Drive Train: Types of transmission system, necessity and selection of clutch, necessity of gear box and different types, fluid flywheel, torque convertor, continuous variable transmission, , overdrive, propeller shaft, final drive and differential.

Unit 2: Axles, Wheels and Tyres, Steering System **6 Hrs**

Axles: Purpose, requirement and types of front and rear axle, loads acting on rear axles.

Wheels and tyres: Wheel construction, alloy wheel, wheel balancing, type of tyres, tyre construction, tyre materials, factors affecting tyre life.

Steering system : Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristics, steering linkages and gearbox, power steering, collapsible steering, reversibility of steering, four wheel steering, wheel alignment.

Unit 3: Suspension and Brake System	**6 Hrs**

__Suspension__ : Types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydro gas, rubber suspension, interconnected suspension, self levelling suspension (active suspension), shock absorbers (hydraulic and air).

__Brake systems__: Drum, disc, mechanical, hydraulic, air brakes, vacuum, power assisted brakes, hand brake, ABS, EBD.

Unit 4: Vehicle Performance and Safety	**6 Hrs**

__Vehicle performance__: Parameters, vehicle resistances, traction and tractive effort, power requirement for propulsion, road performance curves (numericals), stability of vehicles, vehicle testing on chassis dynamometer.

__Vehicle safety__: Types of active and passive safety, vehicle interior and ergonomics, NVH in automobiles.

Unit 5: Electrical System and Vehicle Maintenance	**6 Hrs**

__Batteries__ : Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods, introduction to lithium batteries.

__Electrical system and accessories__ : Insulated and earth return systems, positive and negative earth systems, electrical fuel pump, speedometer, fuel, oil and temperature gauges, horn, wiper system, automotive sensors and actuators, electronic control unit/module.

__Maintenance__: Types of vehicle maintenance, servicing/overhauling of clutch, gear box, propeller shaft, differential, axles, steering system, suspension system, break system, electrical system.

Unit 6: Electric and Hybrid Electric Vehicles	**6 Hrs**

__Introduction__: Concept and environmental importance of EVs, HEVs and solar vehicles.

__Electric vehicles__: Layout, construction and working.

__Hybrid electric vehicles:__ Types, layout, hybridization factor, plug in hybrid electric vehicles, fuel efficiency analysis.

Challenges and future scope of EVs and HEVs.

Books

Text :

1. K. Newton and W. Seeds, T.K. Garrett, “Motor Vehicle”, 13thEdition, Elsevier publications.
2. Hans Hermann Braess, Ulrich Seiffen, “Handbook of Automotive Engineering”, SAE Publications.
3. William H. Crouse., “Automotive Mechanics”, Tata McGraw Hill Publishing House.
4. Joseph Heitner, “Automotive Mechanics”, C.B.S Publishers and Distributors.
5. SAE Manuals and Standards.
6. .N. K. Giri, Automobile Mechanics
7. P. S. Kohali, Automobile Electrical Equipment, Tata McGraw Hill Publishing House.
8. Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.

References :

1. Dr. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers distributors.
2. Automobile Mechanics, “Crouse/Anglin”, TATA Mcgraw-Hill.
3. R. B. Gupta, Automobile Engineering, Satya Prakashan.

4. Chris Mi, M .Abul Masrur, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, ,Willey.
5. Electric and Hybrid Vehicles, Tom Denton, Routledge.
6. Hybrid Electric Vehicle Technology, Automotive Research and Design, American Technical.
7. Husain, Iqbal, Electric and hybrid vehicles, 2 edition, CRC Press.
8. Ron Hodkinson and John Fenton, Butterworth-Heinemann.Lightweight Electric/ Hybrid Vehicle Design,
9. Ehsani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Standards media.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402045 B | **Course Name : Elective – II Operation Research**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR : --**
						TW : --

Pre-requisites	Mathematics I, II and III

Course Objectives:

- To familiarize the students with the use of practice oriented mathematical applications for optimization functions in an organization.
- To familiarize the students with various tools of optimization, probability, statistics and simulation, as applicable in particular scenarios in industry for better management of various resources.

Course Outcomes:

On completion of the course, students will be able to -

- Apply LPP and Decision Theory to solve the problems
- Apply the concept of transportation models to optimize available resources.
- Decide optimal strategies in conflicting situations.
- Implement the project management techniques.
- Minimize the process time
- Optimize multi stage decision making problems

Course Contents

Unit 1: Introduction: Operation Research **6 Hrs**

Introduction: Definition, Evolution and Classification of Quantitative Methods and Operations Research Techniques, Methodology, Advantages and Limitations. Linear Programming Problem: Introduction, Formulation of LPP, Solution of LPP by Two Phase Method only. Decision Theory: Meaning and Steps in Decision Making, Types of Management Decisions, Decision under Certainty, under Risk, under Uncertainty, Decision Trees

Unit 2: Transportation & Assignment Model **6 Hrs**

Introduction, Formulation, Basic Method of Solving Transportation Problem, Optimization Methods like UV and Stepping Stone Method, Assignment Problem- Hungarian Method to solve Assignment Problem.

Unit 3: Theory of Games and Linear Programming **6 Hrs**

Theory of Games : Introduction, Minimax and Maximin Principle, Solution of Game with Saddle Point, Solution by Dominance, Solution by Graphical Method, m x n size Game Problem, Iterative method, Introduction to formulation of games using Linear Programming.

Replacement Analysis: Replacement of Items that Deteriorate, Replacement of Items that Fail

Suddenly.

Unit 4: Project Management **6 Hrs**

Network Models: Fulkerson‘s rule, concept and types of floats, CPM and PERT, Crashing Analysis and Resource Scheduling. Simulation: Introduction, Monte-Carlo Simulation method, Simulation of Inventory and Queuing Problems.

Unit 5: Queuing Theory and Sequencing Models **6 Hrs**

Queuing Theory: Introduction, Basis Structure, Terminology (Kendal‘s Notations) and Applications. *Queuing Model M/M/1*: /FIFO, M/M/c.

Sequencing models : Solution of sequencing Problem - Processing of n jobs through two machines, Processing of n jobs through three machines, Processing of two jobs through m Machines, Processing of n jobs through m Machines

Unit 6: Integer and Dynamic Programming **6 Hrs**

Integer Programming Introduction to Integer Programming, Cutting plane method and Branch and Bound Method. Dynamic Programming: Introduction, DP Model, Applications of DP Model to shortest route problems. Solution of LPP by Dynamic Programming

Books

Text :

1. Prem Kumar Gupta, D. S. Hira, Problems in Operations Research: Principles and Solutions, S. Chand, 1991
2. J. K. Sharma, Operations Research: Theory and Application, Laxmi pub. India.
3. Operations Research, S. D. Sharma, Kedar Nath Ram Nath-Meerut.
4. L.C.Jhamb,Quantative Techniques Vol. I&II, Everest Publication.
5. Manohar Mahajan, Operation Research, Dhanpatrai Publication

References :

1. Hillier F.S., and Lieberman G.J., Operations Research, Eight Edition, Mc. Tata McGraw Hill, India
2. Ravindran, ―Engineering optimization Methods and Applications‖, 2nd edition, Wiley, India
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Second Edition, Mc. WSE Willey,
4. Operations Research - An introduction, Hamdy A Taha, Pearson Education.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402045 C **Course Name : Elective – II Energy Audit and Management**

Teaching Scheme:		Credits		Examination Scheme:		
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR : --
Practical	: --	TW	: --		End-Sem : 70	OR : --
						TW : --

Pre-requisites:	Thermodynamics, Turbo Machines

Course Objectives:

Following concepts to be taught to the students,

- Importance of Energy Management.
- To Carry out Energy Audit.
- Methods to reduce consumption of energy and save cost.
- To improve energy efficiency of overall system.
- Significance of Waste heat recovery and Cogeneration.

Course Outcomes:

On completion of the course, students will be able to -

- Compare energy scenario of India and World.
- Carry out Energy Audit of the Residence / Institute/ Organization.
- Evaluate the project using financial techniques
- Identify and evaluate energy conservation opportunities in Thermal Utilities.
- Identify and evaluate energy conservation opportunities in Electrical Utilities.
- Identify the feasibility of Cogeneration and WHRUse a CFD tool effectively for practical problems and research.

Course Contents

Unit 1: General Aspects of Energy Management **6 Hrs**

Current energy scenario - India and World, Current energy consumption pattern in global and Indian industry, Concept of energy conservation and energy efficiency, Energy and environment, Need of Renewable energy, Principles of Energy management, Energy policy, Energy action planning, Energy security and reliability, Energy reforms.

Unit 2: Energy Audit **6 Hrs**

Need of Energy Audit, Types of energy audit, Components of energy audit, Energy audit methodology, Instruments used in energy audit, Analysis and recommendations of energy audit, Energy audit reporting, Energy audit software, Current Energy Conservation Act.

Unit 3: Energy Economics **6 Hrs**

Costing of Utilities- Determination of cost of steam, natural gas, compressed air and electricity, Financial Analysis Techniques (Numerical) - Simple payback, Time value of money, Net Present Value(NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Risk and Sensitivity analysis.

Unit 4: Energy Efficiency in Thermal Utilities **6 Hrs**

Energy performance assessment (Numerical) and efficiency improvement of Boilers, Furnaces, Heat exchangers, Cooling tower, DG sets, Fans and blowers, Pumps, Compressors, Compressed air system and HVAC systems. Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.

Unit 5: Energy efficiency in Electrical Utilities **6 Hrs**

Electricity billing, Electrical load management and maximum demand control, penalties, Power factor improvement and benefits, Selection and location of capacitors. Distribution and transformer losses, Electrical motors- types, efficiency and selection, Speed control, Energy efficient motors, Introduction of Electricity Act 2003,Lamp types and their features, recommended illumination levels, Lighting system performance assessment and efficiency improvement (Numerical)

Unit 6: Cogeneration and Waste Heat Recovery **6 Hrs**

Cogeneration : Need, applications, advantages, classification, Introduction to Trigeneration, Waste heat recovery- Classification, Application, Concept of Pinch analysis, Potential of WHR in Industries, Commercial WHR devices, saving potential. CDM projects and carbon credit calculations.
Case study: Energy Audit of Institute/Department.

Books

References :

1. Handbook of Energy Audit, Albert Thumann P.E. CEM, William J. Younger CEM, The Fairmont Press Inc., 7th Edition.
2. Energy Management Handbook, Wayne C. Turner, The Fairmont Press Inc., 5th Edition, Georgia.
3. Handbook on Energy Audit and Environment management, Abbi Y. A., Jain Shashank, TERI, Press, New Delhi, 2006
4. Energy Performance assessment for equipment and Utility Systems.-Vol. 2,3.4 BEE Govt. of India
5. Boiler Operator‘s Guide Fourth Edition, Anthony L Kohan, McGraw Hill
6. Energy Hand book, Second edition, Von Nostrand Reinhold Company - Robert L. Loftness.
7. www.enrgymanagertraining.com
8. http://www.bee-india.nic.in

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402046 **Course Name : Project – I**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: --**	**TH**	**: --**	**Theory**	**In-Sem : --**	**PR : --**
Practical	**: 04 hrs per week**	**TW**	**: 02**		**End-Sem : --**	**OR : 25**
						TW : 25

Course Objectives:

- To have ideology of the industrial project.
- Hands on working with tools, tackles and machines
- To carry out literature survey
- To do brain storming for mechanical engineering system

Course Outcomes:

On completion of the course, students will be able to -

- Find out the gap between existing mechanical systems and develop new creative new mechanical system.
- Learn about the literature review
- Get the experience to handle various tools, tackles and machines.

Course Contents

INSTRUCTIONS FOR PROJECT REPORT WRITING (Project Stage I)

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare ***Three Spiral Bound Copies*** of your manuscript.
2. Limit your Project Stage I to *25– 30* pages (preferably)
3. The *footer must include* the following:
   Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be of 5- 7 chapters
6. Use the paper size 8.5’’ × 11’’ or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	**Paper 8.5’’ × 11’’**	**Paper A4 (210 × 197 mm)**
Top	1’’	25.4 mm
Left	1.5’’	37 mm
Bottom	1.25’’	32 mm
Right	1’’	25.4 mm

7. All paragraphs will be *1.5 lines spaced with a one blank line between each paragraph*. Each paragraph will begin with *without any indentation*.
8. *Section titles* should be bold with *14 pt.* typed in all capital letters and should be left aligned.
9. *Sub-Section headings* should be aligning at the left with *12 pt.* bold and Title Case (the first letter of each word is to be capitalized).
10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a) Illustrations should not be more than two per page. One could be ideal
    b) Figure No. and Title at bottom with 12 pt.
    c) Table No. and Title at top with 12 pt.
    d) Legends below the title in 10 pt.
    e) Leave proper margin in all sides
    f) Illustrations as far as possible should not be photo copied.
11. Photographs if any should be of glossy prints
12. Please use SI system of units only.
13. Please number the pages on the front side, centrally below the footer
14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
15. Symbols and notations if any should be included in nomenclature section only
16. Following will be the order of report
    i. Cover page and Front page (*as per the specimen on separate sheet*)
    ii. Certificate from the Institute (*as per the specimen on separate sheet*)
    iii. Acknowledgements
    iv. Contents
    v. List of Figures
    vi. List of Tables
    vii. Nomenclature
    viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt. and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

    1. Introduction (2-3 pages) (TNR – 14 Bold)
        1.1 Problem statement (TNR – 12)
        1.2 Objectives
        1.3 Scope
        1.4 Methodology
        1.5 Organization of Dissertation

    2. Literature Review (12-16 pages)
    Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

    3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (8 - 12 pages)

    4. Experimental Validation - This chapter shall be based on your own experimental work

(2 - 3 pages)

5. Concluding Remarks and Scope for the Future Work (1 - 2 pages)

(IF above Chapters 3, 4, 5 not completed please mention the plan for the same and time period for completion and detail activity chart).

References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, …. and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.
18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citatation of it. Please follow the following procedure for references

Reference Books :

Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

Papers from Journal or Transactions :

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.

Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

Papers from Conference Proceedings :

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

Reports, Handbooks etc. :

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent :

Patent no, Country (in parenthesis), date of application, title, year.

Internet :

www.(Site) [Give full length URL] *accessed on date*

A Project Stage-I Report on
(TNR, 16pt, centrally aligned)

Title of the Project Report

(TNR, 27pt, Bold, Centrally Aligned, Title Case)

By
(TNR, 16pt, Centrally Aligned)

Mr. Student's 1 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 2 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 3 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 4 Name
(TNR, 16pt, Centrally Aligned)

Guide
Guide's Name
(TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute
[2018-19]
(TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute Logo

C E R T I F I C A T E

This is to certify that ***Mr. (Name of the Student)***, has successfully completed the Project Stage – I entitled "(***Title of the Project)*** " under my supervision, in the partial fulfillment of Bachelor of Engineering - Mechanical Engineering of University of Pune.

Date:

Place:

Guide's Name
Guide

Internal Examiner

HoD Name
Head of the Department

Principal Name
Principal

Seal

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402047 **Course Name : Energy Engineering**

Teaching Scheme:		Credits		Examination Scheme:					
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem	: 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem	: 70	OR	: 25
							TW	: 25

Pre-requisites:	Thermodynamics I and II and Heat Transfer

Course Objectives:

- To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle
- To understand details of steam condensing plant, analysis of condenser, the an environmental impacts of thermal power plant, method to reduce various pollution from thermal power plant
- To study layout, component details of hydroelectric power plant, hydrology and elements , types of nuclear power plant
- To understand components; layout of diesel power plant , components; different cycles ; methods to improve thermal efficiency of gas power plant
- To study the working principle , construction of power generation from non-conventional sources of energy
- To learn the different instrumentation in power plant and basics of economics of power generation.

Course Outcomes:

On completion of the course, students will be able to -

- Describe the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle
- Analyze the steam condensers, recognize the an environmental impacts of thermal power plant and method to control the same
- Recognize the layout, component details of hydroelectric power plant and nuclear power plant
- Realize the details of diesel power plant, gas power plant and analyze gas turbine power cycle
- Emphasize the fundaments of non-conventional power plants
- Describe the different power plant electrical instruments and basic principles of economics of power generation.

Course Contents

Unit 1: Introduction and Thermal Power Plant **6 Hrs**

A) *Power Generation* : global scenario, present status of power generation in India, in Maharashtra, Role of private and governmental organizations, load shedding, carbon credits, pitfalls in power reforms, concept of cascade efficiency.

B) *Thermal Power Plant* : General layout of modern thermal power plant with different circuits, site selection criteria, classification of coal, coal blending, coal beneficiation, selection of coal for thermal power plant, slurry type fuels, pulverized fuel handling systems, fuel burning methods, FBC systems, high pressure boilers, ash handling system, Rankine cycle with reheat and regeneration (Numerical Treatment), steam power plants with process heating (Numerical Treatment)

Unit 2: Steam Condenser and Environmental Impacts of Thermal Power Plant **6 Hrs**

A) *Steam Condenser* : Necessity of steam condenser, elements of steam condensing plant, classification, cooling water requirements, condenser efficiency, vacuum efficiency (Numerical Treatment), cooling towers, air leakage and its effects on condenser performance, air pumps (Numerical Treatment for Air Pump capacity)

B) *Environmental impact of thermal power plants* : Different pollutants from thermal power plants, their effects on human health and vegetation, methods to control pollutants such as particulate matter; oxides of sulphur; oxides of nitrogen, dust handling systems, ESP, scrubbers, water pollution, thermal pollution, noise pollution from TPP and its control

Unit 3: Hydroelectric and Nuclear Power Plant **6 Hrs**

A) *Hydroelectric Power Plant* : site selection, classification of HEPP (based on head, nature of load, water quantity), criteria for turbine selection, dams, spillways, surge tank and forebay, advantages and disadvantages of HEPP, hydrograph ,flow duration curve ,mass curve, (Numerical Treatment) environmental impacts of HEPP

B) *Nuclear Power Plants* : elements of NPP, types of nuclear reactor (PWR, BWR, CANDU, GCR, LMCR, OMCR, fast breeder, fusion), material for nuclear fuel, cladding, coolants, control rod and shielding, nuclear waste disposal, environmental impacts of NPP

Unit 4: Diesel and Gas Turbine Power plant **6 Hrs**

A) *Diesel Power Plants* : applications, components of DPP, different systems of DPP, plant layout, performance of DPP (Numerical Treatment) advantages & disadvantages of diesel power plant, environmental impacts of DPP

B) *Gas Turbine Power Plant* : general layout of GTPP, components of GTPP, open, closed & semi-closed cycle gas turbine plant, Brayton cycle analysis for thermal efficiency, work ratio, maximum & optimum pressure ratio, methods to improve thermal efficiency of GTPP: inter-cooling; reheating & regeneration cycle (numerical treatment), gas and steam turbine combined cycle plant, environmental impacts of GTPP

Unit 5: Non-Conventional Power Plants **6 Hrs**

Solar Power Plant based on: flat plate collector, solar ponds, parabolic solar collector, heliostat, solar chimney, SPV cell based plants: working principal, solar photovoltaic systems, applications
Geothermal Plant: superheated steam system, flash type, binary cycle plant.
Tidal Power Plant: components, single basin, double basin systems.
OTEC Plant: principal of working, Claude cycle, Anderson Cycle.
MHD Power Generation : Principal of working, Open Cycle MHD generator, closed cycle MHD generators.
Fuel cell : alkaline, acidic, proton-exchange membrane
Wind Power Plant : wind availability, wind mills and subsystems, classification of wind turbines, operating characteristics, wind solar hybrid power plants, challenges in commercialization of non-conventional power plants, environmental impacts of NCPP

Unit 6: Instrumentation and Economics of Power Plant **6 Hrs**

A) *Power Plant Instruments* : layout of electrical equipment, generator, exciter, generator cooling, short circuits & limiting methods, switch gear, circuit breaker, power transformers, methods of earthling, protective devices & control system used in power plants, measurement of high voltage, current and power, control room

B) *Economics of Power Generation* : cost of electric energy, fixed and operating cost [methods to determine depreciation cost] (Numerical Treatment), selection and type of generation, selection of generation equipment , load curves, performance and operation characteristics of power plants, load division, all terms related to fluctuating load plant (Numerical Treatment)

Books

Text :

1. Domkundwar & Arora, Power Plant Engineering, Dhanpat Rai & Sons, New Delhi
2. Domkundwar & Domkundwar- Solar Energy and Non-Conventional Sources of Energy, Dhanpat Rai& Sons, New Delhi.
3. R.K.Rajput, Power Plant Engineering‖, Laxmi Publications New Delhi.
4. D.K.Chavan & G.K.Phatak, Power Plant Engineering‖, Standard Book House, New Delhi.

References :

1. E.I.Wakil, Power Plant Engineering‖, McGraw Hill Publications New Delhi
2. P.K.Nag, Power Plant Engineering‖, McGraw Hill Publications New Delhi.
3. R.Yadav , Steam and Gas Turbines‖ ,Central Publishing House, Allahabad.
4. G.D.Rai, Non-Conventional Energy Sources, Khanna Publishers,Delhi
5. S.P.Sukhatme, Solar Energy‖ Tata McGraw-Hill Publications, New Delhi
6. G R Nagpal Power Plant Engineering , Khanna Publication

Term Work shall consist of following assignments:

IMP Notes for Term Work:

- Any Eight Experiment should be conducted (*from Experiment No. 1 to 10*) and
- *Experiment No 1, 2, 7,* and *8* are compulsory
- *Experiment No: 3 - 9* can be performed using suitable simulation software

1. Visit to Thermal Power plant /Co-generation Power plant.
2. Visit to HEPP/GTPP/Non-Conventional Power Plants.
3. Study of Fluidized Bed Combustion system.
4. Study of High Pressure Boilers
5. Study of Steam Turbine Systems –governing systems, protective devices, lubricating systems, glands and sealing systems.
6. Study of Co-generation Plants
7. Trial on Steam Power Plant or with help of suitable software to determine
    a) Plant Efficiency, Rankine Efficiency Vs Load
    b) Specific Steam consumption Vs Load
    c) Rate of Energy Input Vs Load
    d) Heat Rate and Incremental heat Rate Vs Load
8. Trial on Diesel Power Plant or with help of suitable software to determine
    a) Plant Efficiency Vs Load

b) Total fuel consumption Vs Load
c) Rate of Energy Input Vs Load
d) Heat Rate and Incremental heat Rate Vs Load

9. Study of Power Plant Instruments.
10. Study of Different Tariff Methods

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402048 **Course Name : Mechanical System Design**

Teaching Scheme:		Credits		Examination Scheme:					
Theory	: 04 Hrs Per Week	TH	: 04	Theory	In-Sem	: 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem	: 70	OR	: 25
							TW	: 50

Pre-requisites:	Engineering Mechanics, Manufacturing Process, Strength of Materials, Machine design, Engineering Mathematics, Theory of Machines, Dynamics of Machinery, and IC Engines.

Course Objectives:

- To develop competency for system visualization and design.
- To enable student to design cylinders and pressure vessels and to use IS code.
- To enable student select materials and to design internal engine components.
- To introduce student to optimum design and use optimization methods to design mechanical components.
- To enable student to design machine tool gearbox.
- To enable student to design material handling systems.
- Ability to apply the statistical considerations in design and analyze the defects and failure modes in components

Course Outcomes:

On completion of the course, students will be able to -

- Understand the difference between component level design and system level design.
- Design various mechanical systems like pressure vessels, machine tool gear boxes, material handling systems, etc. for the specifications stated/formulated.
- Learn optimum design principles and apply it to mechanical components.
- Handle system level projects from concept to product.

Course Contents

Unit 1: Design of Machine Tool Gear Box **8 Hrs**

Introduction to machine tool gearboxes, design and its applications, basic considerations in design of drives, determination of variable speed range, graphical representation of speed and structure diagram, ray diagram, selection of optimum ray diagram, gearing diagram, deviation diagram.
(Note: Full design problem to be restricted up to 2 Stages only)

Unit 2: Statistical Consideration in Design **8 Hrs**

Frequency distribution-Histogram and frequency polygon, normal distribution - units of central tendency and dispersion- standard deviation - population combinations - design for natural tolerances - design for assembly - statistical analysis of tolerances, mechanical reliability and factor of safety.

Unit 3: Design of Belt Conveyor System for Material Handling **8 Hrs**

System concept, basic principles, objectives of material handling system, unit load and containerization.

Belt conveyors, Flat belt and troughed belt conveyors, capacity of conveyor, rubber covered and fabric ply belts, belt tensions, conveyor pulleys, belt idlers, tension take-up systems, power requirement of horizontal belt conveyors for frictional resistance of idler and pulleys.

Unit 4: Design of Cylinders and Pressure Vessels **8 Hrs**

Design of Cylinders: Thin and thick cylinders, Lame's equation, Clavarino's and Bernie's equations, design of hydraulic and pneumatic cylinders, auto-frettage and compound cylinders,(No Derivation) gasketed joints in cylindrical vessels (No derivation).

Design of Pressure vessel : Modes of failures in pressure vessels, unfired pressure vessels, classification of pressure vessels as per I. 2825 - categories and types of welded joints, weld joint efficiency, stresses induced in pressure vessels, materials for pressure vessel, thickness of cylindrical shells and design of end closures as per code, nozzles and openings in pressure vessels, reinforcement of openings in shell and end closures - area compensation method, types of vessel supports (theoretical treatment only).

Unit 5: Design of I.C. Engine Components **8 Hrs**

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, construction of cylinder liners, design of piston and piston-pins, piston rings, design of connecting rod. Design of crank-shaft and crank-pin, (Theoretical treatment only).

Unit 6: Optimum Design **8 Hrs**

Objectives of optimum design, adequate and optimum design, Johnson's Method of optimum design, primary design equations, subsidiary design equations and limit equations, optimum design with normal specifications of simple machine elements- tension bar, transmission shaft and helical spring, Pressure vessel Introduction to redundant specifications (Theoretical treatment).

Books

Text :

1. Bhandari V.B. ―Design of Machine Elements‖, Tata McGraw Hill Pub. Co. Ltd.
2. Juvinal R.C, Fundamentals of Machine Components Design, Wiley, India

References :

1. Design Data- P.S.G. College of Technology, Coimbatore.
2. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
3. I.S. 2825: Code for unfired pressure vessels.
4. Shigley J. E. and Mischke C.R., ―Mechanical Engineering Design‖, McGraw Hill Pub. Co
5. M. F. Spotts, –Mechanical Design Analysis‖, Prentice Hall Inc.
6. Black P.H. and O. Eugene Adams, –Machine Design‖ McGraw Hill Book Co. Inc.
7. Johnson R.C., ―Mechanical Design Synthesis with Optimization Applications‖, Von Nostrand Reynold Pub.
8. S.K. Basu and D. K. Pal, –Design of Machine Tools, Oxford and IBH Pub Co.
9. Rudenko,‖Material Handling Equipment‖, M.I.R. publishers, Moscow
10. P. Kannaiah ,‖Design of Transmission systems‖, SCIETCH Publications Pvt Ltd.
11. Pandy, N. C. and Shah, C. S., Elements of Machine Design, Charotar Publishing House.
12. Mulani, I. G., ―Belt Conveyors‖
13. Singiresu S. Rao, Engineering Optimization: Theory and Practice, John Wiley & Sons.

14. M.V. Joshi, Process Equipment Design, Mc-Millan.

Term Work shall consist of following assignments:

1. One Design Project:

The design project shall consist of two imperial size sheets (Preferably drawn with 3D/2D CAD software) - one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components, manufacturing tolerances, surface finish symbols and geometric tolerances must be specified so as to make it working drawing. A design report giving all necessary calculations of the design of components and assembly should be submitted. Projects shall be in the form of design of mechanical systems including pressure vessel, conveyor system, multi speed gear box, I.C engine, etc.

Each Student shall complete any one of the following assignments.

1. Design of Flywheel.
2. Design for Manufacture, Assembly and safe.
3. Application of Composite Material for different mechanical components.
4. Case study of one patent/ copyright/trademark from the product design point of view.
5. Design of Human Powered system.

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 A **Course Name : Elective – III Tribology**

Teaching Scheme:		**Credits**		**Examination Scheme:**			
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR**	**: --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR**	**: --**
						TW	**: 25**

Pre-requisites	: Physics, Chemistry, Mathematics, Fluid Mechanics, Theory of Machine and Machine Design

Course Objectives:

- To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
- To select proper grade lubricant for specific application.
- To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
- To introduce the concept of surface engineering and its importance in tribology.
- To understand the behavior of Tribological components.

Course Outcomes:

On completion of the course, students will be able to -

- The course will enable the students to know the importance of Tribology in Industry.
- The course will enable the students to know the basic concepts of Friction, Wear, Lubrications and their measurements.
- This course will help students to know the performance of different types of bearings and analytical analysis thereof.
- This course will help students to apply the principles of surface engineering for different applications of tribology.

Course Contents

Unit 1: Introduction to Tribology **6 Hrs**

Importance of Tribology in Design, Tribology in Industry, Economic Considerations, Lubrication-Definition, Lubricant properties, Viscosity, its measurements- Numerical, basic modes of lubrication, types of lubricants, Standard Grades of lubricants, selection of lubricants, commonly used lubricants and Hazards, Recycling of used oil, Disposal of used oil, bearing materials, bearing construction, oil seals and gaskets.

Unit 2: Friction and Wear **5 Hrs**

Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction.

Types of wear, various factors affecting wear, measurement of wear, wear between solids and flowing liquids, theories of wear

Unit 3: Hydrodynamic Lubrication **7 Hrs**

Theory of hydrodynamic lubrication, mechanism of pressure development in an oil film. Two dimensional Reynolds equation, Petroff's equation, pressure distribution in journal bearings - long & short, Load Carrying capacity, Somerfield number and its importance- Numerical. Introduction to Hydrodynamic Thrust Bearing

Unit 4: Hydrostatic Lubrication **5 Hrs**

Introduction to hydrostatic lubrication, hydrostatic step bearing, load carrying capacity and oil flow through the hydrostatic step bearing- Numerical.

Hydrostatic squeeze film : basic concept, circular and rectangular plate approaching a plane- Numerical

Unit 5: Elasto-hydrodynamic lubrication and Gas Lubrication **5 Hrs**

Elasto - hydrodynamic lubrication: Basic concept, Elasto-hydrodynamic lubrication between two contacting bodies, different regimes in EHL contacts.

Gas lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings, porous gas bearings, and Dynamic characteristics of gas lubricated bearing.

Unit 6: Surface Engineering **8 Hrs**

Concept and scope of Surface engineering, surface topography, apparent and real area of contact, tribological behavior of asperities contact- contact stress, surface roughness and hydrodynamic action- Numerical, surface coating-plating, fusion process, vapor phase processes, selection of coating for wear and corrosion resistance. Behavior of tribological components- selection of bearings, plain bearings, gears, wire ropes, seals and packings, conveyor belts, other tribological measures.

Books

Text :

1. Basu S.K., Sengupta S. N. and Ahuja B.B. "Fundamentals of Tribology" PHI Learning, Ltd. India.
2. Majumdar B. C. "Introduction to Tribology and Bearings", S. Chand and Company Ltd., New Delhi.

References :

1. Bharat Bhushan, "Principles and Applications of Tribology", John Wiley and Sons.
2. Sahu P., "Engineering Tribology", PHI Learning, Ltd. India
3. Fuller D.D. "Theory and Practice of Lubrication for Engineers". John Wiley and Sons.
4. Neale M. J. "Tribology hand Book", Butterworths. London.
5. Orlov P., "Fundamentals of Machine Design", Vol. IV, MIR Publication.
6. Cameron A. "Basic Lubrication Theory", Wiley Eastern Ltd.
7. 'Hailing J., "Principles of Tribology", McMillan Press Ltd., 1975.
8. Ghosh M.K., Mujumdar B.C. and Sarangi M., "Theory of lubrication", Tata McGraw Hill Education Pvt. Ltd., New Delhi.

Term Work shall consist of following assignments:

A] *Any one case study of the following*

1. Friction in sliding/ rolling contact bearing.
2. Wear of cutting tool.
3. Surface Coating.
4. Sliding/ rolling contact bearing Performance

B] Assignment based on the Tribological design of the system like I C Engine, Machine Tool, Rolling Mill.

OR

Industrial Visit: Students should visit the industry to study the lubrication systems or to study the techniques of surface coating.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 B — **Course Name : Elective – III Industrial Engineering**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: 02 hrs per week**	**TW**	**: 01**		**End-Sem : 70**	**OR : --**
						TW : 25

Pre-requisites: NIL

Course Objectives:

- To introduce the concepts, principles and framework of contents of Industrial Engineering.
- To acquaint the students with various productivity enhancement techniques.
- To acquaint the students with different aspects of Production Planning and Control and Facility Design.
- To introduce the concepts of various cost accounting and financial management practices as applied in industries.
- To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.
- To acquaint students with different aspect of simulation modeling for various industrial engineering\applications.

Course Outcomes:

On completion of the course, students will be able to -

- Apply the Industrial Engineering concept
- Understand, analyze and implement different concepts involved in method study.
- Design and Develop different aspects of work system and facilities.
- Understand and Apply Industrial safety standards, financial management practices.
- Undertake project work based on modeling & simulation area.

Course Contents

Unit 1: Introduction to Industrial Engineering and Productivity **6 Hrs**

Definition and Role of Industrial Engineering, Types of production systems and organization structure, Functions of management.

***Measurement of productivity*:** Factors affecting the productivity, Productivity Models and Index (Numerical), Productivity improvement techniques.

***Note*:** *Productivity improvement techniques viz. 5S, Kaizen, TPS, KANBAN, JIT, etc. shall be discussed at the end of this* Unit.

Unit 2: Method Study **6 Hrs**

Work Study: Definition, objective and scope of work-study, Human factors in work-study.
Method Study: Definition, objective and scope of method study, work content, activity recording and exam aids.
Charts to record movements: Operation process charts, flow process charts, travel chart, two-handed chart and multiple activity charts. Principles of motion economy, classification of movements, SIMO chart, and micro motion study.
Definition and installation of the improved method, brief concept about synthetic motion studies.
Introduction to Value Engineering and Value Analysis.

Unit 3: Work Measurements **6 Hrs**

Work Measurements: Definition, objectives and uses, Work measurement techniques.
Work Sampling: Need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.
Time Study: Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information, Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.
Introduction to PMTS and MTM: (Numerical), Introduction to MOST.

Unit 4: Production Planning and Control **6 Hrs**

Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning.
Capacity Planning, ERP: Modules, Master Production Schedule, MRP and MRP-II.
Forecasting Techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality (Numerical), Demand Control strategies (MTO, MTA, MTS).
Introduction to Supply Chain Management: Basic terminologies.

Unit 5: Facility Design **6 Hrs**

Plant Location : Need and factors influencing plant location,
Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate.
Material Handling: Objectives, relation with plant layout, principles. Types and purpose of different material handling equipment, Selection of material handling equipment.
Inventory control and Management: Types of inventories, Need of inventories, terminology, costs, Inventory Models: Basic production models, (with and without shortage and discount), ABC, VED Analysis.

Unit 6: Engineering Economy, Human Resource and Industrial Safety **6 Hrs**

Introduction to Costing: Elements of Cost, Break-Even Analysis (Numerical).
Introduction to Debit and Credit Note, Financial Statements (Profit and loss account and Balance Sheet), Techniques for Evaluation of capital investments.
Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training. Concept of KRA (Key Result Areas), Performance Appraisal (Self, Superior, Peer, 3600).
Industrial Safety: Safety Organization, Safety Program

Books

Text :

1. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication
3. Martend Telsang, Industrial Engineering, S. Chand Publication.
4. Banga and Sharma, Industrial Organization& Engineering Economics, Khanna publication.

References :

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi, Second Indian Adaptation, 2008.
2. H. B. Maynard, K Jell, Maynard‘s Industrial Engineering Hand Book, McGraw Hill Education.
3. Askin, Design and Analysis of Lean Production System, Wiley, India
4. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002
5. Martin Murry, SAP ERP: Functionality and Technical Configuration, SAP Press; 3rdNew edition (2010).
6. Barnes, Motion and time Study design and Measurement of Work, Wiley India
7. Raid Al-Aomar, Adwerd J Williams, Onur M. Uigen ‘Process Simulation using WITNESS’, Wiley

Term Work shall consist of following assignments:

- Minimum of *8 Experiments* are compulsory from the following list of Experiments.
- Assignment number *1*, *2*, *3*, *8* and *12* are compulsory.
- It is advisable that, students shall collect data by visiting suitable industry to complete following assignments (*Per batch of Max. 20 students*)
- For completing above assignments *any suitable simulation software* like WITNESS can be used

1. Case study based Assignment on Method Study.
2. Hands on Assignment on application of Work Measurement technique(s).
3. Assignment on simulation of Routing & Scheduling Model
4. Assignment on simulation of Manufacturing System / Service System Operations for demand forecasting of the given product using any two methods.
5. Assignment on simulation determination of EOQ and plot the graphs.
6. Assignment on analysis of Manufacturing / Service Operation for Capacity Planning.
7. Case study based assignment on supply chain model.
8. Assignment on analysis of (selected) plant layout modeling and simulation for bottleneck / line balancing.
9. Assignment on analysis of material handling system - modeling simulation for the selected plant layout.
10. Case study based assignment on identification of Key Result Areas for performance appraisal for selected company (3600 feedback).
11. Case study based assignment on cost-revenue model analysis.
12. Assignment on industrial safety audit of selected work environment.

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402049 C **Course Name : Elective – III Robotics**

Teaching Scheme:		Credits		Examination Scheme:			
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR	: --
Practical	: 02 hrs per week	TW	: 01		End-Sem : 70	OR	: --
						TW	: 25

Pre-requisites:	Engineering Mechanics, TOM, Mechatronics, Basics of Electrical and Electronics Engineering, Control system.

Course Objectives:

- To get acquainted with basic components of robotic systems.
- To study various gripper mechanisms and sensors and understand role of suitable control system.
- To understand statistics & kinematics of robots
- To develop competency in obtaining desired motion of the robot.
- To study various programming methods in robotics.
- To understand need of modern techniques in robotics.

Course Outcomes:

On completion of the course, students will be able to -

- Identify different type of robot configuration with relevant terminology.
- Select suitable sensors, actuators and drives for robotic systems.
- Understand kinematics in robotic systems.
- Design robot with desired motion with suitable trajectory planning.
- Select appropriate robot programming for given application.
- Understand need of IoT, machine learning, simulation in robotics.

Course Contents

Unit 1: **6 Hrs**

Introduction**:** Basic Concepts, laws of Robotics, Robot anatomy, Classification, structure of robots, point to point and continuous path robotic systems. Robot performance- resolution, accuracy, repeatability, dexterity, compliance, RCC device, Applications.

Robot Grippers: Types of Grippers, Design of gripper, Force analysis for various basic gripper systems including Mechanical, Hydraulic and Pneumatic systems.

Unit 2: **6 Hrs**

Robotic Sensors**:** Characteristics of sensing devices, Classification, Selection and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot. GPS, IMU, Vision, PVDF Tactile (construction, working and selection)

Drives and Control Systems : Types and selection of Drives, Actuators and transmission systems, Types of Controllers, closed loop control, second order linear systems and their control, control law of partitioning, trajectory-following control, modeling and control of a single joint, force control.

Unit 3: **6 Hrs**

Kinematics : Transformation matrices and their arithmetic, link and joint description, Denavit–Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics of two joints, solvability, algebraic and geometrical methods.

Velocities and Static Forces in Manipulators: Motion of the manipulator links, Jacobians, singularities, static forces, Jacobian in force domain.

Unit 4: **6 Hrs**

Introduction to Dynamics, Trajectory generations, Motion planning and control: Joint and Cartesian space trajectory planning and generation, potential field method for motion planning Manipulator Mechanism Design, Force control and hybrid position/force control

Unit 5: **6 Hrs**

Machine Vision System: Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image Processing Techniques, Masking, Sampling and quantization, Noise reduction methods, Edge detection, Segmentation.

Robot Programming : Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Robot language structure, Introduction to various types such as RAIL and VAL II

Unit 6: **6 Hrs**

Artificial Intelligence: Introduction, Need and Application, Problem solving through forward and backward search.

Introduction to Internet of Things (Industrial control, Smart Social Network), Industry 4.0, Machine learning

Simulation : Need of simulation, tools, types and techniques of simulation

Books

Text :

1. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

References :

1. Groover M.P.-Automation, production systems and computer integrated manufacturing‘ - Prentice Hall of India
2. S B Niku, Introduction to Robotics, Analysis, Control, Applications, 2nd Edition, Wiley Publication, 2015.
3. John Craig, Introduction to Robotics, Mechanics and Control, 3rd Edition, Pearson Education, 2009
4. Mathia, Robotics for Electronics Manufacturing, Cambridge Uni. Press, India
5. A Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2013.
6. R K Mittal & I J Nagrath, Robotics and Control, McGraw Hill Publication, 2015.

7. K Astrom & T Hagglund, PID Controllers: Theory, Design and Tuning, 2nd Edition, The Instrumentation, Systems, and Automation Society, 1995.
8. Asfahl, Robots and Manufacturing Automation, Wiley, India, 2012
9. S. K. Saha, Introduction to Robotics, TMH International
10. Ganesh Hegde, Industrial Robotics, Laxmi publication
11. www.roboanalyzer.com

Term Work shall consist of following assignments:

The term work shall consist of detailed report on ***any five*** *of the following practical, essentially with* *one demonstration*, *one gripper design* *and an* *industrial visit*.

1. Simulation of Cartesian / Cylindrical/Spherical robot.
2. Simulation of Articulated / SCARA robot.
3. Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software.
4. Design, modeling and analysis of two different types of gripper.
5. Program for linear and non-linear path.
6. Report on industrial application of robot /Industrial visit.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 A **Course Name : Elective – IV**
Advanced Manufacturing Processes

Teaching Scheme:		Credits		Examination Scheme:		
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem : 30	PR : --
Practical	: --	TW	: --		End-Sem : 70	OR : --
						TW : --

Pre-requisites:	Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes

Course Objectives:

- To analyze and identify applications of special forming processes
- To analyze and identify applications of advanced joining processes
- To understand and analyze the basic mechanisms of hybrid non-conventional machining techniques
- To understand various applications and methods of micro and nano fabrication techniques
- To understand advanced Additive Manufacturing (AM) technology for innovations in product development
- To understand various material characterization techniques.

Course Outcomes:

On completion of the course, students will be able to -

- Classify and analyze special forming processes
- Analyze and identify applicability of advanced joining processes
- Understand and analyze the basic mechanisms of hybrid non-conventional machining techniques
- Select appropriate micro and nano fabrication techniques for engineering applications
- Understand and apply various additive manufacturing technology for product development
- Understand material characterization techniques to analyze effects of chemical composition, composition variation, crystal structure, etc.

Course Contents

Unit 1: Special Forming Processes **6 Hrs**

Principle, Machines, Process variables, characteristics, advantages, limitations and application of High Energy Rate Forming process (HERF), High Velocity Forming (HVF), Explosive forming, Magnetic pulse forming, Electro hydraulic forming, Metal spinning, Flow forming, Stretch forming, Incremental sheet metal forming, Petro-forge forming, Micro forming, Micro coining, Micro extrusion, Micro bending/laser bending, fine blanking.

Unit 2: Advanced Joining Processes **6 Hrs**

Friction stir welding, Electron Beam welding, Laser beam welding, Ultrasonic welding, Under water welding, Cryogenic welding, Thermal spray coatings, Welding of plastics and composites, Explosive joining, Adhesive bonding

Unit 3: Hybrid Non-conventional Machining Techniques **6 Hrs**

Introduction to hybrid processes, Abrasive flow finishing, Magnetic abrasive finishing, Abrasive water-jet machining, Wire electric discharge machining, Electrochemical grinding (ECG), Electrochemical Deburring (ECD), Shaped tube electrolytic machining (STEM), Electro-jet Machining (EJM), Electrolytic In-process dressing (ELPD), Ultrasonic assisted EDM, Rotary EDM, Electrochemical discharge Machining (ECDM), Laser surface treatments.

Unit 4: Micro Machining and Nano Fabrication Techniques **6 Hrs**

Introduction, need of micro and nano machining, Machine/setup, Process parameters, Mechanism of material removal, Applications, Advances of the Diamond Turn machining, Ultrasonic micro-machining, Focused Ion Beam Machining, Lithography, photochemical machining, Challenges in micro and nano fabrication techniques.

Unit 5: Additive Manufacturing Processes **6 Hrs**

Introduction and principle of the additive manufacturing process; Generalized additive manufacturing process chain; Classification of additive manufacturing processes and its principle, process steps and materials;

Post-processing of parts manufactured by Additive Manufacturing (AM) processes, Software issues in AM, Design For Additive Manufacturing (DFAM), Applications of Additive Manufacturing in Medical and Aerospace technologies

Unit 6: Material Characterization Techniques **6 Hrs**

Introduction : Material Characterization

Microscopy : Electron Microscopes, Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Scanning Tunneling Microscope (STM), Atomic Force Microscope (AFM), Field Ion Microscope (FIM);

Spectroscopy : Energy-dispersive X-ray spectroscopy (EDX), X-Ray Diffraction (XRD), X-Ray Photoelectron Spectroscopy (XPS), Nuclear Magnetic Resonance Spectroscopy (NMR), Electron Backscatter Diffraction (EBSD)

Books

Text :

1. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd.
2. M. P Groover., Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, 6th Edition, Wiley 2015
3. A. Ghosh, A. K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd., New Delhi

References :

1. ASM: Metal Handbook, Volume 6, "Welding, Brazing and Soldering", Metal Park, Ohio.
2. ASM: Metal Handbook, Volume 14, "Forming", Metal Park, Ohio.
3. R. Balasubramaniam, RamaGopal V. Sarepaka, SathyanSubbiah, Diamond Turn Machining: Theory and Practice, CRC Press, ISBN 9781138748323 - CAT# K32643
4. V. K. Jain, Micro manufacturing Processes, CRC Press ISBN-13: 978-1138076426 ISBN-

10: 1138076422
5. Ian Gibson, David Rosen, B.Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, And Direct Digital Manufacturing, New York, NY : Springer, 2015.
6. Sam Zhang, Lin Li, Ashok Kumar, Materials characterization techniques. Boca Raton: CRC Press. ISBN 1420042947
7. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
8. Schwartz, A. J., Kumar, M., Adams, B. L., and Field, D. P., eds., 2009, Electron Backscatter Diffraction in Materials Science, Springer US.

Savitribai Phule Pune University

Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 B | **Course Name : Elective – IV Solar and Wind Energy**

Teaching Scheme:		**Credits**		**Examination Scheme:**		
Theory	**: 03 Hrs Per Week**	**TH**	**: 03**	**Theory**	**In-Sem : 30**	**PR : --**
Practical	**: --**	**TW**	**: --**		**End-Sem : 70**	**OR : --**
						TW : --

Pre-requisites	: Basic Mechanical Engineering, Basic Electrical and Electronics Engineering and Heat Transfer

Course Objectives:

- To understand fundamentals of solar and wind energies.
- To understand constructions, working principle and design procedure of solar and wind power plants.
- To apply basic engineering principle to design a simple solar and wind power system.

Course Outcomes:

On completion of the course, students will be able to -

- Design of solar food drier for domestic purpose referring existing system
- Design of parabolic dish solar cooker for domestic purpose referring existing system
- Design of solar photovoltaic system for domestic purpose referring existing system
- Design miniature wind mill for domestic purpose referring existing system

Course Contents

Unit 1: Solar Energy Principles **6 Hrs**

Present solar energy scenario, world energy futures, governing bodies (self-study), solar radiations and its measurements, solar constant, solar radiation geometry, solar radiation data, estimation of average solar radiation, solar radiation on tilted surface.

Unit 2: Solar Thermal Systems and Applications **8 Hrs**

Types of Solar thermal collector, flat plate collector analysis, Evacuated tube collectors (ETC) analysis, its design and application, solar air heaters and its types, solar distillation.

Solar Concentrating collectors: types- line and point concentrator, theory of Concentrating collectors, parabolic trough collector, parabolic dish collector, solar tower, concentrated Fresnel linear receiver (CFLR).

Unit 3: Solar Photovoltaic and Applications **6 Hrs**

Forming the PN junction solar cells & its applications, Structure of a solar cell, types of modules, PV array, solar cell equation, Fill factor and maximum power, Grid aspects of solar power, equipment used in solar photovoltaic plants, Power Conditioning Equipment-inverters, Regulators, Other Devices; System Analysis-Design Procedure, Design Constraints, Other Considerations.

Unit 4: Case Study on Solar Energy Applications **6 Hrs** *Case study 1*: Design of solar food drier for domestic purpose referring existing system *Case study 2*: Design of parabolic dish solar cooker for domestic purpose referring existing system *Case study 3*: Design of solar photovoltaic system for domestic purpose referring existing system
Unit 5: Wind Energy **8 Hrs** Principle of wind energy conversion; Basic components of wind energy conversion systems; various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades and estimation of power output; wind data and site selection considerations, wind energy potential and installation in India.
Unit 6: Case Study on Wind Mill Design **2 Hrs** Case study on designing miniature wind mill for domestic purpose referring existing system.
Books
Text : 1. G. D. Rai, 'Non-Conventional Energy Sources', Khanna Publisher 2. S. P. Sukhatme, 'Solar Energy: Principles of thermal collections and storage', McGraw Hill 3. Tiwari G N. 'Solar Energy: Fundamentals, design, modeling and Applications', Narosa, 2002
References : 1. Mukund R. Patel, 'Wind And Solar Power Systems: Design, Analysis and Operation, Second Edition', CRC Press 2. Kreith And Kreider, Solar Energy Handbook, McGraw Hill 3. Ray Hunter, 'Wind Energy Conversion: From Theory to Practice', John Wiley and Son Ltd 4. Gary L Johnson, 'Wind Energy Systems', Prentice-Hall Inc., New Jersey 5. Martin O L Hansen, 'Aerodynamics of Wind Turbines', James & James/Earthscan. 6. Goswami D Y, Kreith F, Kreider J F, 'Principles of Solar Engineering', Taylor & Francis 7. Robert Gasch, 'Wind Power Plant Fundamentals, Design, Construction And Operations', Springer 8. C S Solanki, 'Solar Photovoltaic: Fundamentals, Technology And Applications', PHI Learning

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402050 C **Course Name : Elective – IV**

Product Design and Development

Teaching Scheme:		Credits		Examination Scheme:				
Theory	: 03 Hrs Per Week	TH	: 03	Theory	In-Sem	: 30	PR	: --
Practical	: --	TW	: --		End-Sem	: 70	OR	: --
							TW	: --

Pre-requisites	: Basic Engineering Science - Physics, Chemistry, Material Science, Engineering Metallurgy, Manufacturing processes

Course Objectives:

To explain student's significance of

- Product design and Product development process
- Customer needs, satisfaction and commercialization of product
- Forward & Reverse Engineering and its role in designing a product
- Design Aspects (DFA, DFMEA, Design for Reliability and Safety)
- Product Life Cycle Management and Product Data Management

Course Outcomes:

On completion of the course, students will be able to -

- Understand essential factors for product design
- Design product as per customer needs and satisfaction
- Understand Processes and concepts during product development
- Understand methods and processes of Forward and Reverse engineering
- Carry various design processes as DFA, DFMEA, design for safety
- Understand the product life cycle and product data management

Course Contents

Unit 1: Introduction to Product Design and Development **6 Hrs**

Definition of product design, Essential Factors for product design, Modern approaches to product design, standardization, simplification and specialization in product design product development, product development versus product design, modern product development process, product testing and validation.

Unit 2: Product Development –Technical and Business Concerns **6 Hrs**

Mission Statement and Technical Questioning, Technology Forecasting and S Curve, Customer Needs and Satisfaction, Customer Needs - Types and Models, tools for Gathering Customer Needs, Customer Population and Market Segmentation.

Unit 3: Product Development from Concept to Product Function **6 Hrs**

Product information gathering, brainstorming and lateral thinking, morphological analysis of product, generating concepts, concept selection - design evaluation, estimation of technical feasibility, concept selection process, Pugh's concept, selection charts, concept scoring, process of concept embodiment, system modeling, functional modeling and decomposition, fast method, subtract and operate procedure, Simulation driven design.

Unit 4: Reverse Engineering **6 Hrs**

Product Teardown Process, Tear Down Methods, Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used in Benchmarking Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture.

Unit 5: Design for X **6 Hrs**

Design for manufacture, Design for assembly, Design for robustness, Design for safety, Design for reliability, Design for environment, Design for piece part production, manufacturing cost analysis. Local, Regional and Global issues, basic life cycle assessment - basic method, weighed sum assessment method (Numerical), Design Failure mode effect analysis.

Unit 6: Product Life Cycle Management and Product Data Management **6 Hrs**

Introduction, Concept of Product Life Cycle management, Components/Elements of PLM, Customer Involvement, Product Data and Product Workflow, The Link Between Product Data and Product Workflow, Different Phases of Product Life Cycle and corresponding technology.

Books

Text :

1. K. Chitale; R.C. Gupta, Product Design and Manufacturing, Prentice Hall India.
2. Dieter George E., Engineering Design McGraw Hill Pub. Company, 2000.

References :

1. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education Inc.
2. Grieves, Michael, Product Lifecycle Management McGraw Hill
3. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Pub.
4. Karl Ulrich, product design and development, TMH.

Savitribai Phule Pune University
Final Year of Mechanical Engineering (2015 Course)

Course Code : 402051 **Course Name : Project – II**

Teaching Scheme:		Credits		Examination Scheme:				
Theory	: --	TH	: --	Theory	In-Sem	: --	PR	: --
Practical	: 12 hrs per week	TW	: 06		End-Sem	: --	OR	: 100
							TW	: 100

Course Contents

INSTRUCTIONS FOR PROJECT REPORT WRITING

It is important that the procedures listed below be carefully followed by all the students of B.E. (Mechanical Engineering).

1. Prepare ***Three Hard Bound Copies*** of your manuscript.
2. Limit your Dissertation report to *80– 120* pages (preferably)
3. The *footer must include* the following:
   Institute Name, B.E. (Mechanical) Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 pt. centrally aligned.
5. Print the manuscript using
   a) Letter quality computer printing.
   b) The main part of manuscript should be Times New Roman 12 pt. with alignment - justified.
   c) Use 1.5 line spacing.
   d) Entire report shall be of 5- 7 chapters
6. Use the paper size 8.5’’ × 11’’ or A4 (210 × 197 mm). Please follow the margins given below.

Margin Location	Paper 8.5’’ × 11’’	Paper A4 (210 × 197 mm)
Top	1’’	25.4 mm
Left	1.5’’	37 mm
Bottom	1.25’’	32 mm
Right	1’’	25.4mm

7. All paragraphs will be 1.5 lines spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
8. Section titles should be bold with 14 pt. typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt. bold and Title Case (the first letter of each word is to be capitalized).
10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.
    a) Illustrations should not be more than two per page. One could be ideal
    b) Figure No. and Title at bottom with 12 pt.
    c) Table No. and Title at top with 12 pt.
    d) Legends below the title in 10 pt.
    e) Leave proper margin in all sides

f) Illustrations as far as possible should not be photo copied.

11. Photographs if any should be of glossy prints
12. Please use SI system of units only.
13. Please number the pages on the front side, centrally below the footer
14. References should be either in order as they appear in the thesis or in alphabetical order by last name of first author
15. Symbols and notations if any should be included in nomenclature section only
16. Following will be the order of report
    i. Cover page and Front page (*as per the specimen on separate sheet*)
    ii. Certificate from the Institute (*as per the specimen on separate sheet*)
    iii. Acknowledgements
    iv. Contents
    v. List of Figures
    vi. List of Tables
    vii. Nomenclature
    viii. Abstract (A brief abstract of the report not more than 150 words. The heading of abstract i.e. word "Abstract" should be bold, Times New Roman, 12 pt and should be typed at the center. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on motive, method, key-results and conclusions in Abstract

    1. Introduction (2-3 pages) (TNR – 14 Bold)
        1.1 Problem statement (TNR – 12)
        1.2 Objectives
        1.3 Scope
        1.4 Methodology
        1.5 Organization of Dissertation

    2. Literature Review (20-30 pages)
    Discuss the work done so far by researchers in the domain area and their significant conclusions. No derivations, figures, tables, graphs are expected.

    3. This chapter shall be based on your own simulation work (Analytical/ Numerical/FEM/CFD) (15- 20 pages)

    4. Experimental Validation - This chapter shall be based on your own experimental work (15-20 pages)

    5. Concluding Remarks and Scope for the Future Work (2-3 pages)
    References ANNEXURE (if any) (Put all mathematical derivations, Simulation program as Annexure)

17. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, … and for subheadings 1.1, 1.2, …. etc and section subheadings 2.1.1, 2.1.2, …. etc.
18. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source / citation of it. Please follow the following procedure for references

<u>Reference Books</u> :

Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford

University Press, UK, 1996, pp. 110 – 112.

<u>*Papers from Journal or Transactions*</u> :

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.

Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

<u>*Papers from Conference Proceedings*</u> :

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

<u>*Reports, Handbooks etc.*</u> :

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002.

ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

<u>*Patent*</u> :

Patent no, Country (in parenthesis), date of application, title, year.

<u>*Internet*</u> :

www.(Site) [Give full length URL] *accessed on date*

A Project Report on
(TNR, 16pt, centrally aligned)

Title of the Project Report

(TNR, 27pt, Bold, Centrally Aligned, Title Case)

By
(TNR, 16pt, Centrally Aligned)

Mr. Student's 1 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 2 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 3 Name
(TNR, 16pt, Centrally Aligned)

Mr. Student's 4 Name
(TNR, 16pt, Centrally Aligned)

Guide
Guide's Name
(TNR, 16pt, Centrally Aligned)

Institute Logo

Department of Mechanical Engineering
Name of the Institute
[2018-19]
(TNR, 22pt, Title Case Centrally Aligned)

Name of the Institute

Institute Logo

C E R T I F I C A T E

This is to certify that ***Mr. (Name of the Student)***, has successfully completed the Project Stage – I entitled "(***Title of the Project)***" under my supervision, in the partial fulfillment of Bachelor of Engineering - Mechanical Engineering of University of Pune.

Date:

Place:

Guide's Name
Guide

Internal Examiner

HoD Name
Head of the Department

Principal Name
Principal

External Examiner

Seal

Savitribai Phule University of Pune

Third Year Civil Engineering

(2015 Course)

Semester I

Course Code	Course	Teaching Scheme hour/week			Semester Examination Scheme of marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	T W	OR	PR	Total	TH/TUT	PR/OR/TW
301001	Hydrology and water resource engineering.	03	--	02	30	70	--	50	--	**150**	03	01
301002	Infrastructure Engineering and Construction Techniques	03	--	--	30	70	--	--	--	**100**	04	--
301003	Structural Design-I	04	--	04	30	70	50	50	--	**200**	04	02
301004	Structural Analysis-II	04	--	--	30	70	--	--	--	**100**	03	--
301005	Fluid Mechanics-II	04	--	02	30	70	--	50	--	**150**	04	01
301006	Employability Skills development	--	--	02	--	--	50	--	--	**50**	--	01
	Total	18	--	10	**150**	**350**	**100**	**150**		**750**	**18**	**05**

Semester II

Course Code	Course	Teaching Scheme hour/week			Semester Examination Scheme of marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	T W	OR	PR	Total	TH/TUT	PR/OR/TW
301007	Advanced Surveying	03	--	02	30	70	50	--	--	**150**	03	01
301008	Project Management and Engineering Economics	04	--	--	30	70	--	--	--	**100**	04	--
301009	Foundation Engineering	03	--	--	30	70	--	--	--	**100**	03	--
301010	Structural Design-II	04	--	04	30	70	50	50	--	**200**	04	02
301011	Environmental Engineering-I	04	--	02	30	70	--	--	50	**150**	04	01
301012	Seminar	--	--	01	--	--	--	50	--	**50**	--	01
	Total	18	--	09	**150**	**350**	**100**	**100**	**50**	**750**	**18**	**05**

Savitribai Phule Pune University

TE Civil (2015 Course) w.e.f. June 2017

301001 Hydrology and Water Resource Engineering

Teaching scheme	Examination scheme
Lectures: 3 hours/week	In semester exam: 30 marks---1 hour Paper
Practical: 2 hours/week	End semester exam: 70 marks—2.5 hours Paper
	Oral: 50 Marks

Unit – I **(06 hours)**

Introduction to Hydrology:
Hydrological cycle, Application of hydrology

Precipitation:
Types of precipitation, measurement, Rain gauge network, Preparation of data-estimation of missing data, Consistency test, Presentation of rainfall data-mass rainfall curves, Hyetograph, Point rainfall, Moving average, Mean precipitation over an area- arithmetic mean method, Thiessen's polygon, isohyetel method, Concepts of depth-area-duration analysis, Frequency analysis - frequency of point rainfall and plotting position, Intensity-duration curves, Maximum Intensity-duration- frequency analysis

Abstractions of Precipitation: Intersection, Depression storage, Evaporation- Elementary concepts, factors affecting, Measurement of evaporation, Transpiration, Evapotranspiration- process and measurement, Infiltration –introduction, Infiltration capacity, Infiltrometer, Horton's method and infiltration indices

Stream Gauging:
Selection of site, various methods of discharge measurement (velocity-area method, dilution method, slope-area method), Advance techniques/equipments used in gauge discharge measurements such as Radar, Current meter, ADCP (Acoustic Doppler Current Profiler)

Unit – II **(06 hours)**

Introduction to Irrigation:
Definition, Functions, Advantages and Necessity, Methods of Irrigation, Surface Irrigation, Subsurface Irrigation, Micro-Irrigation

Water Requirements of Crops:
Soil moisture and Crop water relationship, Factors governing Consumptive use of water, Principal Indian crops, their season and water requirement, Crop planning, Agricultural practices, Calculations of canal and reservoir capacities – duty, delta, irrigation efficiency

Assessment of Canal Revenue:
Various methods (Area basis or crop rate basis, volumetric basis, seasonal basis, composite rate basis, permanent basis or betterment levy basis)

Unit III **(06 hours)**

Ground Water Hydrology:
Occurrences and distribution of ground water, Specific yield of aquifers, Movement of ground water, Darcy's law, Permeability, Safe yield of basin, Hydraulics of wells under steady flow condition in confined and unconfined aquifers, Specific capacity of well, Well Irrigation: Tube wells, Open wells and their construction

Unit – IV **(06 hours)**
Runoff:
Introduction, Factors affecting runoff, Rainfall-Runoff relationships, Empirical Techniques to determine runoff, Runoff hydrograph- Introduction, Factors affecting Flood Hydrograph, Components of Hydrograph, Base flow separation, Effective rainfall,
Unit hydrograph theory, S-curve hydrograph, uses and limitations of Unit Hydrograph
Floods:
Estimation of peak flow, Rational formula and other methods, Flood frequency analysis, Gumbel's method, Design floods

Unit – V **(06 hours)**
Reservoir Planning: Introduction, Term related to reservoir planning (Yield, Reservoir planning and operation curves, Reservoir storage, Reservoir clearance), Investigation for reservoir planning, Significance of mass curve and demand curves, Applications of mass curve and demand curves, Fixation of reservoir capacity from annual inflow and outflow, Fixation of reservoir capacity using elevation capacity curve and dependable yield, Reservoir regulation, Flood routing- Graphical or I.S.D method, Trial and error method, Reservoir losses, Reservoir sedimentation- Phenomenon, Measures to control reservoir sedimentation, Density currents Significance of trap efficiency, Useful life of reservoir, Costs of reservoir, Apportionment of total cost, Use of facilities method, Equal apportionment method, Alternative justifiable expenditure method

Unit VI **(06 hours)**
Water Management:
Distribution, Warabandi, Rotational water supply system, Participatory Irrigation Management, Cooperative water distribution systems, Introduction to auto weather station
Water Logging and Drainage:
The process of water logging**,** Causes of water logging, Effects of water logging, preventive and curative measures, Land drainage, Reclamation of water logged areas, Alkaline and saline lands.
Reference Books
1. Irrigation Engineering - S. K. Garg, Khanna Publishers
2. Irrigation, Water Resources and water power engineering- P. N. Modi, Standard Book House.
3. Irrigation and water power Engineering- Dr. Punmia and Dr. Pande, Standard Publisher
4. Elementary Engineering Hydrology- M.J.Deodhar-Pearson Education

5. Engineering Hydrology. –Ojha—Oxford University Press
6. Engineering hydrology – K. Subramanyam Tata McGraw Hill.
7. Hydrology- Principles, Analysis and Desin, Raghunath, New Age International
8. Irrigation Engineering-Raghunath--Wiley
9. Groundwater Hydrology, 3ed—Todd--Wiley
10. Applied Hydrology – Chow, Maidment, Mays, McGraw-Hill
11. Principles of Hydrology- Ward and Robinson, Tata McGraw Hill
12. Irrigation Engineering - Bharat Singh

Term Work

Assignments (Hydrology and Water Resources Engineering)

Term work will consist of a journal giving the detailed report on assignments performed and visit report. **(any 8)**

1. Analysis of rainfall data (Double mass curve technique/Missing rainfall data).
2. Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods.
3. Analytical method of measurement of infiltration
4. Flood frequency studies assuming Gumbel's extreme value distribution.
5. Determination of peak flood discharge in a basin using unit hydrograph technique.
6. Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
7. Application of HEC-RAS for Hydrologic routing.
8. Site visit to Meteorological station
9. Measurement of / video demonstration of evaporation by Pan Evaporimeter
10. Measurement of / video demonstration of infiltration by Infiltrometer

Savitribai Phule Pune University TE Civil (2015 Course) w.e.f. June 2017 301002
Infrastructure Engineering and Construction Techniques

Teaching scheme	Examination scheme
Lectures: 3 hours/week	In semester exam: 30 marks---1 hour Paper
	End semester exam: 70 marks—2.5 hours Paper

Unit I - Infrastructure Engineering **(06 hours)**
a) Meaning and scope of Infrastructure Engineering: Scope of infrastructure engineering in national and global development, Forthcoming infrastructure projects at national and global level, Necessity, advantages and disadvantages of PPP (Public Private Partnership), Salient features of smart city , Bus rapid transit system.
b) Railways: Permanent way, Track structure of BG, Functions of rail, Standard rail, Tilting of rail, Coning of wheels, Types of sleepers, Fastenings, Ballast, Modern development in railways- metro rails, mono rails, bullet train.

Unit II- Railways **(06 hours)**
Rail joints, types, evil effects, remedial measures, Welding of rails, Short and long welded rails, Types of gradients, Curves, Grade compensation on curves, Alignment, Super elevation, Equilibrium cant, Equilibrium speed, Maximum permissible limits for cant, Cant deficiency, Cant excess, Speed on curves, Safe speed on curves using Indian railways formula only for fully transition curves, Concept of negative cant, Points, crossings and turnouts- functions, Components, elements of points, Types of crossings and turnouts, Track maintenance: Regular and Periodic. **(Site visit is recommended to learn this topic)**

Unit III - Construction Techniques **(06 hours)**
Necessity of mechanization, Dredging techniques, Use of barges, Dewatering techniques- Well Point system, Vacuum dewatering, Electro osmosis, Underwater drilling and blasting, Grouting methods in soft and hard soil, Diaphragm walls- purpose and construction methods, Prefabrication – applications, advantages and disadvantages.

Unit IV – Tunneling **(06 hours)**
Tunneling, functions & types of tunnel, Criteria for selection of size & shape of tunnels. Pilot tunnel, shaft, addit and portal, Needle beam, NATM, TBM & earth pressure balance method of tunneling in soft soil, Drilling & blasting method of tunneling including various operations like mucking, Drainage in tunneling- Pre drainage and permanent drainage, Ventilation in tunneling-temporary and permanent, Micro tunneling and trenchless tunneling.

Unit V- Docks & Harbors **(06 hours)**
Introduction, Requirements of harbors and ports, Classification of harbors with examples, Selection of site for harbor, Various components of ports, Break waters- types, comparison, design criteria , methods of construction, Tetra pod, Tri bar, Hexapod, Quay wall, Wet & dry dock, Floating dock, Wharves, Jetties, Types of fenders, Dolphins, Marin railway.

Unit VI - Construction Equipments **(06 hours)**

Dozers, Power shovels, Excavators, Loaders, Scrapers, Dumpers, Drag line, Clamp shell, Compactors, Pavers, Factors affecting performance, selection of equipment, Various types of hoists and cranes and selection, Boom placers, Simple numerical problems on cycle time and production rate, Economic maintenance & repair of construction equipment.

Reference books

1. Construction Planning Methods & Equipment:Puerifoy –Tata MC Graw Hill
2. Construction Equipments & its Management: S.C Sharma,Khanna Publication
3. Railway Engineering, 2/E by Chandra—Oxford University Press
4. Railway Track Engineering: J.S.Mundrey,Tata McGraw Hill
5. Harbour,Dock & Tunnel Engineering:R. Srinivasan
6. Dock & Harbour Engineering:Hasmukh P.Oza & Gautam H.Oza-Charoter Book Stall
7. Construction Project Scheduling & Control, 2ed—Mubarak--Wiley

University of Pune---TE Civil (2015 Course)---w.e.f. June 2017

301003 Structural Design I

Teaching scheme	**Examination scheme**
Lectures: 4 hours/week	**In semester exam: 30 marks---1.5 hour Paper**
Practical: 4 hours/week	**End semester exam: 70 marks—3 hours Paper**
	Oral based on T.W. : 50 Marks **Term Work: 50 Marks**

Design shall be based on IS: 800-2007

Unit I **(08 hours)**

a) Types of steel structures, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP38. IS:4000- 1992, codes for welded connections (mention code) . Philosophy of limit state design for strength and serviceability, partial safety factor for load and resistance, various design load combinations, classification of cross section such as plastic, compact, semi-compact and slender.

b) Tension member: various cross sections such as solid threaded rod, cable and angle sections. Limit strength due to yielding, rupture and block shear. Design of tension member: using single and double angle sections, connections of member with gusset plate by bolts and welds.

Unit II **(08 hours)**

a) Buckling classification as per geometry of cross section, buckling curves, design of struts in trusses using single and double angle section, connections of members with gusset plate by bolts and welds.

b) Design of axially loaded column using rolled steel section. Design of built-up column, lacing and battening, connection of lacing/battening with main components by bolts and welds.

Unit III **(08 hours)**

a) Design of eccentrically loaded column providing uniaxial and biaxial bending (check for section strength only).

b) Design of column bases: Design of slab base, gusseted base, and moment resistant base. (axial load and uni-axial bending)

Unit IV **(08 hours)**

a) Design of laterally supported beams using single rolled steel section with and without flange plate, curtailment of flange plates, strength in flexure, low and high shear, check for web buckling, web crippling and deflection.

b) Design of laterally unsupported beams using single rolled steel section with and without flange plate, curtailment of flange plates, strength in flexure and shear, check for deflection.

Unit V **(08 hours)**

a) Secondary and main beam arrangement for floor of a building, design of beam to beam and beam to column connections using bolt / weld.

b) Design of welded plate girder: design of cross section, curtailment of flange plates, stiffeners and connections.

Unit VI **(08 hours)**

a) Design of gantry girder: Selection of gantry girder, design of cross section, check for moment capacity, buckling resistance, bi-axial bending, deflection at working load and fatigue strength.

b) Roof truss: assessment of dead load, live load and wind load, design of purlin, design of members of a truss, detailing of typical joints and supports

Term work

Term work will consists of the following.

A) Four full imperial size drawing sheet showing structural detailing of 16 sketches based on syllabus. (Hand drawn)

B) Design of industrial building including roof truss, purlin, bracings, gantry girder, column, column base and connections.

Three full imperial size drawing sheets. (Hand drawn)

C) Design of welded plate girder, design of cross section, curtailment of flange plates, stiffeners and connections. One full imperial size drawing sheets.

Site visit is recommended to learn this topic.

OR

C) Design of building including primary and secondary beams, column, column base and connections. One full imperial size drawing sheets. (Using suitable software)

D) Two site visits: Report should contain structural details with sketches.

Oral Examination shall be based on the above term work.

Note: 1. Maximum number of students in a group, if any, should not be more than three to five for the term work design assignments.

2. Draw any one sheet from (B) and (C) Using suitable software.

Reference Books

1. Design of Steel Structure by N Subramanian, Oxford University Press, New Delhi.
2. Limit state design of Steel Structure by V L Shah & Gore, Structures Publication, Pune
3. Limit state design in Structural Steel by M.R. Shiyekar, PHI, Delhi
4. Structural Design in Steel—Sarwar Alam ,Raz—New Age International Publishers
5. Analysis and Design: Practice of Steel Structures—Karuna Ghosh-- PHI Learning Pvt. Ltd .Delhi
6. Limit state design of steel structures by S K Duggal, Tata McGraw Hill Education, New Delhi.
7. Design of Steel Structures by K. S. Sai Ram, Pearson, New Delhi.
8 Fundamentals of structural steel design M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.
9. Limit state design of Steel Structure by Ramchandra & Gehlot, Scientific Publishers, Pune.
10. Design of steel structure by Limit State Method as per IS: 800- 2007 by Bhavikatti S S, I.K. International Publishing House, New Delhi

Savitribai Phule Pune University
TE Civil (2015 Course) w.e.f. June 2017
301004 Structural Analysis II

Teaching scheme	Examination scheme
Lectures:4 hours/week	In semester exam: 30 marks---1 hour Paper
	End semester exam: 70 marks—2.5 hours Paper

Unit I **(08 hours)**

a) Slope-deflection method of analysis: Slope-deflection equations, equilibrium equation of Slope-deflection method, application to beams with and without joint translation and rotation, yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid jointed rectangular portal frames using slope-deflection method (Involving not more than three unknowns)

Unit II **(08 hours)**

a) Moment distribution method of analysis: Stiffness factor, carry over factor, distribution factor, application to beams with and without joint translation and yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid jointed rectangular single bay single storey portal frames using moment distribution method (Involving not more than three unknowns).

Unit III **(08 hours)**

a) Fundamental concepts of flexibility method of analysis, formulation of flexibility matrix, application to pin jointed plane trusses (Involving not more than three unknowns).

b) Application of flexibility method to beams and rigid jointed rectangular portal frames (Involving not more than three unknowns).

Unit IV **(08 hours)**

a) Fundamental concepts of stiffness method of analysis, formulation of stiffness matrix, application to trusses by member approach. Application to beams by structure approach only, (Involving not more than three unknowns).

b) Application to rigid jointed rectangular portal frames by structure approach only (Involving not more than three unknowns).

Unit V **(08 hours)**

a) Finite Difference Method – Introduction, application to deflection problems of determinate beams by central difference method

b) Approximate methods of analysis of multi-storied multi-bay 2 - D rigid jointed fames by substitute frame method, cantilever method and portal method.

Unit VI **(08 hours)**

a) Finite element method: Introduction, discretization, types of elements-1D, 2D, 3D, isoparametric and axisymmetric, convergence criteria, Pascals triangle, direct stiffness method, principal of minimum potential energy, principal of virtual work. (No numerical)
b) Shape functions: CST elements by using polynomials, 1D, 2D elements by using Lagrange's method

Reference Books

1. Structural Analysis: Deodas Menon---Narosa Publishing House.
2. Structural Analysis: Thandavamoorthy---Oxford University Press.
3. Structural Analysis: A Matrix Approach by Pundit and Gupta, McGraw Hills.
4. Structural Analysis by Hibbler, Pearson Education.
5. Structural Analysis: M. M. Das, B. M. Das---PHI Learning Pvt Ltd. Delhi.
6. Fundamentals of Structural Analysis: 2nd ed---West---Wiley.
7. Theory of Structures: Vol. I & II by B. C. Punmia, Laxmi Publication.
8. Theory of Structures: Vol. I & II by Perumull & Vaidyanathan, Laxmi Publication.
9. Fundamentals of Structural Analysis: K. M. Leet, Vang, Gilbert—McGraw Hills
10. Matrix Methods for structural engineering.by Gere, Weaver.
11. Introduction to Finite element method, Dr. P.N. Godbole, New Age Publication, Delhi.
12. Finite element Analysis, S.S. Bhavikatti, New Age Publication, Delhi.
13. Basic Structural Analysis: Wilbur and Norris.

Savitribai Phule Pune University
TE Civil (2015 Course) w.e.f. June 2017

301005 Fluid Mechanics-II

Teaching scheme	Examination scheme
Lectures: 4 hours/week	In semester exam: 30 marks---1 hour Paper
Practical: 2 hours/week	End semester exam: 70 marks—2.5 hours Paper
	Oral: 50 Marks

Unit I **(8 hours)**

a) Fluid Flow around Submerged Objects: Practical problems involving fluid flow around submerged objects, Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Drag on sphere, cylinder, flat plate and Aerofoil, Karman's vortex street, Effects of free surface and compressibility on drag, Development of lifts, Lift on cylinder and Aerofoil, Magnus effect, Polar diagram.

B)Unsteady Flow: Types of unsteady flow; Flow through openings under varying head, Fluid compressibility, Celerity of elastic pressure wave through fluid medium; Water hammer phenomenon; Rise of pressure due to water hammer, Surge Tanks and their functions.

Unit -II **(08 hours)**

a) Introduction to Open channel flow: Classification of channels, and Channel flows. Basic governing equations of Channel flow viz. continuity equation, energy equation and momentum equation, One dimensional approach, Geometric elements of channel, Velocity distribution in open channel flow, Introduction to notches and weirs ((Rectangular, Triangular, Trapezoidal).

b) Depth-Energy Relationships in Open Channel Flow:
Specific energy, Specific force Specific energy diagram, Specific force diagram, Depth discharge Diagram, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Important terms pertaining to critical flow viz. section factor, concept of first hydraulic exponent; Critical flow computations; channel transitions

Unit –III **(08 hours)**

a) Uniform flow in open channels : Characteristics and establishment of uniform flow, uniform flow formulae :Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient; Important terms pertaining to uniform flow, viz. normal depth, conveyance, section factor, concept of second hydraulic exponent, Uniform flow computations. Most efficient channel sections (rectangular, triangular, trapezoidal and circular).

b) Hydraulic Jump-Phenomenon of hydraulic jump; Location and examples of occurrence of hydraulic jump; Assumptions in the theory of hydraulic jump; Application of momentum equation to hydraulic jump in rectangular channel: Conjugate depths and relations between conjugate depths. Energy dissipation in hydraulic jump; Graphical method of determination of energy dissipation, Classification of hydraulic jump; Practical uses of hydraulic jump, venture flume, standing wave flume

Unit -IV **(08 hours)**

a) Impact of Jet: Force and work done due to impact of jet on stationary and moving, flat and curved surfaces using linear momentum principle.

b) **Centrifugal Pumps**: General classification of pumps, Centrifugal pumps- Classification, theory working, Selection of pumps, Centrifugal head, Work done by impeller, Heads and efficiencies, minimum starting speed, Cavitation in centrifugal pumps, multistage pumping, Introduction to submersible pumps and reciprocating pumps,

Unit -V **(08 hours)**

a) Hydropower generation: Elements of hydropower plant; hydraulic turbines- Classification, heads and efficiencies, Design and governing of Pelton Wheel, Francis turbine-parts and working. Cavitation in hydraulic turbines- **Site visit is recommended to learn this topic.**

b) Performance of hydraulic turbines: Prediction of performance in terms of unit quantities and specific quantities, Specific speed, Characteristic curves, Dimensional analysis as applied to hydraulic turbines, selection of turbines

Unit-VI **(08 hours)**

a) Gradually Varied Flow in Open Channels-Definition and types of non-uniform flow; Gradually Varied Flow (GVF) and Rapidly Varied Flow (RVF); Basic Assumptions of GVF; Differential equation of GVF - Alternative forms; Classification of channel bed slopes, Various GVF profiles, their general characteristics and examples of their occurrence; Control section

b) **Gradually varied flow computations:** Methods of GVF computations. Direct Step method, Graphical Integration method, Standard Step method, VenTe Chow method.

Oral

The Oral is based on the term work which consists of a journal giving the detailed report on experiments and assignments performed and visit report.

List of Experiments

Following experiments and assignments shall be performed.

A) Experiments (All compulsory, Fluid Mechanics II)

1. Flow around a Circular Cylinder/Aerofoil
2. Study of Uniform Flow Formulae of Open channel.
3. Velocity Distribution in Open Channel Flow.
4. Calibration of Standing Wave Flume/Venturi flume
5. Study of Hydraulic Jump as Energy Dissipater. 6.
Impact of Jet on flat plate and curved vane
7. Characteristics of a Pelton Wheel
8. Characteristics of a Centrifugal Pump
9. Calibration of Notch

B) Assignments (All compulsory, Fluid Mechanics II):

(a) Graphical determination of energy loss in Hydraulic Jump.
(b) Assignment on GVF computation using Direct Step and VenTe Chow method.

C) Report on Site visit to Hydropower generation plant/Research Institute.

Reference Books

1. Engineering Fluid Mechanics by Garde, Mirajgaonkar, Scitech
2. Hydraulics and Fluid Mechanics by P. N. Modi & S. N. Seth Standard book house
3. Open Channel Flow by K Subranmanya, TMH, Third Ed.
4. Open Channel Hydraulics: Vente Chow - Tata McGraw Hill.
5. Open Channel Flow: K. G. RangaRaju - Tata McGraw Hill.
6. Fluid Mechanics- Fundamental and Applications by Cengel and Cimbala- McGraw Hill
7. Flow through Open Channels—Srivastava-- Oxford University Press
8. A test book of Fluid mechanics and Machinary by Bansal
9. Fluid Mechanics by Streeter, Wylie and Bedford – Tata McGraw Hill
10. Fluid Mechanics by White – Mc-Graw Hill
11. Fluid Mechanics-A.K.Mohanty- PHI Learning PvtLtd.Delhi
12. Open Channel Flow by M. M. Das - PHI Learning PvtLtd.Delhi

Savitribai Phule Pune University

TE Civil (2015 Course) w.e.f. June 2017

301006 Employability Skills Development

Teaching scheme	Examination scheme
Practical: 2 hours/week	Term Work: 50 Marks

How to handle this course? **(02 hours)**

This course has been introduced with the objective of enhancing the employability of the students through development of their skills. Following topics and their contents are expected to be explored through following 10 activities.

1. Expert lectures 2.Group discussions 3.Case study analysis 4.Group presentations 5.Company and corporate visits 6.Mock interviews and exercises 7.Demo presentations 8. Audio-video shows 9. Use of e-resources 10.Games.

The term work will consist of detailed report of any 8 out of above 10 activities. The activities which need to be performed in a group will have a group of not more than 6 students. However, the report for the term work will be prepared at individual level.

Unit I **(02 hours)**

a) What is Employability? What are Employability Skills? Focus on what skills do employers expect from graduates? Career planning with action plan.

Unit –II **(02 hours)**

b) Interpersonal Skills-Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, Negotiation, Avoiding Stress.

Unit –III **(02 hours)**

c) Presentation Skills-Presentation Skills What is a Presentation? Writing Your Presentation Coping with Nerves

Unit –IV **(02 hours)**

d) Communication Skills-Verbal Communication, Written Communication, Difference between C.V. Bio data and Resume

Unit –V **(02 hours)**

e) Commercial Awareness-Professional etiquettes and manners, Global negotiating and Persuading, Integrity. Global trends and statistics about civil engineering businesses.

Unit-VI **(02 hours)**

f) Personal skills-Leadership, Ability to work in a team, Conceptual ability, Subject Knowledge and competence, Analysing and investigating, Planning, Flexibility, Self, Lifelong Learning, ,Stress Tolerance, Creativity

Reference Reading

1.Cambridge English for Job Hunting—Colm Downes---Cambridge University Press(ISBN-978-0- 521-14470-4)

2.Polyskills--Foundation books-- Cambridge University Press—(ISBN 978-81-7596-916-2)

3.Global Business Foundation Skills-- Foundation books-- Cambridge University Press—(ISBN 978-81-7596-783-0)

E-Resources

www.skillsyouneed.com/general/employability-skills.html-
*www.kent.ac.uk/careers/sk/top-ten-skills.htm*www.skillsyouneed.com/general/employability-
www.fremont.k12.ca.us/cms/lib04/.../Domain/.../employability-skills.pdf

Savitribai Phule Pune University

TE Civil (2015 Course)---w.e.f. June 2017

301007 Advanced Surveying

Teaching scheme	Examination scheme
Lectures: 3 hours/week	In semester exam: 30 marks---1 hour Paper
Practical: 2 hours/week	End semester exam: 70 marks—2.5 hours Paper
	TW: 50 Marks

Unit-I Geodetic Surveying & SBPS (06 hours)

a) Objects, Methods of Geodetic Surveying, Introduction to triangulation, Classification of triangulation systems, Triangulation figures, Concept of well-conditioned triangle, selection of stations, Intervisibility and height of stations.

b) Introduction to SBPS; Positioning with SBPS - Absolute & Differential methods, Use of SBPS in Surveying, SBPS Co-ordinates & heights, Factors governing accuracy in SBPS positioning, Different types of errors in SBPS positioning. Earth ellipsoid, Geodetic datum and Co-ordinate systems, Applications of GPS in civil engineering.

Unit-II Hydrographic Surveying (06 hours)

Objects, Applications, Establishing controls, Shore line survey, Sounding, Sounding equipment, Methods of locating soundings – conventional and using GPS, Reduction of soundings, Plotting of soundings, Nautical sextant and its use, Three point problem and its use, solution of three point problem by all methods, Tides and tide gauges, determination of MSL

Unit-III Remote Sensing and Geographical Information System (06 hours)

a) Remote Sensing introduction, Definition, Necessity, Importance and use; Basic concepts in Remote Sensing , Basic Laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter, Resolution in remote sensing, Satellite remote sensing, Problems confronting remote sensing system. Ideal and Real remote sensing systems. Space platforms for remote sensing: Imaging sensors and techniques. Image interpretation:- Visual image processing & Digital image processing. Applications of remote sensing. Introduction to LIDAR & Underground utility survey. Comparison between aerial photograph and satellite image.

b) Geographical Information System -Introduction, Definition, Objectives, Components (people, procedure, hardware, software & data) & functions (input, manipulation, management, querry & analysis and visualization) of GIS. Coordinate systems and projections, Georeferencing, GIS data – spatial (Raster & vector) & aspatial data. Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of aspatial data. Applications of GIS such as visibility analysis, Slope analysis, Watershed analysis & Preparation of thematic maps. Limitations of GIS,

Unit -IV Triangulation Adjustment (06 hours)

Kinds of errors, Laws of weights, Determination of most probable values (MPV) of conditioned and independent quantities, Method of least squares, Indirect observations, Probable error and its determination, Distribution of error to the field measurements, Normal equation, Method of correlates. Station and figure adjustment of geodetic quadrilateral without central station.

Spherical triangle, Calculations of spherical excess and sides of spherical triangle.

Unit – V Aerial Photogrammetry **(06 hours)**

Objects, Classification- qualitative & quantitative photogrammetry, Applications, comparison of Map and aerial photograph, Vertical, Tilted and Oblique photographs, Scale of vertical photograph, Relief displacement in vertical photograph, Flight planning, Stereoscopic parallax & its measurement by parallax bar.
Mirror stereoscope, Differential height from differential parallax, Ground control points (GCPs), Introduction to digital photogrammetry, different stereo viewing techniques in digital photogrammetry, Method of creation of elevation data, Different products of digital photogrammetry.

Unit –VI Trigonometric Levelling and Setting out works **(06 hours)**

a) Trigonometric Levelling :- Terrestrial refraction, Angular corrections for curvature and refraction, Axis signal correction, Determination of difference in elevation by single observation and reciprocal observations.
b) Setting out of Construction works:- Setting out of a bridge, Determination of the length of the central line and the location of piers. Setting out of a tunnel – Surface setting out and transferring the alignment underground.

Term work

Term work shall consist of the following practicals and project.
Geodetic Surveying and Trigonometrical levelling (any three)
1. Measurement of horizontal and vertical angles with 1" theodolite.
2. Determination of elevation of inaccessible objects by trigonometrical levelling.
3. Practical based on various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stakeout .
4. Establishing control station using single or dual frequency GPS receiver

1. Study and use of nautical sextant and measurement of horizontal angles
2. Plotting of river cross-section by hydrographic surveying
3. Solution to three point problem by analytical method

1. Study of aerial photograph and finding out the scale of the photograph.
2. Determination of air base distance using mirror stereoscope.
3. Determination of difference in elevation by parallax bar.

1. Study and applications of different RS data products available with National Remote Sensing Centre (NRSC)
2. Use of RS images and visual interpretation
3. Use of interface and tools in GIS software such as GRAM++ or QGIS or equivalent software.

Project: (Any one)

1. Adjustment of geodetic quadrilateral without central station by method of correlates.
2. Field survey (500 sq.m.) using Differential GPS (Control as well as mapping).

Reference Books

1. Surveying & Levelling, 2/E—Subramanian—Oxford University Press
2. Surveying: Vol. II. and III by Dr. B. C. Punmia : Laxmi Publication - New Delhi.
3. Surveying and Levelling Vol. II by T. P. Kanetkar and S. V. Kulkarni Pune Vidyarthi Publication.
4. GPS Sattelite Surveying—Alfred Leick—Wiley
5. Remote sensing and Geographical Information System, By A. M. Chandra and S. K. Ghosh, Narosa Publishing House.
6. Remote Sensing & GIS,2/E—Bhatta-- Oxford University Press
7. Principles of Geographical Information System—Burrough-- Oxford University Press
8. Surveying—M.D.Saikia—PHI Learning Pvt .Ltd.Delhi
9. Advanced Surveying -Total Station, GIS and Remote Sensing by SatheeshGopi, R.Sathikumar and N. Madhu , Pearson publication
10. Surveying Vol. 2 by S. K. Duggal, McGraw Hill Publication
11. Remote sensing & image interpretation, Lillesand& Kiefer, John wiley Pub.
12. Surveying &levelling by R. Subramanian, Oxford Publication.

Suggested Reading

Bureau Gravimetrique International (BGI)
International GPS Service for Geodynamics (IGS)
International Association of Geodesy (IAG)
International Federation of Surveyors (FIG)
Permanent Service for Mean Sea Level (PSMSL)
Commission X Global and Regional Geodetic Networks
www.nrsa.gov.in
www.iirs-nrsa.gov.in
www.surveyofindia.gov.in

Savitribai Phule Pune University

TE Civil (2015 Course) w.e.f. June 2017

301008 Project Management and Engineering Economics

Teaching scheme	Examination scheme
Lectures: 4 hours/week	In semester exam: 30 marks---1 hour Paper
	End semester exam: 70 marks—2.5 hours Paper

Unit I **(8 hours)**

Introduction to project management

Importance, Objectives & Functions of Management , Principles of Management, Categories of Project, Project Failure, Project--- Life Cycle Concept and Cost Components, Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and Certified Project Management Professionals (PMP). Importance of organizational Structure in Management- Authority / Responsibility Relation, Management by objectives (MBO)

Unit –II **(08 hours)**

Project planning and scheduling

WBS – Work Breakdown Structure, Gantt/Bar chart & its Limitations, Network Planning, Network analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical path and type of Floats, Precedence network analysis (A.O.N.), Types of precedence relationship, P. E. R.T. Analysis

Unit –III **(08 hours)**

Project Resources and Site Planning

Objectives of Materials Management – Primary and Secondary Material Procurement Procedures - Material requirement - raising of Indents, Receipts, Inspection, Storage, Delivery, Record keeping – Use of Excel Sheets, ERP Software, Inventory Control - ABC analysis, EOQ, Introduction to Equipment Management – Fleet Management, Productivity Studies, Equipment Down Time, Sizing - Matching , Site Layout and Planning, Safety Norms – Measures and Precautions on Site, Implementation of Safety Programs

Unit –IV **(08 hours)**

Project Monitoring and Control

Resource Allocation – Resource Smoothening and Levelling, Network Crashing – Time- Cost – Resource optimization, Project Monitoring - Methods, Updating and Earned Value Analysis, Introduction to use of Project Management Softwares – MS Project / Primavera, Case study on housing project scheduling for a small project with minimum 25 activities.

Unit –V (08 hours) Project Economics

Introduction to Project Economics - Definition, Principles, Importance in Construction Industry, Difference between Cost, Value, Price, Rent, Simple and Compound Interest, Profit, Annuities, Demand, Demand Schedule, Law of Demand, Demand Curve, Elasticity of Demand, Supply, Supply Schedule, Supply Curve, Elasticity of Supply Equilibrium, Equilibrium Price, Equilibrium Amount, Factors affecting Price Determination, Law of Diminishing Marginal Utility, Law of Substitution, Concept of Cost of Capital, Time Value of Money, Sources of Project Finances –

Concepts of Debt Capital and Equity Capital. Types of Capital – Fixed and Working, Equity Shares and Debenture Capital, FDI in Infrastructure

Unit-VI **(08 hours)**

Project appraisal

Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility report and Detailed Project Report (DPR), Role of Project Management Consultants in Pre-tender and Post-tender.

Reference Books

1. Project Management—Khatua—Oxford University
2. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
4. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
5. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
6. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
7. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Savitribai Phule Pune University
TE Civil (2015 Course) w.e.f. June 2017
301009 Foundation Engineering

Teaching scheme	Examination scheme
Lectures: 3 hours/week	In semester exam: 30 marks---1 hour Paper
	End semester exam: 70 marks—2.5 hours Paper

Unit-I

Subsurface Investigations for Foundations (06 hours) Purpose and planning of subsurface exploration. Methods of Investigation: Trial pits, borings, depth & number of exploration holes, core recovery, RQD, Core Log. Geophysical methods– Seismic refraction and Electrical resistivity method. Disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler. Field tests- SPT, N value correction and significance, DCPT, SCPT and introduction of advanced testing techniques like Pressure meter test. **Site visit is recommended to learn this topic.**

Unit-II

Bearing capacity and Shallow Foundation (06 hours) Basic definitions, Modes of shear failure, bearing capacity analysis- Terzaghi's, Hanson's, Meyerhof's, Skempton's, Vesics equations and IS code method - Rectangular and Circular footings. Bearing Capacity evaluation: - Plate Load Test and SPT. Housel's perimeter shear concept. Bearing capacity of layered soil. Effect of water table on bearing capacity. Effect of eccentricity. Shallow foundation- Types and Applications. Floating foundation. Presumptive bearing capacity.

Unit-III **(06 hours)**

a) Settlement and Consolidation Settlement: - Introduction, Causes of settlement. Pressure bulb, Contact pressure, Significant Depth of foundation, Allowable settlement, Differential settlement - I.S. criteria, Types - Elastic settlement, Consolidation settlement. Use of Plate Load test and SPT in settlement analysis. Allowable soil pressure.

b) Consolidation - Introduction, spring analogy, Terzaghi's consolidation theory, Laboratory consolidation test, Determination of coefficient of consolidation- Square root of time fitting method and logarithm of time fitting method. Time factor. Rate of settlement and its applications in shallow foundation. Introduction of Normal consolidation, over consolidation and Preconsolidation pressure.

Unit-IV **(06 hours)**

Deep Foundations

Introduction, Pile classification, Pile installation-Cast in-situ, driven and bored pile, Load carrying capacity of pile by static method, Dynamic methods-Engineering news formula and Modified ENR formula. Pile load test and Cyclic Pile load test. Group action- Feld rule. Rigid Blocks method. Negative skin friction. Settlement of pile group in cohesive soil by approximate method. Piers and Caissons- Definition, Types and uses. Well foundation: components, sand Island method.

Unit V **(06 hours)**

Cofferdams and Foundation on Black Cotton Soils

a) Cofferdams: Types and concepts of Steel Sheet Piles and Precast Concrete Piles, Interlocking Circular Piles, RC Diaphragm wall method.

b) Foundation on Black Cotton Soils: Characteristics of black cotton soil, swelling potential and its evaluation methods, Engineering problems, Swelling pressure measurement, Foundations on black cotton soil: design principles, Construction techniques in B.C soils, under reamed piles-Design principles and its construction Techniques. Stone Columns prefabricated vertical Drains, Preloading technique, and vibro flotation technique.

Unit VI **(06 hours)**

Soil Reinforcement and Earthquake Geo-techniques

a) Soil Reinforcement: Basic components and Mechanism of reinforced soil. Geosynthetics: type's, functional properties and requirements. Geosynthetic Applications in Civil Engineering.

b) Earthquake Geo-techniques Introduction, Earthquake Terminology, Sources of earthquake, Seismic zones of India, Magnitude of an earthquake, Intensity of earthquakes, Effect of ground motion on structures, General principles of earthquake resistant design. Liquefaction Phenomenon.

Reference Books

1. Dr. B. J. Kasmalkar, "Foundation Engineering", Pune Vidyarthi Griha Prakashan, Pune
2. Gopal Ranjan and A. S. Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, (2010)
3. Dr. B. C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publications.
4. Soil Mechanics- T.William Lambe--Wiley
5. J. E. Bowels, "Foundation Analysis and Design", McGraw-Hill
6. Foudation Enginnering- P. C. Varghese-- PHI Learning Pvt. Ltd.
7. Soil Mechanics and Foundation Engineering- V. N. S Murthy, Marcel Dekker, Inc. Newyork.
8. Soil Mechanics & Foundation Engineering - Rao --Wiley
9. A. K. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers, 2009.
10. Engineering in Rocks for Slopes. Foundations and Tunnels - T Ramamurthy - PHI Learning
11. Geotechnical Engineering by Conduto, PHI, New Delhi.
12. Foundation Design Manual: N V Nayak, Dhanpat Rai Publications.
13. International Steven Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Publications.
14. Practical Handbook of Grouting: Soil-Rock and Structures---James Warner-- Wiley
15. IS 1892, 1893, 2911, 6403, SP36 (PART-II)

Savitribai Phule Pune University
TE Civil (2015 Course) w.e.f. June 2017

301010 Structural Design –II

Teaching scheme	Examination scheme
Lectures: 4 hours/week	In semester exam: 30 marks---1.5 hours Paper
Practical: 4 hours/week	End semester exam: 70 marks—2.5 hours Paper
	Term Work: 50 Marks, Oral Based on T.W.: 50 Marks

Unit I **(8 hours)**

Introduction to various design philosophies R.C structures: Historical development, Working stress method, Ultimate load method and Limit state method.

a) Working stress method: Moment of resistance of singly reinforced rectangular R.C. sections, Under reinforced, Balanced and Over reinforced sections. Moment of resistance of doubly reinforced rectangular sections.

b) Limit state method: Limit state of collapse, Limit state of serviceability and Limit state of durability. Characteristic strength, Characteristic load, concept of Safety - Probabilistic approach, Semi probabilistic approach. Partial safety factors for material strengths and loads. Study of Structural Properties of Concrete.

Unit II **(8 hours)**

a) Assumptions of Limit State Method, Strain variation diagram, Stress variation diagram, Design parameters for singly reinforced rectangular R.C. section, Moment of resistance of under reinforced and balanced section, M.R. of doubly reinforced rectangular section and flanged section.

b) Design of slab: One way, Simply supported, Cantilever and Continuous slabs by using IS code coefficients.

Unit III **(8 hours)**

a) Design of slab: Two way slabs: Simply supported, Continuous and Restrained.

b) Design of staircase: Dog legged and Open well.

Unit IV **(8 hours)**

Design of flexural members: Simply supported, Continuous, Cantilever beams (singly reinforced, doubly reinforced and flanged) for flexure.

Unit V **(08 hours)**

Design of flexural members:

a) Design of flexural members: For Shear, Bond and Torsion.

b) Design of flexural members: Redistribution of moments in continuous reinforced concrete beam.

Unit VI **(08 hours)**

a) Column: Introduction, Strain and Stress variation diagrams, axially loaded Short Column with minimum eccentricity requirements. Design of Short Column for axial load, Uni-axial, Biaxial bending using interaction curves.

b) Design of Isolated Column footing for axial load and uni-axial bending .

Term work

Design Assignments

a) Design of G + 2 (Residential/Commercial/Public) building covering all types of Slabs, Beams, Columns, Footings and Staircase (first and intermediate flights).

i. Minimum plan area of each floor shall be more than 150 m^2.

ii. Design of all plinth and ground beams.

iii. Design of all slabs, beams of first floor.

iv. Design of three types columns for, (a) axial load, (b)axial load + uniaxial BM, (c)axial load + biaxial BM), from terrace level to footing along with detailed load calculations and footing for columns with (a) axial load (b)axial load + uniaxial BM

v. Design any one element by using spread sheet.

vi. Detailing of reinforcement should be as per SP-34 & IS 13920

vii. Full imperial drawing sheets in four numbers. Out of which only structural plan drawing sheet shall be drawn by using any drafting software.

b) Reports of two site visits. (Building under construction)

Oral Examination shall be based on the above term work.

Note: Maximum number of students for projects not more than Four

Reference Books

1. "Illustrated Reinforced Concrete Design" by Dr. V.L.Shah and Dr. S.R. Karve, 'Structures Publications' , Pune 411009
2. "Illustrated Design of Reinforced Concrete Buildings (G+3)" by Dr. V.L.Shah and Dr. S.R. Karve, 'Structures Publications', Pune 411009.
3. "Design of Reinforced Concrete Structures" by Subramanian, 'Oxford University Press'.
4. "Limit State Analysis and Design" by P. Dayaratnram, 'Wheeler Publishing company', Delhi.
5. "Comprehensive Design of R.C. Structures" by Punmia, Jain and Jain, 'Standard Book House', New Delhi.
6. "RCC Analysis and Design" by Sinha, S, Chand and Co. New Delhi.
7. "Reinforced Concrete Design" by Varghese, PHI, New Delhi.
8. "Reinforced Concrete Design" by Pillai Menon, 'Tata McGraw Hill', New Delhi.
9. "Design of Concrete Structure" by J N Bandyopadhyay, PHI, New Delhi.

Savitribai Phule Pune University

TE Civil (2015 Course) w.e.f. June 2017

301011 Environmental Engineering-I

Teaching scheme	Examination scheme
Lectures: 4 hours/week	In semester exam: 30 marks--1 hour Paper
Practical: 2 hours/week	End semester exam: 70 marks—2.5 hours Paper
	Practical Exam: 50 Marks

Unit-I **(08 hours)**

A) Noise Pollution: Sound measurements – Sound pressure, Intensity, Sound pressure level, Loudness, Equivalent noise level and Cumulative noise level.

B) Air Pollution: Atmospheric stability, Mixing heights, Meteorological parameters.

Air pollution control mechanism. Equipment for particulate contaminants. Principle and working of Settling chamber, Cyclone, Fabric filter, ESP. Gaseous contaminants control by adsorption and absorption technique.

C) Municipal Solid Waste: Concept of Municipal Solid waste management, Sources, Classifications, Treatment (composting &anaerobic digestion) Disposal (sanitary land fill)

Unit -II **(08 hours)**

A) Introduction to water supply scheme: Data collection for water supply scheme, Components and layout. Design period, Factors affecting design period.

B) Quantity: Rate of water consumption for various purposes like domestic, Industrial, Institutional, Commercial, Fire demand and Water system losses, Factors affecting rate of demand, Population forecasting.

C) Quality: Physical, Chemical, Radioactivity and Bacteriological Characteristics, Heavy metals. Standards as per IS: 10500 (2012)

Unit –III **(08 hours)**

A) Water treatment: Principles of water treatment operations and processes, Water treatment flow sheets.

B) Aeration: Principle and Concept, Necessity, Methods, Removal of taste and odour. Design of aeration fountain.

C) Sedimentation: Plain and chemical assisted - principle, efficiency of an ideal settling basin, Settling velocity, Types of sedimentation tanks, Design of sedimentation tank. Introduction & design of tube settlers.

Unit -IV **(08 hours)**

A) Coagulation and flocculation: Principle of coagulation, Common coagulants alum & ferric salts, Introduction to other coagulant aids like bentonite clay, Lime stone, Silicates and Polyelectrolytes, Introduction of natural coagulants, Mean velocity gradient "G" and Power consumption, Design of Flocculation chamber, Design of Clari-flocculator.

B) Filtration: Theory of filtration, Mechanism of filtration, Filter materials, Types: Rapid, Gravity, Pressure filter, Multimedia and dual media filters, Components, Under drainage system, Working and cleaning of filters, Operational troubles, Design of Rapid sand Gravity filters.

Unit -V **(08 hours)**

A) Disinfection: Mechanism, Factors affecting disinfection, Types of disinfectants, Types and methods of chlorination, Break point chlorination, Bleaching powder estimation.
B) Water softening methods and Demineralization : lime-soda, Ion-Exchange, R.O. and Electrodialysis
C) Fluoridation and defluoridation.

Unit-VI **(08 hours)**

A) Water distribution system: System of water supply- Continuous and intermittent system. Different distribution systems and their components. ESR- Design of ESR capacity. Wastage and leakage of Water- Detection and Prevention.
B) Rainwater harvesting: Introduction, need, methods and components of domestic rainwater harvesting system. Design of roof top rainwater harvesting system.
C) Introduction to Packaged WTP in townships, big commercial plants, necessity (On-site water treatment)

Term Work

Note- Any 8 out of 10 Practicals. (a ,b & c are compulsory.)

a) Practicals.
1. pH and Alkalinity of raw water, soft drinks & tea.
2. Total hardness and components of raw water.
3. Chlorides in water.
4. Chlorine demand and residual chlorine.
5. Sodium or Potassium or Calcium using flame photometer.
6. Turbidity and optimum dose of alum.
7. Fluorides or Iron contents in water.
8. Most Probable Number (MPN)
9. Ambient air quality monitoring for PM10/PM2.5,SO2 & NOx.
10. Measurement of noise levels at various locations using sound level meter, Calculate cumulative noise level at any one location.

b) Site visit to water treatment plant and Detailed Report.

c) Assignment 1. Study of Water intake structures.
2. Complete Design of WTP using appropriate software.

Text / Reference Books

Reference Books:

1. Environmental Engineering: Peavy and Rowe, McGraw Hill Publications.
2. Optimal Design of Water Distribution Networks: P. R. Bhave, Narosa Publishing House.
3. Rain Water Harvesting: Making water every body's business by CSE (Centre for Science and Environment) www.cse.org
4. Harvesting Faith: Linda K. Hubalek. Published by Butterfield books.
5. CPHEEO Manual on Water Supply & Treatment.
6. Standard Methods for the examination of water and waste water, 20th Edition (American Public health Association).

Text Books:

1.Water Supply Engineering: S. K. Garg, Khanna Publishers, New Delhi.
2.Water Supply and Sanitary Engineering: G. S. Birdie and J. S. Birdie, DhanpatRai Publishing Company, New Delhi.
3 Environmental Engineering 1: Water Supply Engineering: B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd.
4 Air Pollution: H. V. N. Rao and M. N. Rao, TMH Publications.
5. Theory and practice of water and waste water treatment--Wiley
6. Water Supply and Treatment Manual: Govt. of India Publication.
7. Waste Water Treatment-Concept Design and Approach---C.L.Karia,R.A.Christian--PHI
8. Environmental Remote Sensing from Regional to Global Scales—Ed.Giles Foody—Wiley
9. Water Supply and Sanitary Engineering: G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi.

Suggested Reading:

- Environmental Engineering by N. N. Barak , MGH
- Environmental Engineering by Venugopal Rao, PHI
- Environmental Engineering by Steel,McGhee , MGH
- Water Supply & Engineering by Pande andCarne , Tata McGraw Hill
- Water Supply Engineering by Harold Eaton Babbit & James Joseph Doland , MGH
- Principles of Water Treatment by Keny J. Howe, MWH.
- Water treatment : principles & Design 3rd edition by John C Crittenden R. Rhodes
- Water quality &Treatment : Handbook on Drinking Water 6th Edition by James K. Edzwald.
- Standard Methods, APHA,AWWA.
- Environmental Engineering Laboratory Manual by B. Kotain & Dr. N. Kumarswamy
- NEERJ Laboratory Manual

Savitribai Phule Pune University
TE Civil (2015 Course) w.e.f. June 2017

301012 Seminar

Teaching scheme	Examination scheme
Practical: 1 hour/week	**Oral Exam: 50 Marks**

Oral examination shall be conducted based on a Seminar report to be prepared by each individual. The seminar report should contain the following.

1. Introduction of the topic, its relevance to the construction industry, need for the study, aims and subjunctives, limitations.
2. Literature review from books, journals, conference proceedings, published reports / articles / documents from minimum 8 references.
3. Theoretical chapter on the topic of study, advantages and limitations.
4. Photographs from web search / experiments done / projects visited / organizations visited for studying documents / procedures/ systems / materials/ equipment/ technologies used.
5. Ongoing research areas, information, about commercial vendors, information on benefit – cost aspects.
6. Concluding remarks with respect to commercial/ practical and social applications.
7. References in standard format.

Note:- In order to arouse the interest of students and engage them in active learning, mini-projects/ complex problems may be given in groups of maximum 4students, covering different aspects involved in Civil engineering so as to also enable the students to submit separate individual reports as required above.

Internal guides may prepare a continuous evaluation sheet of each individual and refer it to the external examiner for consideration.

The oral examination of each individual may then be conducted as per the practice adopted for other subjects.

Faculty of Engineering
Savitribai Phule Pune University, Pune

Syllabus

for

Third Year
Bachelor of Computer Engineering
(2015 Course)

(with effect from 2017-18)

Prologue

It is with great pleasure and honor that I share the syllabi for Third Year of Computer Engineering (2015 Course) on behalf of Board of Studies, Computer Engineering. We, members of BOS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BOS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

Case Studies are included in almost all courses. Course Instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks

Dr. Varsha H. Patil
Coordinator, Board of Studies (Computer Engineering), SPPU, Pune
Tuesday, March 28, 2017

[This document contents Program Educational Objectives - Program Outcomes - Program Specific Outcomes(page 3), Courses (teaching scheme, examination, marks and credit)(page 4-5), Courses syllabi(page 6-62), all four year courses(page 63), Course-Credit share(page 64)]

Savitribai Phule Pune University, Pune
Bachelor of Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals, domain knowledge, updated with modern technology to provide the effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professional with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.
4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis and mathematical modeling to the solution of complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practice of lifelong learning.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

PSO2: Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Savitribai Phule University of Pune
Third Year Computer Engineering (2015 Course)
(with effect from 2017-18)

Semester I

Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/ TUT	PR
310241	Theory of Computation	03	--	--	30	70	--	--	--	100	03	--
310242	Database Management Systems (DBMS)	03	--	--	30	70	--	--	--	100	03	--
310243	Software Engineering & Project Management	03	--	--	30	70	--	--	--	100	03	--
310244	Information Systems & Engineering Economics	03	--	--	30	70	--	--	--	100	03	--
310245	Computer Networks (CN)	04	--	--	30	70	--	--	--	100	04	--
310246	Skills Development Lab	--	02	04	--	--	50	--	50	100	02	02
310247	DBMS Lab	--	--	04	--	--	25	50	--	75	--	02
310248	CN Lab	--	--	02	--	--	25	50	--	75	--	01
										Total Credit	18	05
	Total	16	02	10	150	350	100	100	50	750	23	
310249	Audit Course 3										Grade	

310249-Audit Course 3 (AC3) Options:

AC3-I: Cyber Security

AC3-II: **Professional Ethics and Etiquettes**

AC3-III: **Emotional Intelligence**

AC3-IV: **MOOC- Learn New Skills**

AC3-V: **Foreign Language (Japanese- Module 3)**

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **TUT**: Tutorial **PR**: Practical **Sem:** Semester

Savitribai Phule University of Pune
Third Year Computer Engineering (2015 Course)
(with effect from 2017-18)

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/ TUT	PR
310250	**Design & Analysis of Algorithms**	04	--	--	30	70	--	--	--	100	04	
310251	**Systems Programming & Operating System** (SP & OS)	04	--	--	30	70	--	--	--	100	04	--
310252	**Embedded Systems & Internet of Things** (ES & IoT)	04	--	--	30	70	--	--	--	100	04	--
310253	**Software Modeling and Design**	03	--	--	30	70	--	--	--	100	03	--
310254	**Web Technology**	03	--	--	30	70	--	--	--	100	03	--
310255	**Seminar & Technical Communication**	--	01	--	--	--	50	--	--	50	01	--
310256	**Web Technology Lab**	--	--	02	--	--	25	50	--	75	--	01
310257	**SP & OS Lab**	--	--	04	--	--	25	50	--	75	--	02
310258	**ES & IoT Lab**	--	--	02	--	--	50	--	--	50	--	01
										Total Credit	**19**	**04**
	Total	**18**	**01**	**08**	**150**	**350**	**150**	**100**	**--**	**750**	**23**	
310259	**Audit Course 4**										**Grade**	

310259-Audit Course 4(AC4) Options:

AC4-I: Digital and Social Media Marketing **AC4-II:** Green Computing
AC4-III: Sustainable Energy Systems **AC4-IV:** Leadership and Personality Development
AC4-V: Foreign Language (Japanese- Module 4)

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **TUT**: Tutorial **PR**: Practical **Sem**: Semester

SEMESTER I

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310241: Theory of Computation

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Discrete Mathematics (210241), Principles of Programming Languages (210254)

Course Objectives:

- To Study abstract computing models
- To learn Grammar and Turing Machine
- To learn about the theory of computability and complexity.

Course Outcomes:

On completion of the course, student will be able to–

- design deterministic Turing machine for all inputs and all outputs
- subdivide problem space based on input subdivision using constraints
- apply linguistic theory

Course Contents

Unit I	Formal Language Theory and Finite Automata	08 Hours

Introduction to Formal language, introduction to language translation logic, Essentials of translation, Alphabets and languages, Finite representation of language, Finite Automata (FA): An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA(DFA and NFA), epsilon- NFA, FA with output: Moore and Mealy machines -Definition, models, inter-conversion.

Case Study: FSM for vending machine, spell checker

Unit II	Regular Expressions (RE)	07 Hours

Introduction, Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Conversions: NFA to DFA, RE to DFA Conversions: RE to DFA, DFA to RE Conversions: State/loop elimination, Arden's theorem Properties of Regular Languages: Pumping Lemma for Regular languages, Closure and Decision properties.

Case Study: RE in text search and replace

Unit III	Context Free Grammars (CFG) and Languages	08 Hours

Introduction, Regular Grammar, **Context Free Grammar**- Definition, Derivation, Language of grammar, sentential form, parse tree, inference, derivation, parse trees, ambiguity in grammar and Language- ambiguous Grammar, **Simplification of CFG:** Eliminating unit productions, useless production, useless symbols, and Є-productions, **Normal Forms-** Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, **Application of CFG:** Parser, Markup languages, XML and Document Type Definitions.

Case Study- CFG for Palindromes, Parenthesis Match,

Unit IV	Turing Machines (TM)	08 Hours

Turing Machine Model, Representation of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Variants of Turing Machines, The Model of Linear Bounded Automata , TM & Type 0 grammars, TM's Halting Problem.

Unit V	Pushdown Automata(PDA)	07 Hours

Basic Definitions, Equivalence of Acceptance by Finite State & Empty stack, PDA & Context Free Language, Equivalence of PDA and CFG, Parsing & PDA: Top-Down Parsing, Top-down Parsing Using Deterministic PDA, Bottom-up Parsing, Closure properties and Deterministic PDA.

Unit VI	Undecidability & Intractable Problems	07 Hours

A Language that is not recursively enumerable, An un-decidable problem that is RE, Post Correspondence Problem, The Classes P and NP : Problems Solvable in Polynomial Time, An Example: Kruskal's Algorithm, Nondeterministic Polynomial Time, An NP Example: The Traveling Salesman Problem, Polynomial-Time Reductions NP Complete Problems, An NP-Complete Problem: The Satisfiability Problem, Tractable and Intractable, Representing Satisfiability, Instances, NP Completeness of the SAT Problem, A Restricted Satisfiability Problem: Normal Forms for Boolean Expressions, Converting Expressions to CNF, The Problem of Independent Sets, The Node-Cover Problem.

Books:

Text:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1.
2. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787

References:

1. John Martin, "Introduction to Languages and The Theory of Computation", 2nd Edition, Mc Graw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
2. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Pre ss, ISBN:0521424267 9780521424264
3. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 9788126513345
4. J. Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-4
5. Kavi Mahesh, "Theory of Computation : A Problem-Solving Approach", Wiley India, ISBN10 8126533110
6. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 9781133187813
7. Vivek Kulkarni "Theory of Computation", Oxford University Press, ISBN 0-19-808458

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310242 : Database Management Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisites Courses : Discrete Mathematics (210241), Data Structures (210243 & 210252)

Companion Course: Database Management System Lab (310247)

Course Objectives :

- To understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation
- To provide a strong formal foundation in database concepts, technology and practice
- To give systematic database design approaches covering conceptual design, logical design and an overview of physical design
- Be familiar with the basic issues of transaction processing and concurrency control
- To learn and understand various Database Architectures and Applications
- To learn a powerful, flexible and scalable general purpose database to handle big data

Course Outcomes :

On completion of the course, student will be able to–

- Design E-R Model for given requirements and convert the same into database tables.
- Use database techniques such as SQL & PL/SQL.
- Use modern database techniques such as NOSQL.
- Explain transaction Management in relational database System.
- Describe different database architecture and analyses the use of appropriate architecture in real time environment.
- Use advanced database Programming concepts

Course Contents

Unit I	Introduction	07 Hours

Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.

Unit II	SQL AND PL/SQL	07 Hours

SQL: Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries. **PL/SQL:** concept of Stored Procedures & Functions, Cursors, Triggers, Assertions, roles and privileges , Embedded SQL, Dynamic SQL.

Unit III	Relational Database Design	08 Hours

Relational Model: Basic concepts, Attributes and Domains, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF, Modeling Temporal Data.

Unit IV	Database Transactions and Query Processing	08 Hours

Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlocks, Time-stamping Methods, Recovery methods : Shadow-Paging and Log-Based Recovery, Checkpoints, Query Processing, Query Optimization, Performance Tuning.

Unit V	Parallel and Distributed Databases	07 Hours

Introduction to Database Architectures: Multi-user DBMS Architectures, Case study- Oracle Architecture. **Parallel Databases:** Speedup and Scale up, Architectures of Parallel Databases.
Distributed Databases: Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database.

Unit VI	NoSQL Database	08 Hours

Introduction to NoSQL Database, Types and examples of NoSQL Database- Key value store, document store, graph, Performance, Structured verses unstructured data, Distributed Database Model, CAP theorem and BASE Properties, Comparative study of SQL and NoSQL, NoSQL Data Models, Case Study-unstructured data from social media. Introduction to Big Data**,** HADOOP: HDFS, MapReduce.

Books:

Text:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4
3. Pramod J. Sadalage and Martin Fowler, “NoSQL Distilled”, Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626

References:

1. C J Date, “An Introduction to Database Systems”, Addison-Wesley, ISBN: 0201144719
2. S.K.Singh, “Database Systems : Concepts, Design and Application”, Pearson, Education, ISBN 978-81-317-6092-5
3. Kristina Chodorow, Michael Dirolf, “MangoDB: The Definitive Guide” ,O’Reilly Publications, ISBN: 978-1-449-34468-9.
4. Adam Fowler, “NoSQL For Dummies”, John Wiley & Sons, ISBN-1118905628
5. Kevin Roebuck, “Storing and Managing Big Data - NoSQL, HADOOP and More”, Emereopty Limited, ISBN: 1743045743, 9781743045749
6. Joy A. Kreibich, “Using SQLite”, O'REILLY, ISBN: 13:978-93-5110-934-1
7. Garrett Grolemund, “Hands-on Programming with R”, O'REILLY, ISBN : 13:978-93-5110-728-6

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310243: Software Engineering and Project Management

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Fundamentals of Programming Languages (110003, 110011)

Course Objectives:

- To learn and understand the principles of Software Engineering
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To apply Design and Testing principles to S/W project development.
- To understand project management through life cycle of the project.
- To understand software quality attributes.

Course Outcomes:

On completion of the course, student will be able to–

- Decide on a process model for a developing a software project
- Classify software applications and Identify unique features of various domains
- Design test cases of a software system.
- Understand basics of IT Project management.
- Plan, schedule and execute a project considering the risk management.
- Apply quality attributes in software development life cycle.

Course Contents

Unit I	Introduction to Software Engineering, Software Process Models	07 Hours

Software Engineering Fundamentals: Nature of Software, Software Engineering Principles, The Software Process, Software Myths. **Process Models :**A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process(RAD), Evolutionary Process, Unified Process, Concurrent. **Advanced Process Models & Tools:** Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming. Introduction to agile tools: JIRA, Kanban,

Case Studies: An information system (mental health-care system), wilderness weather system

Unit II	Software Requirements Engineering& Analysis	08 Hours

Requirements Engineering: User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. **Software Requirements Specification (SRS):** The software requirements Specification document, The structure of SRS, Ways of writing a SRS, structured & tabular SRS for an insulin pump case study, **Requirements elicitation & Analysis:** Process, Requirements validation, Requirements management. **Case Studies:** The information system.

Case study - Mental health care patient management system (MHC-PMS).

Unit III	Design Engineering	08 Hours

Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. **Architectural Design :**Design Decisions, Views, Patterns, Application Architectures, **Modeling Component level Design:** component, Designing class based components, conducting component-level design, **User Interface Design:** The golden rules, Interface Design steps & Analysis, Design Evaluation, **Case Study:** Web App Interface Design

Unit IV	Project Management: Process, Metrics, Estimations & Risks	08 Hours
Project Management Concepts: The Management Spectrum, People, Product, Process, Project, The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size & function oriented metrics(FP & LOC), Metrics for Project and Software Quality, **Project Estimation :**Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation **Case Study:** Software Tools for Estimation, **Project Scheduling:** Basic Concepts, Defining a Task Set for the Software Project, Defining Task Network, Scheduling with time-line charts, Schedule tracking Tools:- Microsoft Project, Daily Activity Reporting & Tracking (DART)		
Unit V	Project Management: Risk Management, Configuration Management, Maintenance & Reengineering	07 Hours
Project Risk Management : Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, The RMMM plan for case study project **Software Configuration Management :** The SCM repository, SCM process, Configuration management for WebApps, **Case study:** CVS and Subversion Tools, Visual Source Safe from Microsoft & Clear Case. **Maintenance & Reengineering:** Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering		
Unit VI	Software Testing	07 Hours
Introduction to Software Testing, Principles of Testing, Testing Life Cycle, Phases of Testing, Types of Testing, Verification & Validation, Defect Management, Defect Life Cycle, Bug Reporting, GUI Testing, Test Management and Automation.		

Books:

Text:

1. Roger Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, " Software Engineering", Addison and Wesley, ISBN 0-13-703515-2

References:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN-10: 0133056996
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN-13: 978-8120348981
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715.
4. S K Chang, "Handbook of Software Engineering and Knowledge Engineering", World Scientific, Vol I, II, ISBN: 978-981-02-4973-1
5. Tom Halt, "Handbook of Software Engineering", Clanye International, ISBN-10: 1632402939

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310244: Information Systems and Engineering Economics

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Course Objectives:

- To prepare the students to various forms of the Information Systems and its application in organizations.
- To expose the students to the managerial issues relating to information systems and help them identify and evaluate various options in Information Systems.
- To Prepare engineering students to analyze cost / revenue data and should be able to do economic analyses in the decision making process to justify or reject alternatives / projects on an economic basis for an organization.

Course Outcomes:

On completion of the course, student will be able to–

- Understand the need, usage and importance of an Information System to an organization.
- Understand the activities that are undertaken while managing, designing, planning, implementation, and deployment of computerized information system in an organization.
- Further the student would be aware of various Information System solutions like ERP, CRM, Data warehouses and the issues in successful implementation of these technology solutions in any organizations
- Outline the past history, present position and expected performance of a company engaged in engineering practice or in the computer industry.
- Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.

Course Contents

Unit I	Basic of Management Theory & Practices	07 Hours

Role of Information Systems in Organizations, The Information System Manager and his challenges, Concepts of Information Systems, Information Systems and Management Strategy Case Studies - Information Systems in the Indian Railways, Information Systems in an e-Commerce Organization.

Unit II	Management Information System (MIS)	08 Hours

Managing Information Systems, Ethical and Social Issues, Information Technology Infrastructure and Choices, Information Systems Security and Control,
Case Studies -Information Technology Infrastructure in a Bank, Information Technology Infrastructure in a manufacturing / process industry.

Unit III	Leveraging Information Systems	07 Hours
Information Systems Development and Project Management, Managing Data Resources, Business Process Integration and Enterprise Systems, ICT for Development and E-Governance, Case Studies - in-house or cloud based ERP implementation, UIDAI Unique Identification Authority of India.		
Unit IV	**Money and Economic Value**	**08 Hours**
Engineering Economic Decisions, Time Value of Money, Understanding Money Management, Case Studies- Economic decisions done in Multi-national companies.		
Unit V	**Economics and Management**	**07 Hours**
Equivalence Calculations under Inflation, Present-Worth Analysis, Annual-Equivalence Analysis. Case Studies -comparative analysis of software enterprises from relevant domains.		
Unit VI	**Understanding Cash Flow and Taxes**	**08 Hours**
Accounting for Depreciation and Income Taxes, Project Cash-Flow Analysis, Understanding Financial Statements, Case Studies - cash flow analysis done in start-up companies.		

Books:

Text:

1. Rahul De, “MIS: Management Information Systems in Business, Government and Society”, Wiley India, ISBN: 13: 978-81-265-2019-0.
2. Chan S. Park , "Fundamentals of Engineering Economics”, 3rd Edition, Pearson Education, ISBN 13: 978-02-737-7291-0

References:

1. Turban and Wali, “Information Technology on Management”, Willey India, ISBN:9788126558711
2. William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Pearson Education, ISBN13: 978-01-334-3927-4

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310245: Computer Networks

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Organization and Architecture (210244)

Companion Course: Computer Network Lab (310248)

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies.
- To learn different techniques for framing, error control, flow control and routing.
- To learn role of protocols at various layers in the protocol stacks.
- To learn network programming.
- To develop an understanding of modern network architectures from a design and performance perspective

Course Outcomes:

On completion of the course, student will be able to–

- Analyze the requirements for a given organizational structure to select the most appropriate networking architecture, topologies, transmission mediums, and technologies
- Demonstrate design issues, flow control and error control
- Analyze data flow between TCP/IP model using Application, Transport and Network Layer Protocols.
- Illustrate applications of Computer Network capabilities, selection and usage for various sectors of user community.
- Illustrate Client-Server architectures and prototypes by the means of correct standards and technology.
- Demonstrate different routing and switching algorithms

Course Contents

Unit I	Physical Layer	09 Hours

Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; Distributed and SDN, OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for Layers, Transmission Mediums: CAT5, 5e, 6, OFC and Radio Spectrum, Network Devices: Bridge, Switch, Router, Brouter and Access Point, Manchester and Differential Manchester Encodings; IEEE802.11: Frequency Hopping (FHSS) and Direct Sequence (DSSS)

Unit II	Logical Link Control	09 Hours

Design Issues: Services to Network Layer, Framing, Error Control and Flow Control. Error Control: Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, WAN Connectivity : PPP and HDLC

Unit III	Medium Access Control	09 Hours

Channel allocation: Static and Dynamic, Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, IEEE 802.3 Standards and Frame Formats, CSMA/CD, Binary Exponential Back -off algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.

Unit IV	Network Layer	09 Hours

Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols: Distance Vector, Link State, Path Vector, Routing in Internet: RIP ,OSPF, BGP, Congestion control and QoS, , MPLS, Mobile IP, Routing in MANET : AODV, DSR

Unit V	Transport Layer	09 Hours

Services, Berkley Sockets, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP, TCP Timer management, TCP Congestion Control, Real Time Transport protocol(RTP), Stream Control Transmission Protocol (SCTP), Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless.

Unit VI	Application Layer	09 Hours

Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).

Books:

Text:

1. Andrew S. Tenenbaum, “Computer Networks”, PHI, ISBN 81-203-2175-8.
2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw- Hill, Publications, ISBN: 0 – 07 – 058408 – 7

References:

1. Kurose, Ross “Computer Networking a Top Down Approach Featuring the Internet”, Pearson, ISBN-10: 0132856204
2. Matthew S. G, “802.11 Wireless Networks”, O’Reilly publications, ISBN: 81-7656-992-5
3. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks: Architectures and Protocols” Prentice Hall, ISBN-10: 8131706885; ISBN-13: 978-8131706886
4. Holger Karl and Andreas Willing, “Protocols and Architectures for Wireless Sensor Networks”, Wiley India , ISBN: 9788126533695
5. Eldad Perahia, Robert Stacey, “Next Generation Wireless LANs”, Cambridge, ISBN-10: 1107016762; ISBN-13: 978-1107016767
6. Efraim Turban, Linda Volonino, Gregory R. Wood “Computer Networking a Top Down Approach Featuring the Internet”, 10th Edition, Wiley; ISBN13: 978-1-118-96126-1

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310246: Skill Development Lab

Teaching Scheme:	Credit (04)		Examination Scheme:
TUT: 02 Hour/Week	Tutorial	PR	TW: 50 Marks
PR: 04 Hours/Week	02	02	OR: 50 Marks

Prerequisite Courses: Fundamentals of Programming Languages (110003 and 110011), Principles of Programming Languages (210254), Data Structures and Algorithms (210243), Object Oriented Programming(210245)

Course Objectives:

- To adapt the usage of modern tools and recent software.
- To evaluate problems and analyze data using current technologies
- To learn the process of creation of data-driven web applications using current technologies
- To understand how to incorporate best practices for building enterprise applications
- To learn how to employ Integrated Development Environment(IDE) for implementing and testing of software solution
- To construct software solutions by evaluating alternate architectural patterns.

Course Outcomes:

On completion of the course, student will be able to–

- Evaluate problems and analyze data using current technologies in a wide variety of business and organizational contexts.
- Create data-driven web applications
- Incorporate best practices for building applications
- Employ Integrated Development Environment(IDE) for implementing and testing of software solution
- Construct software solutions by evaluating alternate architectural patterns.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of tool/framework/language used, Design, test cases, conclusion. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Oral Examination

It is recommended to conduct examination based on Mini-Project demonstration and related skill learned. Team of 3 to 4 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

For this laboratory total five Skill Development Modules plus one Aptitude Development Module are provided as below:

SD Module-I: Advanced JAVA and Mobile Application Development
SD Module-II: PYTHON and DATA Science with R
SD Module-III: Advanced JAVA and GROOVY on GRAILS
SD Module-IV: SCHEME and SCALA and GROOVY on GRAILS
SD Module-V: Advanced JAVA and Data Science with R
SD Module VI: Aptitude Development (To be EXCLUDED for Oral Exam)

Instructions:
Each college has to select at least one module out of five modules provided. College can select more than one module too! Set of suggested assignments is provided. Each student must perform 7 to 8 assignments and at least one mini-project provided in each module excluding Module VI. Instructor should frame set of mini projects or guide students to frame the problem statement of mini-project by sticking to technologies in respected module.
Term Work will be based on assignments be carried out by students and **Oral Examination will be based on Mini-Project demonstration and related skill learned ONLY.**
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - Open Source C,C++, JAVA, PYTHON, G++/GCC, R, Grails, Groovy, Android Studio for Linux.

Course Contents

SD Module-I	Advanced JAVA and Mobile Application Development	
	Theory Content for Lab	

ADVANCED JAVA

Data Structures in Java: Enumeration, BitSet, Vector, Stack, Dictionary, Hash table, Properties. **Generics and Collection Framework:** Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

MOBILE APPLICATION DEVELOPMENT

Introduction to Android: Android Platform Architecture, Basic components of android, Features of ART and Delvik Virtual Machine, Activity Life Cycle, Intents and Intent Filters, Resources, System Permissions, Android Application Structure, Device screen size compatibility, Android Emulator

User Interface components: Layouts, Recycler View, List View, Grid View and Web view, Input Controls: Buttons, Checkboxes, Radio Buttons, Toggle Buttons, Spinners**,** Input Events, Menus, Toast, Dialogs, Styles and Themes, **Multimedia, Animation and Graphics:** Playing Audio, Playing Video, Rotate Animation, FadeIn/FadeOut Animation, Zoom Animation, Scale Animation, 2D and 3D Graphics. **Data Storage:** Shared Preferences, Internal Storage, External Storage, SQLite Databases, Content provider. and Remote Databases, **Advanced Components of Android:** Web App**,** JSON Parsing, Google Map, GPS, Sensors, Bluetooth/Wi-Fi Connectivity

Books:

Text:

1. Herbert Schildt, "Java: The Complete Reference", TMG Publication, ISBN 9780070636774
2. Thomas Powell, "Java generics and collections", O'Reilly Media, ISBN: 0596527756
3. Neil Smyth, "Android Studio 2 Development Essentials", Payload Media, ISBN: 1532853319
4. John Horton, "Android Programming for Beginners", ISBN 10:1785883267

Reference:

1. Sharanam Shah and Vaishali Shah , "JAVA EE 7 for Beginners", SPD, ISBN: 13:978-93-5110-349-3
2. Reto Meier, "Professional Android 4 Application Development", Wrox, ISBN-10: 1118102274; ISBN-13: 978-1118102275
3. Greg Nudelman, "Android Design Patterns :Interaction Design Solutions for Developers", ISBN-10: 1118394151; ISBN-13: 978-1118394151
4. Sharanam Shah, Vaishali Shah," Core Java 8 for beginners", THE TEAM, ISBN: 13:978-93-5213-080-1

Suggested List of Laboratory Assignments for Advanced JAVA

1.	Design a system with the help of advance data structures in Java and enhance the system using collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, ThreadPools using ExecutorService.
4.	Transform the above system from command line system to GUI based application

Suggested List of Laboratory Assignments for Mobile Application Development

1.	Download Install and Configure Android Studio on Linux/windows platform.
2.	Design a mobile app for media player.
3.	Design a mobile app to store data using internal or external storage.
4.	Design a mobile app using Google Map and GPS to trace the location.

Suggested Mini Project on Advanced JAVA and Mobile Application Development

Design and develop a mobile app for novice trekkers by recording the paths from regular trekkers by using, Material Design Pattern for UI, Storage [SQLite database/File/Shared Preference/cloud], Internet connection /Wi-Fi/Bluetooth, GPS and Google Map.

SD Module-II	PYTHON and DATA Science with R	
	Theory Content for Lab	

PYTHON

Python Basics: Data types, Statements and Expressions, Operators and Math's, Conditionals, Loops, Strings, List , Tuples , Set Operation, Dictionary (Dict), Date and Times.
Functions, Packages and Classes: Lambda function, Regular expression, Packages, Files, Exception Handling, Classes ,Objects, Method ,class and instance variable, constructor, destructor, inheritance.
Numpy and Matplotlib : Array operations, Numpy Side Effects, 2D Numpy Arrays , Numpy Basic Statistics, Universal Function, Matplotlib: Introduction, Simple plots, Line API, Legend API, Figures, Subplots, Axes and Ticks.
Pandas: Look Ups, Selections and Indexing, Filling Methods, Series operation, Handling NaN values, Mapping, Data Frames, Reading Files, Plotting, Joins, Correlation, Histograms, Rolling calculation, Date Time indexing, Grouping, Aggregate Functions, pandas.IO. Data, Panel.

DATA SCIENCE WITH R

Introduction to Data Science- What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load.
Introduction to R-What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions.
Descriptive Statistics using R - Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package.
Predictive Analysis using Machine Learning Techniques using R: Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R. Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.

Books:

Text:

1. Zed A. Shaw, "Learn PYTHON The Hard Way", Pearson, ISBN: 978-93-325-8210-1
2. Kenneth A Lambert and B L Juneja, "Fundamentals of PYTHON", CENGAGE Learning, ISBN:978-81-315-2903-4
3. Peng, Roger D and Elizabeth Matsui, "The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162.
4. Evans, James R., and Carl H. Lindner, "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.

Reference:

1. Allen B Downey, "Think PYTHON", O'Rielly, ISBN: 13:978-93-5023-863-9, 4th Indian Reprint 2015
2. Jiawei Han and Micheline Kamber, Morgan Kaufman, "Learning R, Richard Cotton", O'Reilly, ISBN: 13:978-93-5110-286-1, First Edition, Fourth Indian Reprint 2015

Suggested List of Laboratory Assignments on PYTHON

1.	Getting Started with Python (Example Word count exercise)
2.	Build the Hangman Game using Python.

3.	Write python code that loads any dataset (example Game_medal.csv), and plot the graph.
4.	Write python code that loads any dataset (example Game_medal.csv), and does some basic data cleaning. Add component on data set.
Suggested List of Laboratory Assignments on DATA Science with R	
1.	Getting Started with R installation, R objects and basic statistics.
2.	Using R for data preprocessing, exploratory analysis, visualization.
3.	Using R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm

Suggested Mini Project on PYTHON and DATA Science with R

1. Implementing a simple Recommender System based on user buying pattern.
2. Twitter Sentiment Analysis in Python
3. Applying linear regression model to a real world problem.

SD Module-III Advanced JAVA and GROOVY on GRAILS

Theory Content for Lab

ADVANCED JAVA

Data Structures in Java: Enumeration, BitSet, Vector, Stack, Dictionary, Hash table, Properties. **Generics and Collection Framework:** Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

GROOVY on GRAIL

Introduction to Grails: Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments.
Web Layer: Model, View**, Controllers** (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plug-in, Grails and Hibernate.

Books:

Text:

1. Herbert Schildt, "Java: The Complete Reference", TMG Publication, ISBN 9780070636774
2. Thomas Powell, "Java Generics and collections", O'Reilly Media, ISBN: 0596527756.
3. Christopher M. Judd, Joseph Faisal Nusairat, and James Shingler, "Beginning Groovy and Grails From Novice to Professional", Apress, ISBN-13: 978-1-4302-1045-0

Reference:

1. Sharanam Shah and Vaishali Shah, "JAVA EE 7 for Beginners", SPD, ISBN: 13:978-93-5110-349-3
2. Official Website http://docs.grails.org/latest/

Suggested List of Laboratory Assignments for Advanced JAVA	
1.	Design a system with the help of advance data structures in Java and enhance the system using collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, Thread Pools using Executor Service.
4.	Transform the above system from command line system to GUI based application

Suggested List of Laboratory Assignments on GROOVY on GRAILS

1.	Download Install and Configure IDE with Grails Plug-in on Windows/Linux platform.
2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations

Suggested Mini Project on Advanced JAVA and GROOVY on GRAILS

Design a **dynamic** web application system(Ex, Employee Payroll System, Student Result System)

SD Module-IV SCHEME and SCALA and GROOVY on GRAILS

Theory Content for Lab

SCHEME and SCALA

SCHEME: lambda calculus, Atoms, Lists, lambda expressions. Functions as first class objects. Control structures, Recursion and continuations, operations on objects, basic input output, Exceptions and conditions, lazy evaluation and streams.

SCALA: Classes and Objects, Data Types, Control structures, composition and inheritance. Packages. Pattern matching. Collections API. Working with XML. Actors and concurrency. GUI programming in SCALA.

GROOVY on GRAILS

Introduction to Grails: Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments

Web Layer: Model ,View ,Controllers (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plug-in, Grails and Hibernate

Books:

Text:

1. R Kent Dybvig, "the Scheme Programming Language", MIT Press, ISBN 978-0-262-51298-5.
2. Martin Odersky, Lex Spoon, and Bill Venners, "Programming in SCALA", Artima. ISBN :-13: 978-0-9815316-1-8.
3. Beginning Groovy and Grails From Novice to Professional, Christopher M. Judd, Joseph Faisal Nusairat, and James Shingler, Apress, ISBN-13: 978-1-4302-1045-0

Reference:

1. Cay S Horstmann, "Scala for the Impatient", Pearson, ISBN: 978-81-317-9605-4,
2. Scala Cookbook, Alvin Alexander, O'Reilly, SPD,ISBN: 978-93-5110-263-2
3. Jason Swartz, "Learning Scala", O'REILLY, ISBN: 13:978-93-5213-256-0
4. Official Website http://www.groovy-lang.org/download.html
5. Official Website https://en.wikipedia.org/wiki/Scheme_(programming_language)
6. Official Website https://www.scala-lang.org/
7. Official Website https://grails.org/

Suggested List of Laboratory Assignments on SCHEME and SCALA

1.	Create a recursive function in Scheme that displays the sum of n odd numbers starting from 1.
2.	Write a program to find sum and product of all the elements of a list in scheme without using built in functions.
3.	Write a SCALA Program to perform following operations on Strings: 1. Create a String Object. 2. Check String is palindrome or not. 3. Check length of String 4. Replace all 'a' in a string with 'A'
4.	Develop a SCALA pattern matching programming which matches a given Person object and displays whether he/she is Eligible for Election or not. Use name, age and eligibility as class members.

Suggested List of Laboratory Assignments on GROOVY on GRAILS	
1.	Download Install and Configure IDE with Grails Plugins on Windows/Linux platform.
2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations

Suggested Mini Project on SCHEME and SCALA and GROOVY on GRAILS

Design a dynamic web application system Use Front End: Groovy on Grails, Back End: Scheme and Scala (Ex, Employee Payroll System, Student Result System)

SD Module-V Advanced JAVA and Data Science with R

Theory Content for Lab

ADVANCED JAVA

Data Structures in Java: Enumeration, BitSet, Vector, Stack, Dictionary, Hash table, Properties.
Generics and Collection Framework: Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

DATA SCIENCE WITH R

Introduction to Data Science- What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load.
Introduction to R-What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions.
Descriptive Statistics using R - Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package.
Predictive Analysis using Machine Learning Techniques using R: Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R. Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.

Books:

Text:

1. Herbert Schildt, “Java: The Complete Reference” ,TMG Publication, ISBN 9780070636774
2. Thomas Powell, “Java generics and collections”, O'Reilly Media, ISBN: 0596527756, 2006.
3. Peng, Roger D., and Elizabeth Matsui. "The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162.
4. Evans, James R., and Carl H. Lindner. "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.

Reference:

1. JAVA EE 7 for Beginners, Sharanam Shah and Vaishali Shah, SPD, ISBN: 13:978-93-5110-349-3
2. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufman, ISBN 978-81-312-0535-8
3. Learning R, Richard Cotton, O’Reilly, ISBN: 13:978-93-5110-286-1

Suggested List of Laboratory Assignments for Advanced JAVA	
1.	Design a system with the help of advance data structures in Java and enhance the system using

	collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, Thread Pools using Executor Service.
4.	Transform the above system from command line system to GUI based application

Suggested List of Laboratory Assignments on Data Science with R

1.	Getting Started with R installation, R objects and basic statistics.
2.	Use R for data preprocessing, exploratory analysis, visualization.
3.	Use R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm

Suggested Mini Project on Advanced JAVA and Data Science with R

1. Implementing a simple Recommender System based on user buying pattern.
2. Applying linear regression model to a real world problem.

SD Module-VI Aptitude Development

Quantitative Aptitude, Logical Reasoning and Verbal Ability

An aptitude is a component of a competence to do a certain kind of work at a certain level. Outstanding aptitude can be considered "talent". An aptitude may be physical or mental. Aptitude is inborn potential to do certain kinds of work whether developed or undeveloped. Ability is developed knowledge, understanding, learned or acquired abilities (skills) or attitude. The innate nature of aptitude is in contrast to skills and achievement, which represent knowledge or ability that is gained through learning. (Ref: https://en.wikipedia.org/wiki/Aptitude).

Aptitude and ability tests are designed to assess your logical reasoning or thinking performance. The statistics reveal that 70 percent of world's recruitment companies use aptitude test as a part of their recruitment procedure. These types of tests often permit potential companies to learn more about candidate's personality and abilities.

It is well said that aptitude isn't really something one can easily improve, but surely practice can help to improve. Solving number of high level of questions will surely help to succeed while subsequent practices of solving same. Each attempt should aim to attain a level of efficiency. Practice of solving hundreds of similar questions helps to choose right approach to solve.

It is recommended to conduct few expert talks and conduct practice tests for students for minimum 15 minutes per week in current semester and continue in semester VI, VII and VIII.

Text:

1. R.S Aggarwal, "Quantitative Aptitude", S Chand Publisher, ISBN- 9788121924986
2. Aptipedia- Aptitude Encyclopedia, Wiley, ISBN:978-81-265-6223-7
3. Shakuntala Devi, "Puzzles to Puzzle You" and "More Puzzles to Puzzle You", Orient Paperbacks, 2005. ISBN, 8122200141, 9788122200140

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310247: Database Management System Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Practical: 50 Marks Term Work: 25 Marks

Companion Course: Database Management System (310242)

Course Objectives:
- To develop basic, intermediate and advanced Database programming skills
- To develop basic Database administration skills
- To percept transaction processing

Course Outcomes:

On completion of the course, student will be able to–
- Develop the ability to handle databases of varying complexities
- Use advanced database Programming concepts

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Database design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A and B. Each student must perform at least 13 assignments (8-Mandotory plus 4 from remaining 8 assignments) from group A , 5 from group B and 2 mini projects from Group C

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: SQL, PL/SQL, Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : Monod/MYSQL/Oracle, Database Connectivity : ODBC/JDBC

Books:

References:

1. Ivan Bayross, “SQL, PL/SQL: The Programming Language of Oracle”, BPB Publication, ISBN-10: 8176560723; ISBN-13: 978-8176560726

2. Kristina Chodorow, Michael Dirolf, “MangoDB: The Definitive Guide”, O’Reilly Publications, ISBN: 9781449381561

3. Import, Tidy, Transform,” R for Data Science”, O'REILLY, ISBN: 13:978-93-5213-497-7

4. http://www.tutorialspoint.com/json/ & http://docs.mongodb.org/manual/

Suggested List of Laboratory Assignments

Group A- Database Programming Languages – SQL, PL/SQL

1. Study of Open Source Relational Databases : MySQL

2. Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym

3. Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, Delete with operators, functions, and set operator.

4. Design at least 10 SQL queries for suitable database application using SQL DML statements: all types of Join, Sub-Query and View.

5. Unnamed PL/SQL code block: Use of Control structure and Exception handling is mandatory. Write a PL/SQL block of code for the following requirements:-

Schema:

1. Borrower(Rollin, Name, DateofIssue, NameofBook, Status)
2. Fine(Roll_no,Date,Amt)

- Accept roll_no & name of book from user.
- Check the number of days (from date of issue), if days are between 15 to 30 then fine amount will be Rs 5per day.
- If no. of days>30, per day fine will be Rs 50 per day & for days less than 30, Rs. 5 per day.
- After submitting the book, status will change from I to R.
- If condition of fine is true, then details will be stored into fine table.

Frame the problem statement for writing PL/SQL block inline with above statement.

6. Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor)

Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped.

Frame the separate problem statement for writing PL/SQL block to implement all types

	of Cursors inline with above statement. The problem statement should clearly state the requirements.
7.	PL/SQL Stored Procedure and Stored Function. Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks 899 and 825 category is Higher Second Class Write a PL/SQL block for using procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class) **Frame the separate problem statement for writing PL/SQL Stored Procedure and function, inline with above statement. The problem statement should clearly state the requirements.**
8.	Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. **Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.**
	Group B Large Scale Databases
1.	Study of Open Source NOSQL Database: MongoDB (Installation, Basic CRUD operations, Execution)
2.	Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators)
3.	Implement aggregation and indexing with suitable example using MongoDB.
4.	Implement Map reduces operation with suitable example using MongoDB.
5.	Design and Implement any 5 query using MongoDB
6.	Create simple objects and array objects using JSON
7.	Encode and Decode JSON Objects using Java/Perl/PHP/Python/Ruby
	Group C Mini Project : Database Project Life Cycle
1.	Write a program to implement MogoDB database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit etc.) using ODBC/JDBC.
2.	Implement MYSQL/Oracle database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
3.	Using the database concepts covered in Part-I & Part-II & connectivity concepts covered in Part C, students in group are expected to design and develop database application with following details: **Requirement Gathering and Scope finalization** **Database Analysis and Design:** • Design Entity Relationship Model, Relational Model, Database Normalization **Implementation :** • Front End : Java/Perl/PHP/Python/Ruby/.net • Backend : MongoDB/MYSQL/Oracle • Database Connectivity : ODBC/JDBC **Testing : Data Validation** Group of students should submit the Project Report which will be consist of documentation related to different phases of Software Development Life Cycle: Title of the Project, Abstract, Introduction, scope, Requirements, Data Modeling features, Data Dictionary, Relational Database Design, Database Normalization, Graphical User Interface, Source Code, Testing document, Conclusion. Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310248: Computer Networks Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 25 Marks PR: 50 Marks

Companion Course: 310245 Computer Networks (CN)

Course Objectives:

- To establish communication among the computing nodes in P2P and Client-Server architecture
- Configure the computing nodes with understanding of protocols and technologies.
- Use different communicating modes and standards for communication
- Use modern tools for network traffic analysis
- To learn network programming.

Course Outcomes:

On completion of the course, student will be able to–

- Demonstrate LAN and WAN protocol behavior using Modern Tools.
- Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.
- Demonstrate basic configuration of switches and routers.
- Develop Client-Server architectures and prototypes by the means of correct standards and technology.

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A and B. Each student must perform at least 8 assignments (4-Mandotory plus 4 from remaining 8 assignments) from group A and 4 from group B (2-Mandotory plus 2 from remaining 5 assignments).

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C,C++, JAVA, PYTHON,

Programming tool like G++/GCC, Wireshark, Etheral and Packet Tracer

Books:

References:

1. Thomas D. Nadean and Ken Gray, "Software Defined Networks", O'REILLY, ISBN: 13:978-93-5110-264-9
2. Robert Faludi, "Building Wireless Sensor Networks", O'REILLY, ISBN: 13:978-93-5023-289-7

Suggested List of Laboratory Assignments

Group A

All assignments should be implemented using Open Source Linux flavors, Open Source Tools: Wireshark and Packet Tracer and C/C++, JAVA, PYTHON.

1.	**Lab Assignment on Unit I: (Mandatory Assignment)** **Part A:** Setup a wired LAN using Layer 2 Switch and then IP switch of minimum four computers. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrate the PING packets captured traces using Wireshark Packet Analyzer Tool. **Part B:** Extend the same Assignment for Wireless using Access Point
2.	**Lab Assignment on Unit II: (Use C/C++)** Write a Program with following four options to transfer- a. Characters separated by space b. One Strings at a time b. One Sentence at a time c. file between two RS 232D or USB ports using C/C++. (To demonstrate Framing, Flow control, Error control).

3.	**Lab Assignment on Unit II: (Use C/C++)** Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.(50% students will perform Hamming Code and others will perform CRC)
4.	**Lab Assignment on Unit II: (Use JAVA/PYTHON)** Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode and demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
5.	**Lab Assignment on Unit IV: (Use JAVA/PYTHON)** Write a program to demonstrate subletting and find the subnet masks.
6.	**Lab Assignment on Unit IV: (Use JAVA/PYTHON)** Write a program to simulate the behavior of link state routing protocol to find suitable path for transmission.
7.	**Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)** Write a program using TCP socket for wired network for following a. Say Hello to Each other (For all students) b. File transfer (For all students) c. Calculator (Arithmetic) (50% students) d. Calculator (Trigonometry) (50% students) Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
8.	**Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)** Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
9.	**Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++)** Write a program to analyze following packet formats captured through Wireshark for wired network. 1. Ethernet 2. IP 3.TCP 4. UDP
10.	Write a program to simulate the behavior of Slow Start and AIMD (Additive Increase and Multiplicative Decrease) congestion control protocols. **(Use JAVA/PYTHON)**
11.	**Lab Assignment on Unit VI: (Use JAVA/PYTHON)** Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa.
12.	**Lab Assignment on Unit VI:** Installing and configure DHCP server and write a program to install the software on remote machine.
	Group B
1.	**Lab Assignment on Unit II: (Use JAVA/PYTHON)** Write a Program to transfer- By using Bluetooth **a.** Characters separated by space **b.** One Strings at a time **c.** One Sentence at a time d. File
2.	**Lab Assignment on Unit IV: (Use JAVA/PYTHON)** Study of any network simulation tools - To create a network with three nodes and establish a TCP connection between node 0 and node 1 such that node 0 will send TCP packet to node 2 via node 1
3.	**Lab Assignment on Unit V: (Use JAVA/PYTHON)** Write a program using TCP sockets for wired network to implement a. Peer to Peer Chat b. Multiuser Chat

	Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
4.	**Lab Assignment on Unit V: (Use JAVA/PYTHON)** Write a program using UDP sockets for wired network to implement a. Peer to Peer Chat b. Multiuser Chat Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
5.	**Lab Assignment on Unit V: (Use JAVA/PYTHON)** Write a program to prepare TCP and UDP packets using header files and send the packets to destination machine in peer to peer mode. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
6.	**Lab Assignment on Unit IV and Unit V: (Mandatory Assignment)** Use network simulator NS2 to implement: a. Monitoring traffic for the given topology b. Analysis of CSMA and Ethernet protocols c. Network Routing: Shortest path routing, AODV. d. Analysis of congestion control (TCP and UDP).
7.	**Lab Assignment on Unit IV: (Mandatory Assignment)** Configure RIP/OSPF/BGP using packet Tracer.

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310249: Audit Course 3

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC3- I	Cyber Security
AC3-II	Professional Ethics and Etiquettes
AC3-III	Emotional Intelligence
AC3-IV	MOOC-Learn New Skills
AC3-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for **Japanese (Module 3) are provided. For other languages institute may design suitably.**

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310249: Audit Course 3
AC3 – I: Cyber Security

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

- To assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures;
- To critique and assess the strengths and weaknesses of general cyber security models, including the CIA triad
- To appraise the interrelationships among elements that comprise a modern security system, including hardware, software, policies, and people;
- To assess how all domains of security interact to achieve effective system-wide security at the enterprise level.

Course Outcome:

On completion of the course, learner will be able to–

- Compare the interrelationships among security roles and responsibilities in a modern information-driven enterprise—to include interrelationships across security do mains (IT, physical, classification, personnel, and so on)
- Assess the role of strategy and policy in determining the success of information security;
- Estimate the possible consequences of misaligning enterprise strategy, security policy, and security plans;

Course Contents:

1. **Cyber Security Basics:** Introduction, Elements of Information security, Security Policy, Techniques, Operational Model of Network Security, Terminologies in Network Security
2. **Introduction to Cryptography:** Introduction, Encryption Methods: Symmetric, Asymmetric, Public Key and Management, Authentication methods, Digital Signatures
3. **Security requirements:** Electronic Mail Security: Pretty Good Privacy, MIME, S/MIME, And Comparison. WEB Security, Secure Electronic Transaction(SET).
4. **Intrusion and Firewall:** Introduction to threats, Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges, Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control
5. **Security perspective of Hacking and its counter majors :** Introduction to Hacking, Counter majors: General Strategies

Books:

1. William Stallings, “Cryptography and Network Security”, Pearson, ISBN:978-93-325-1877-3
2. Oded Goldreich, “Foundations of Cryptography: Basic Tools”, Cambridge University Press, ISBN-10: 0521035368; ISBN-13: 978-0521035361
3. Jonathan Katz and Yehuda Lindell, “Introduction to Modern Cryptography”, CRC Book

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310249: Audit Course 3
AC3 – II: Professional Ethics and Etiquettes

Professional ethics is the underlying concept behind the successful accomplishment of any act of a professional towards achieving the individual and societal goals. These goals should ultimately result in morally, legally, ethically and even culturally acceptable good things for all. Engineers being special group of professionals need to be more conscious of their acts since their duties, rights and responsibilities permeate into the society and the surroundings. To practice professional ethics, understanding of values and concepts are essential.

Course Objectives:

- To create awareness on professional ethics and Human Values.
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards.
- To inculcate knowledge and exposure on Safety and Risk.
- To expose students to right attitudinal and behavioral aspects

Course Outcome:

On completion of the course, learner will be able to–

- understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories
- Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
- Follow Ethics as an engineering professional and adopt good standards & norms of engineering practice.
- apply ethical principles to resolve situations that arise in their professional lives

Course Contents:

1. **Human Values And Engineering Ethics:** Morals, values and Ethics, Integrity, Work ethic, Civic virtue , Valuing time, Cooperation**,** Commitment, Empathy, Self-confidence , stress management, Senses of Engineering Ethics, Kohlberg"s theory, Gilligan"s theory, Models of professional roles, Uses of Ethical Theories.
2. **Research Ethics and Codes of Ethics:** Industrial standardization, ethical code and its importance, ethical accountability, law in engineering, engineering as social experimentation.
3. **Safety, Responsibilities And Rights:** Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk collegiality, Collective Bargaining , Confidentiality , Conflicts of Interest, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination, Utilitarianism
4. **Professional Etiquette:** Etiquette at Meetings, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics.

Books:

1. Caroline Whitbeck, "Ethics in Engineering Practice and Research", Cambridge Press, ISBN:978-1-107-66847-8
2. Prabhuddha Ganguli: ―Intellectual Property Rights‖ Tata Mc-Graw –Hill, New Delhi, ISBN-10:0070077177
3. Professional Ethics and Etiquette (Mastering Career Skills), Checkmark, ISBN-10: 0816071179
4. A Alavudeen, "Professional Ethics And Human Values" Firewall, ISBN13 : 8131803066

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310249: Audit Course 3
AC3 – III: Emotional Intelligence

This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

Course Objectives:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

- Expand your knowledge of emotional patterns in yourself and others
- Discover how you can manage your emotions, and positively influence yourself and others
- Build more effective relationships with people at work and at home
- Positively influence and motivate colleagues, team members, managers
- Increase your leadership effectiveness by creating an atmosphere that engages others
- Apply EI behaviors and supports high performance

Course Contents:

1. **Introduction to Emotional Intelligence (EI) :** Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace
2. **Know and manage your emotions:** emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize 'negative' and 'positive' emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing 'negative' emotions, Techniques to manage your emotions in challenging situations
3. **Recognize emotions in others :** The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy
4. **Relate to others**: Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

Books:

1. Daniel Goleman," Emotional Intelligence – Why It Matters More Than IQ," , Bantam Books, ISBN-10: 055338371X13: 978-0553383713
2. Steven Stein , "The EQ Edge" , Jossey-Bass, ISBN : 978-0-470-68161-9
3. Drew Bird , "The Leader's Guide to Emotional Intelligence" , ISBN: 9781535176002

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310249: Audit Course 3
AC3 – IV: MOOC-learn New Skill

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcome:

On completion of the course, learner will acquire additional knowledge and skill.

About Course:

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.
The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: These are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructor is requested to promote students to opt for courses with proper mentoring. The departments will take care of providing necessary infrastructural facilities and other facilities for the learners.

References:

1. https://swayam.gov.in/
2. https://onlinecourses.nptel.ac.in/
3. https://www.edx.org

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310249: Audit Course 3
AC3 – V: Foreign Language(Japanese Module 3)

Prerequisite Courses: Audit Course AC1-V(210250), AC2-V(210258)

About Course:

With changing times, the competitiveness has gotten into the nerves and ‗Being the Best' at all times is only the proof of it. Nonetheless, ‗being the best' differs significantly from Communicating the best'. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‗resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome:

On completion of the course, learner will be able to–

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Introduction to Kanji Script, Describing one's daily routine. To ask what someone does. Expressions of Giving & Receiving.
2. Adjectives (Types of adjectives), Asking impression or an opinion about a thing / person / place that the listener, has experienced, visited, or met, Describing things / person / places with the help of the adjectives.
3. Expressions of Like & Dislikes. Expressing one's ability, hobby, Comparison between objects, persons & cities, which resulted from a certain action in the past.

References:

1. Minna No Nihongo, ―Japanese for Everyone‖, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.

2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx

SEMESTER II

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310250: Design and Analysis of Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Discrete Mathematics (210241), Data Structures (210243, 210252), Theory of Computation (310241)

Course Objectives:

- To develop problem solving abilities using mathematical theories
- To analyze the performance of algorithms
- To study algorithmic design strategies

Course Outcomes:

On completion of the course, student will be able to–

- Formulate the problem
- Analyze the asymptotic performance of algorithms
- Decide and apply algorithmic strategies to solve given problem
- Find optimal solution by applying various methods

Course Contents

Unit I	Fundamentals	09 Hours

The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues.

Unit II	Models and Design	09 Hours

Functional Model – Features, Recursive processes, Scope rules, Tail recursion, Checking correctness of Iterative process. Imperative Model – Basics, Specifications and Prototyping, Stepwise Refinement, Proof Rules – Basics, For loops, Goto and Exit loops, Functions and Procedures, Problem Solving using Greedy strategy - Knapsack problem, Huffman code generation algorithm.

Unit III	Abstract Algorithms	09 Hours

Dynamic Programming, Divide and Conquer, Greedy strategy, Branch-n-Bound, Natural Algorithms –Evolutionary Algorithms and Evolutionary Computing, Introduction to Genetic Algorithm, Simulated Annealing, Artificial Neural Network and Tabu Search.

Unit IV	Complexity Theory	09 Hours

Complexity theory – Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O, Ω, ϴ, o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.

Unit V	Amortized Analysis	09 Hours

Amortized Analysis – Binary, Binomial and Fibonacci heaps, Dijkstra's Shortest path algorithm, Splay Trees, Time-Space tradeoff, Introduction to Tractable and Non-tractable Problems, Introduction to Randomized and Approximate algorithms, Embedded Algorithms: Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

Unit VI	Multithreaded and Distributed Algorithms	09 Hours

Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms, Parallel loops, Race conditions.

Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreaded merge sort.

Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree.

String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm

Books:

Text:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Design And Analysis of Algorithms", Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, "Fundamentals of Algorithmics", PHI, ISBN 978-81-203-1131-2

References:

1. Michael T. Goodrich, Roberto Tamassia , "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 81 7371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press,ISBN:0-521-67035-7

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310251: Systems Programming and Operating System

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: **Fundamentals of Programming Languages(110011,110003), Data Structures (210243,210252)**

Companion Course: **Systems Programming and Operating System Lab (310257)**

Course Objectives:

- To understand basics of System Programming.
- To learn and understand data structures used in design of system software.
- To learn and understand basics of compilers and tools.
- To understand functions of operating system.
- To learn and understand process, resource and memory management.

Course Outcomes:

On completion of the course, student will be able to–

- Analyze and synthesize system software
- Use tools like LEX & YACC.
- Implement operating system functions.

Course Contents

Unit I	Introduction	09 Hours

Introduction: Components of System Software: Text editors, Loaders, Assemblers, Macro processors, Compilers, Debuggers. Machine Structure, Machine language and Assembly Language. Assemblers: General design procedure, design of two pass assembler

Unit II	Macro Processor, Linker and Loader	09 Hours

Macro Processor: Macro instructions, Features of macro facility, Design of two-pass, single pass and nested macro processor. Loaders: Loader schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, overlay structure. Design of an absolute loader, Design of direct linking loader. Linkers: Relocation and linking concepts, Design of linker, self relocating programs, Static and dynamic link libraries, use of call back functions. Case Study: Loading phases using Java.

Unit III	Language Translator	09 Hours

Role of lexical analysis -parsing & Token, patterns and Lexemes & Lexical Errors, regular definitions for the language constructs & strings, sequences, Comments & Transition diagram for recognition of tokens, reserved words and identifiers, examples Introduction to Compilers and Interpreters: General Model of Complier, Program interpretation, Comparison of compiler and Interpreter, Use of Interpreter and components of Interpreter. Case Study: Overview of LEX and YACC specification and features.

Unit IV	Operating Systems	09 Hours

Operating Systems: Introduction to different types of operating Real Time Operating Systems, System Components, OS services, System structure- Layered Approach.
Process Management: Process Concept- Process states, Process control block, Threads, Process Scheduling: Types of process schedulers, Types of scheduling: Preemptive, Non preemptive. Scheduling algorithms: FCFS, SJF, RR, Priority,
Deadlocks: Methods of handling deadlocks, Deadlock prevention, avoidance and detection, Recovery from deadlocks.
Case Study: Process Management in multi-cores OS.

Unit V	Memory Management	09 Hours

Memory management: Review of Programming Model of Intel 80386, Contiguous and non-contiguous, Swapping, Paging, Segmentation, Segmentation with Paging. Virtual Memory: Background, Demand paging, Page replacement scheme- FIFO, LRU, Optimal, Thrashing.
Case Study: Memory Management in multi-cores OS.

Unit VI	I/O Management	09 Hours

I/O Management: I/O Devices, Organization of I/O function, I/O Buffering, Disk Scheduling- Disk Scheduling policies like FIFO, LIFO, STTF, SCAN, C-SCAN.
File Management: Concept, Access methods, Directory Structure, Protection, File System implementation, Directory Implementation, Allocation methods, Free Space management.
Case Study: I/O and File Management in multi-cores OS
Case Study: Light weight and heavy weight OS: Linux, Tizen

Books:

Text:

1. John Donovan, “System Programming”, McGraw Hill, ISBN 978-0--07-460482-3.
2. Silberschatz, Galvin, Gagne, "Operating System Principles", 9th Edition, Wiley, ISBN 978-1-118-06333-0

References:

1. Dhamdhere D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
2. Randal Bryant and David O'Hallaron, “Computer Systems: A Programmer's Perspective” , Pearson, ISBN 10: 0-13-610804-0
3. Stallings W., "Operating Systems", 6th Edition, Prentice Hall, ISBN-978-81-317-2528-3.
4. John. R. Levine, Tony Mason and Doug Brown, “Lex and Yacc”, O'Reilly, 1998, ISBN: 1-56592-000-7

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310252: Embedded Systems and Internet of Things

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

Prerequisite Course: **Computer Networks (310245)**

Companion Course: **Embedded Systems and IoT Lab (310258)**

Course Objectives:

- To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling.
- To introduce students a set of advanced topics in embedded IoT and lead them to understand research in network.
- To develop comprehensive approach towards building small low cost embedded IoT system.
- To understand fundamentals of security in IoT,
- To learn to implement secure infrastructure for IoT
- To learn real world application scenarios of IoT along with its societal and economic impact using case studies

Course Outcomes:

On completion of the course, student will be able to–

- Implement an architectural design for IoT for specified requirement
- Solve the given societal challenge using IoT
- Choose between available technologies and devices for stated IoT challenge

Course Contents

Unit I	Introduction to Embedded System and Internet of Things	09 Hours

Embedded Systems: Application Domain and Characteristic of Embedded System, Real time systems and Real time scheduling, Processor basics and System-On-Chip, Introduction to ARM processor and its architecture. **IoT:** Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications

Unit II	Embedded IoT Platform Design Methodology	09 Hours

Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development

Unit III	Pillars of Embedded IoT and Physical Devices	09 Hours

Horizontal, verticals and four pillars of IoT, M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: The internet of controllers, DCM: Device, Connect and Manage, Device: Things that talk, Connect: Pervasive Network, Mangae: To create business values. IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Beagle board and Other IoT Devices.

Unit IV	IoT Protocols and Security	09 Hours

Protocol Standardization for IoT, Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACNet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer.

IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.

Unit V	Web of Things and Cloud of Things	09 Hours

Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture.

Unit VI	IoT Physical Servers, Cloud Offerings and IoT Case Studies	09 Hours

Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Djanjo, Amzon Web Services for IoT, SkyNet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation.

Books:

Text:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515

2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012. ISBN : 9781439892992

3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011. ISBN: 978-3-642-19156-5

4. Lyla B. Das, "Embedded Systems: An Integrated Approach" Pearson , ISBN: 9332511675, 9789332511675.

References:

1. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010, ISBN:10: 0521195330

2. Olivier Hersent, Omar Elloumi and David Boswarthick, "The Internet of Things: Applications to the Smart Grid and Building Automation", Wiley, 2012, 9781119958345

3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012, ISBN:978-1-119-99435-0

4. Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010.ISBN : 978-0-470-90356-8

5. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014, ISBN: 978-1-118-43063-7

6. Christopher Hallinan, "Embedded Linux Primer", Prentice Hall, ISBN:13: 978-0-13-167984-9

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310253: Software Modeling and Design

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Course: Software Engineering and Project Management (310243)

Course Objectives:

- To understand and apply Object Oriented(OO) concept for designing OO based model/application
- To transform Requirement document to Appropriate design
- To understand different architectural designs and to transform them into proper model
- To choose and use modern design tools for project development and implementation.
- To choose and use appropriate test tool for testing web-based/desktop application

Course Outcomes:

On completion of the course, student will be able to–

- Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application
- Design and analyze an application using UML modeling as fundamental tool
- Apply design patterns to understand reusability in OO design
- Decide and apply appropriate modern tool for designing and modeling
- Decide and apply appropriate modern testing tool for testing web-based/desktop application

Course Contents

Unit I	Introduction	07 Hours

Introduction to software design, design methods- procedural / structural and object oriented, Requirement Vs Analysis Vs Architecture Vs Design Vs Development 4+1 Architecture, case study of transferring requirement to design, UP, COMET use case based software life cycle, Introduction to UML -Basic building blocks, Reusability, Use case modeling, Use case template

Case study – Transferring requirements into design using advanced tool

Unit II	Static Modelling	08 Hours

Analysis Vs Design, Class diagram- Analysis - Object & classes finding analysis & Design- design classes, refining analysis relationships, Inheritance & polymorphism, Object diagram, Component diagram- Interfaces & components, deployment diagram, Package diagram

Unit III	Dynamic Modelling	07 Hours

Interaction & Interaction overview diagram, sequence diagram, Timing diagram, Communication diagram, Advanced state machine diagram, Activity diagram

Unit IV	Architecture Design	08 Hours

Introduction to Architectural design, overview of software architecture, Object oriented software architecture, Client server Architecture, Service oriented Architecture, Component based Architecture, Real time software Architecture

Unit V	Design patterns	07 Hours

Introduction to Creational design pattern – singleton, Factory ,Structural design pattern- Proxy design pattern, Adapter design pattern, Behavioral – Iterator design pattern, Observer design pattern

Unit VI	Testing	08 Hours

Introduction to testing, Error, Faults, Failures, verification and validation, Whit Box Testing, Black Box Testing, Unit testing, Integration testing, GUI testing, User acceptance Validation testing, integration testing, scenario testing, performance testing. Test cases and test plan. Case studies expected for developing usability test plans and test cases.

Note: Instructor should frame appropriate case studies/ mini-project (different case study for a group of 6-8 students) on unit-I to unit-V. The case study framed for unit-I may be continued/carry forward for next units if necessary. The same case studies/mini-projects should be tested using appropriate testing tool (preferably open source like Selenium). Draw UML diagrams for mini project.

Books:

Text Books:

1. Jim Arlow, Ila Neustadt, "UML 2 and the unified process –practical object-oriented analysis and design" Addison Wesley, Second edition, ISBN 978-0201770605
2. Hassan Gomaa, "Software Modeling and Design- UML, Use cases, Patterns and Software Architectures" Cambridge University Press, 2011, ISBN 978-0-521-76414-8
3. Srinivasan Desikan, Gopalaswamy Ramesh, "Software testing- Principles and practices" Prentice Hall, 2007, ISBN 9788177581218

References Books:

1. Eric J. Braude, "Software Design: from Programming to Architecture", J. Wiley, 2004, ISBN 978-0-471-20459-6
2. Gardy Booch, James Rambaugh, Ivar Jacobson, "The unified modeling language user guide" , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310254: Web Technology

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: Computer Network (310245) , Database Management Systems (310242)

Companion Course: Web Technology Lab (**3**10256)

Course Objectives:

- To understand the principles and methodologies of web based applications development process
- To understand current client side and server side web technologies
- To understand current client side and server side frameworks
- To understand web services and content management

Course Outcomes:

On completion of the course, student will be able to–

- analyze given assignment to select sustainable web development and design methodology
- develop web based application using suitable client side and server side web technologies
- develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management

Course Contents

Unit I	Web Development Process, Front End Tools	07 Hours

Introduction to web technology, internet and www, Web site planning and design issues, HTML: structure of html document , HTML elements: headings, paragraphs, line break, colors & fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. CSS: Introduction to Style Sheet, Inserting CSS in an HTML page, CSS selectors, XML: Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.

Unit II	Client Side Technologies	08 Hours

JavaScript: Overview of JavaScript, using JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Loading JQuery, Selecting elements, changing styles, creating elements, appending elements, removing elements, handling events.

Unit III	Server Side Technologies	08 Hours

Introduction to Server Side technology and TOMCAT, Servlet: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, session management. JSP: Introduction to JSP, advantages of JSP over Servlet , elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC Connectivity with JSP.

Unit IV	Server Side Technologies	07 Hours

PHP: Introduction to PHP, Features, sample code, PHP script working, PHP syntax, conditions & Loops, Functions, String manipulation, Arrays & Functions, Form handling, Cookies & Sessions, using MySQL with PHP, WAP & WML, AJAX: Introduction, Working of AJAX, AJAX processing steps, coding AJAX script.

Unit V	Client and Server Side Frameworks	07 Hours
Angular JS : Overview, MVC architecture, directives, expression, controllers, filters, tables, modules, forms, includes, views, scopes, services, dependency injection, custom directives, Internationalization, Introduction to NodeJS. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.		
Unit VI	**Web Services**	**08 Hours**
Web Services: Overview, types of WS, difference between SOAP and REST, EJB: types of EJB, benefits, Architecture, EJB technology, JNDI lookup, Introduction to Content Management System(CMS) ,Wordpress / Joomala, Advanced Technology: Bootstrap, JSF, Spring.		

Books:

Text:

1. Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
2. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676

References:

1. Adam Bretz & Colin J Ihrig, "Full Stack Javascript Development with MEAN", SPD, ISBN-13: 978-0992461256
2. Giulio Zambon, " Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10: 1430246235; ISBN-13: 978-1430246237
3. Jeremy McPeak& Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937
4. Black Book, "Struts 2", Dreamtech Press, ISBN 13, : 9788177228700
5. Black Book, " JDBC 4.2, Servlet 3.1 & JSP 2.3", Dreamtech Press, ISBN-13: 978-8177228700
6. Sandeep Panda, "Angular JS: Novice To Ninja", SPD, First Edition 2014, ISBN-13: 978-0992279455
7. B. V. Kumar, S. Sangeetha, S. V. Subrahmanya,, "J2EE Architecture, an illustrative gateway to enterprise solutions", Tata McGraw Hill Publishing Company. ISBN: 9780070621633
8. Brian Fling, "Mobile Design and Development", O'REILLY, ISBN: 13:978-81-8404-817-9
9. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3
10. Allan Cole, Raeiva Jackson Armitage Brandon R. Jones Jeffrey Way, "Build Your Own Wicked Wordpress Themes", SPD, ISBN: 978-93-5213-154-9
11. Ed Burnette, "Hello , Android Introducing Google' Mobile Development Platform", SPD, ISBN: 13:978-93-5213-085-6

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310255: Seminar and Technical Communication

Teaching Scheme:	Credit	Examination Scheme:
TUT: 01 Hour/Week	01	TW: 50 Marks

Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To expose the student to new technologies, researches, products, algorithms, services

Course Outcomes:

On completion of the course, student will–

- be able to be familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
- be able to improve skills to read, understand, and interpret material on technology.
- improve communication and writing skills

Guidelines:

- Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.
- The topic must be selected in consultation with the institute guide.
- Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only.
- Active participation at classmate seminars is essential.
- BoS has circulated the Seminar Log book and it is recommended to use it.

Guidelines for Assessment:

Panel of staff members along with a guide would be assessing the seminar work based on these parameters-Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Recommended Format of the Seminar Report:

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year & University
- Seminar Approval Sheet/Certificate
- Abstract and Keywords
- Acknowledgements
- Table of Contents, List of Figures, List of Tables and Nomenclature
- Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/ …..,Discussions and Conclusions ,Bibliography/References
- Plagiarism Check report
- Report Documentation page

References:

1. Rebecca Stott, Cordelia Bryan, Tory Young, "Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)", Longman, ISBN-13: 978-0582382435
2. Johnson-Sheehan, Richard, "Technical Communication", Longman. ISBN 0-321-11764-6
3. Vikas Shirodka, "Fundamental skills for building Professionals", SPD, ISBN 978-93-5213-146-5

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310256: Web Technology Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 25 Marks PR: 50 Marks

Companion Course: Web Technology (310254)

Course Objectives:

- To use current client side and server side web technologies
- To implement communication among the computing nodes using current client side and server side technologies
- To design and implement web services with content management

Course Outcomes:

On completion of the course, student will be able to–

- develop web based application using suitable client side and server side web technologies
- develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept/technology/tool in brief, design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Suggested List of Laboratory Assignments

1.	**Lab Assignment on Unit I:** **Assignment 1a:** Installation and Configuration of Web Application Servers Tomcat, Apache, WebSphere, JBoss, GlassFish. **Assignment 1b:** Design and develop any suitable web application using HTML, CSS and XML in consultation of course instructor.
2.	**Lab Assignment on Unit II:** **Assignment 2:** Perform validation of all fields in **assignment no.1** by using Java script/JQuery.
3.	**Lab Assignment on Unit III:** **Assignment 3:** Add dynamic web application essence in **assignment no. 2** using Servlet, JSP and backend.
4.	**Lab Assignment on Unit IV:** **Assignment 4:** Add dynamic web application essence in **assignment no. 2** using PHP, MySQL database connectivity and AJAX controls.
5.	**Lab Assignment on Unit V:** **Assignment 5:** Re-Design, develop and deploy **assignment no. 3 of unit –III** using Strut Re-Design, develop and deploy **assignment no. 4 of unit –IV** using Angular JS
6.	**Lab Assignment on Unit VI:** **Assignment 6:** Design, Develop and Deploy separate web application using EJB/CMS/JSF/Spring/Bootstrap.
7.	**Assignment on Software Modeling and Design**

Reference Books:

1. Aleksa V and James Goodwill, "Apache Tomcat 7", Apress, 2011, ISBN: 10: 1430237236
2. Bryan Basham, Kathy Sierra, Bert Bates, "JSP: Passing the Sun Certified Web Component Developer Exam", O'Reilly Media ISBN: 978-0-596-51668-0
3. Chirag Rathod, Jonathan Wetherbee, Peter Zadrozny, and Raghu R. Kodali, "Beginning EJB 3: Java EE 7 Edition", Apress, 2013, ISBN : 9781430246923
4. Richard Monson-Haefel, "J2EE Web Services", Addison-Wesley Professional, First Edition, 2004, ISBN: 10: 0321146182
5. Chuck Cavaness, "Programming Jakarta Struts", O'relly Media, second edition 2004, ISBN: 978-0-596-00651-8;
6. Michael Morrison, Lynn Beighley, "Head First PHP & MySQL: A Brain-Friendly Guide", O'relly Media, second edition 2008, ISBN :13: 9788184046588
7. Dan Rahmel, "Advanced Joomla!", Apress, First Edition, 2013, ISBN: 13: 9781430216285
8. Iwein Fuld, Marius Bogoevici, Mark Fisher, Jonas Partner", Spring Integration in Action", Manning, 2012, ISBN : 13: 9781935182436.

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310257: System Programming & Operating System Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	TW: 25 Marks PR: 50 Marks

Companion Course: Systems Programming and Operating System (310251)

Course Objectives:

- To implement basic language translator by using various needed data structures
- To implement basic Macroprocessor
- To design and implement Dynamic Link Libraries
- To implement scheduling schemes

Course Outcomes:

On completion of the course, student will be able to–

- Understand the internals of language translators
- Handle tools like LEX & YACC.
- Understand the Operating System internals and functionalities with implementation point of view

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, Design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation.

So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned.

Set of suggested assignment list is provided in groups- A, B, C, D (All Compulsory)
Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - Eclipse IDE

Books:

1. Paul Gries Jennifer Campbll, Jason Montojo, "Practical Programming Second Edition", SPD, ISBN: 978-93-5110-469-8

Suggested List of Laboratory Assignments

Group A

1.	Design suitable data structures and implement pass-I of a two-pass assembler for pseudo-machine in Java using object oriented feature. Implementation should consist of a few instructions from each category and few assembler directives.
2.	Implement Pass-II of two pass assembler for pseudo-machine in Java using object oriented features. The output of assignment-1 (intermediate file and symbol table) should be input for this assignment.
3.	Design suitable data structures and implement pass-I of a two-pass macro-processor using OOP features in Java
4.	Write a Java program for pass-II of a two-pass macro-processor. The output of assignment-3 (MNT, MDT and file without any macro definitions) should be input for this assignment.

Group B

1.	Write a program to create Dynamic Link Library for any mathematical operation and write an application program to test it. (Java Native Interface / Use VB or VC++).
2.	Write a program using Lex specifications to implement lexical analysis phase of compiler to generate tokens of subset of 'Java' program.
3.	Write a program using Lex specifications to implement lexical analysis phase of compiler to count no. of words, lines and characters of given input file.
4.	Write a program using YACC specifications to implement syntax analysis phase of compiler to validate type and syntax of variable declaration in Java.
5.	Write a program using YACC specifications to implement syntax analysis phase of compiler to recognize simple and compound sentences given in input file.

Group C

1.	Write a Java program (using OOP features) to implement following scheduling algorithms: FCFS , SJF (Preemptive), Priority (Non-Preemptive) and Round Robin (Preemptive)
2.	Write a Java program to implement Banker's Algorithm
3.	Implement UNIX system calls like ps, fork, join, exec family, and wait for process management (use shell script/ Java/ C programming).
4.	Study assignment on process scheduling algorithms in Android and Tizen.

Group D

Write a Java Program (using OOP features) to implement paging simulation using

1. Least Recently Used (LRU)
2. Optimal algorithm

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310258: Embedded Systems & Internet of Things Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 50 Marks

Companion Course-Embedded Systems & Internet of Things (310252)

Course Objectives:
- To understand functionalities of various single board embedded platforms fundamentals
- To develop comprehensive approach towards building small low cost embedded IoT system.
- To understand different sensory inputs.

Course Outcomes:

On completion of the course, student will be able to–
- Design the minimum system for sensor based application
- Solve the problems related to the primitive needs using IoT
- Develop full fledged IoT application for distributed environment

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 11 assignments as at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 1 from group E. **UML diagrams are to be drawn for group E assignment**.

References:

1. Nitesh Dhanjani, "Abusing the Internet of Things", O'REILLY, ISBN: 13:978-93-5313-217-1
2. Cuno Pfister, "Getting Started with the Internet of Things", O'REILLY, ISBN: 13:978-93-53023-413-6
3. Massimo Banzi and Michael Shiloh, "Getting Started with Arduino", MAKER MEDIA, ISBN: 13:978-93-5110-907-5
4. Don Wilcher, "BASIC Arduino Projects", MAKER MEDIA, ISBN: 13:978-93-5110-503-9
5. Cefn Hoile, Clare Bowman, Sjoerd Dirk Meijer, Brian Corteil, Lauren Orsini, "Raspberry Pi and AVR Projects", MAKER MEDIA, ISBN: 13:978-93-5110-914-3
6. Wolfrom Donot, "A Raspberry Pi Controlled Robot", MAKER MEDIA, ISBN: 13:978-93-5110-913-6
7. Kimmo Karvinen and Tero Karvinen, "Arduino Bots and Gadgets", O'REILLY, ISBN: 13:978-93-5023-374-0
8. Derek Molley, "Exploring Beaglebone", Willey, ISBN: 978-1-118-935125
9. Matt Richardson and Shawn Wallace, "Getting with Raspberry Pi", MAKER MEDIA, ISBN: 978-93-5213-450-2
10. Dr. Simon Monk, "Raspberry PiCook-Book", O'REILLY, ISBN: 978-93-5213-389-5

Suggested List of Laboratory Assignments

	Group A
1.	Study of Raspberry-Pi, Beagle board, Arduino and other micro controller (History & Elevation)
2.	Study of different operating systems for Raspberry-Pi /Beagle board. Understanding the process of OS installation on Raspberry-Pi /Beagle board
3.	Study of Connectivity and configuration of Raspberry-Pi /Beagle board circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.
4.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs
	Group B
5.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
6.	Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.
7.	Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee.
8.	Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi /Beagle board

Group C	
9.	Write an application using Raspberry-Pi /Beagle board to control the operation of stepper motor.
10.	Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated traffic signal.
11.	Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated lift elevator
Group D	
12.	Write a server application to be deployed on Raspberry-Pi /Beagle board. Write client applications to get services from the server application.
13.	Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
14.	Create a simple web interface for Raspberry-Pi/Beagle board to control the connected LEDs remotely through the interface.
Group E	
15.	Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group.
16.	Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

Savitribai Phule Pune University
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are as suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

AC4- I	Digital and Social Media Marketing
AC4-II	Green Computing
AC4-III	Sustainable Energy Systems
AC4-IV	Leadership and Personality Development
AC4-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for **Japanese (Module 4) are provided. For other languages institute may design suitably.**

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4
AC4 – I: Digital & Social Media Marketing

The importance of social media's role in modern marketing efforts can no longer be ignored. It's an integral component in almost all successful marketing strategies. With this increasing emphasis on integrated social media strategies, there is an Irrefutable need for marketing professionals and organizations to have end- to- end social media expertise. Through case studies, interactive sessions, and class exercises, students will learn best practices and develop the skills to connect business objectives with social media strategy, platforms and tactics. Topics will include choosing appropriate platforms, creating effective and engaging social media content, content management, social listening and creating a social media policy

Course Objectives:

- Identify best practices for Social Media Marketing, including platform level best practices.
- Connect business objectives to appropriate Social Media tactics.
- Create strong content that engages their target audience with their marketing message.

Course Outcome:

On completion of the course, learner will be able to–

- Create editorial calendars to manage content distribution.
- Use Social Listening tools to create timely, relevant content.
- Create Social Media policies that combine business objectives with appropriate use of social media channels and content.

Course Contents:

1. Introductions and review class objectives, Discuss class goals and individual goals, Fill out questionnaire, Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post.
2. Introduction to Facebook and channel advertising and campaigns, Introduction to Twitter and channel advertising and campaigns, Creative Campaign examples across social channels
3. Introduction to both Google+ and LinkedIn. Provide an overview on LinkedIn advertising, Create Google+ and LinkedIn outlines for your project and include: types of posts and an example post for each platform.
4. Introduction to both Instagram and Pinterest as well as channel advertising and campaigns, Create Instagram and Pinterest outlines for your project and include: types of posts and an example post for each platform, review a content calendar, Lay out your own content calendar.

References:

1. Vandana Ahuja, Digital Marketing, Oxford Press, ISBN: 9780199455447,
2. Wiley, Jeanniey Mullen, David Daniels, David Gilmour " Email Marketing: An Hour a Day", ISBN: 978-0-470-38673-6
3. David Scott, "The New Rules of Marketing and PR", Wiley India, ISBN: 978-1-119-07048-1

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4
AC4 – II: Green Computing

Green computing is the study and practice of using computing resources efficiently. Green computing or green IT, refers to environmentally sustainable computing or IT. The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, Maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste.

Course Objectives:

- To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
- To examine technology tools that can reduce paper waste and carbon footprint by user.
- To understand how to minimize equipment disposal requirements.
- To gain skill in energy saving practices in their use of hardware

Course Outcome:

On completion of the course, learner will be able to–

- Understand the concept of green IT and relate it to sustainable development.
- Apply the green computing practices to save energy.
- Discuss how the choice of hardware and software can facilitate a more sustainable operation,
- Use methods and tools to measure energy consumption

Course Contents:

1. **Fundamentals of Green IT:** Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot Print - Measuring, Details, reasons to bother,Plan for the Future, Cost Savings: Hardware, Power.
2. **Green Assets and Power Problems:** Green Assets: Buildings, Data Centers, Networks, and Devices, Green Information Systems : Design andDevelopment Models, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Low-Power Computers and peripheral devices
3. **Greening Information Systems:** Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling
4. **Green Grid Framework:** Virtualizing of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center Case Studies – Applying Green IT Strategies and Applications to a Home Hospital, Packaging Industry and Telecom Sector

References:

1. Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August2009, ISBN: 978-0-470-46745-9
2. Alvin Galea, Michael Schaefer, Mike Ebbers, “Green Data Center: steps for theJourney”,Shoff/IBM rebook, 2011. ISBN: 10: 1-933742-05-4; 13: 978-1-933742-05-2
3. John Lamb, “The Greening of IT”, Pearson Education, 2009, ISBN 10: 0137150830
4. Jason Harris, “Green Computing and Green IT- Best Practices on regulations & industry”,Lulu.com, 2008, ISBN: 1558604898
5. Bud E. Smith, “Green Computing Tools and Techniques for Saving Energy, Money and Resources”, CRC Press, 2014, 9781466503403

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4
AC4 – III: Sustainable Energy Systems

Course Objectives:

- To understand the impact of engineering solutions on a global, economic, environmental, and societal context.
- To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Course Outcome:

On completion of the course, learner will be able to–

- Demonstrate an overview of the main sources of renewable energy.
- Understand benefits of renewable and sustainable energy systems.

Course Contents:

1. Introduction and Energy Fundamentals, Sustainable Energy Systems: Issues for the 21st century, the critical challenges for a sustainable energy future, Sustainable energy systems: definitions, indicators, Physics of Energy: Laws of Thermodynamics Energy Forms and Conversion, First and Second Laws and Efficiencies Devices: Heat Engines, Refrigerators and Heat Pumps Instantaneous and Average Power.
2. Introduction to Renewable Energy, Wind Energy Wind Turbine Technologies Wind Resources and Modeling Energy Performance and Environmental Impacts Economics and Economic Development Impacts, Photovoltaic: PV and BIPV Technologies Solar Resources and Modeling Energy Performance and Environmental Impacts, Economics and Net Metering
3. Biomass: Electricity Biomass Technologies Introduction Biomass Productivity and Modeling Biopower: MSW, willows/switch grass/ poplar, wood waste, Biomass: Transport Fuels Biofuels, Bioethanol, Biodiesel, Algal, Jatropha Biofuels and Water Land Use Impacts, Food vs Fuel, Renewable Fuels Standards
4. Building Energy Technologies and Policy, Smart buildings, Lighting and LEDs, Heating/cooling, technologies.

References:

1. İbrahim Dinçer, Calin Zamfirescu, “Sustainable Energy Systems and Applications”, Springer; 2012 edition, ISBN-10: 0387958606
2. D. Mukherjee, “Fundamentals of Renewable Energy Systems”, Atlantic, ISBN: 10: 8122415407
3. John R. Barker and Marc H. Ross Am. J. Phys ,“An introduction to global warming”, ISBN: 0-632-03779-2

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4
AC4 – IV: Leadership and Personality Development

Personality is considered as one of the integral part of an individual's existence. Where a student is concerned, paying close attention to **Personality** which is extremely important to enhance holistic development of students and improve their employability skills

Course Objectives:

- To develop inter personal skills and be an effective goal oriented team player.
- To develop professionals with idealistic, practical and moral values.
- To develop communication and problem solving skills.
- To re-engineer attitude and understand its influence on behavior

Course Outcome:

On completion of the course, learner will be able to–

- Enhance holistic development of students and improve employability skills

Course Contents:

1. **Introduction to Personality and working towards developing it:** Definition & Basics of personality, Analyzing strengths & weaknesses, Corporate theories on personality Development, Increasing Vocabulary, Body Language, gestures, Preparation of Self Introduction
2. **Communication skill and handling attitude:** Communication Skills, Listening, Communication Barriers, Overcoming these Barriers, Building Self Esteem and Self Confidence, Working on attitudes: aggressive, assertive, and submissive
3. **Leadership Techniques in Personality development:** Introduction to Leadership, Leadership Styles, Group Dynamics, Team Building
4. **Stress and time management skills:** Interpersonal Relationships, Analysis of Ego States, transactions & Life positions, Stress Management: Causes, Impact & Managing Stress, Introduction to conflict management, Time Management: Concept of time management, Steps towards better time management

References:

1. SOFT SKILLS, " Career Development Centre", Green Pearl Publications
2. Covey Sean," Seven Habits of Highly Effective Teens", New York, Fireside Publishers, 1998, ISBN: 978-1476764665
3. Carnegie Dale, " How to win Friends and Influence People", New York: Simon & Schuster, 1998, ISBN: 1-4391-6734-6
4. Thomas A Harris, I am ok, You are ok , New YorkHarper and Row, 1972, ISBN 13: 978-0060724276ISBN:
5. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006, ISBN: 055380491X, 9780553804911
6. Shiv Khera, "You Can Win", A&C Black, ISBN: 9780230331198.

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
310259: Audit Course 4
AC4 – V: Foreign Language(Japanese Module 4)

Prerequisite Courses: Audit Course AC1-V(210250), AC2-V(210258), AC3-V(310249)

About Course:

With changing times, the competitiveness has gotten into the nerves and Being the Best‘ at all times is only the proof of it. Nonetheless, being the best differs significantly from Communicating the best. The best can merely be communicated whilst using the best suitable Language!

Foreign languages like Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer‘s companion in current times with an assertion of a thriving future. Metro cities like Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the resume since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome:

On completion of the course, learner will be able to–

- Possess ability of basic communication.
- Possess the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Stating existence or a presence of thing (s), person (s), Relative positions, Counters
2. Expressing one’s Desire & wants, Verb groups, Asking, Instructing a person to do something
3. Indicating an action or motion is in progress, Describing habitual action, describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition

References:

1. Minna No Nihongo, “Japanese for Everyone”, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx

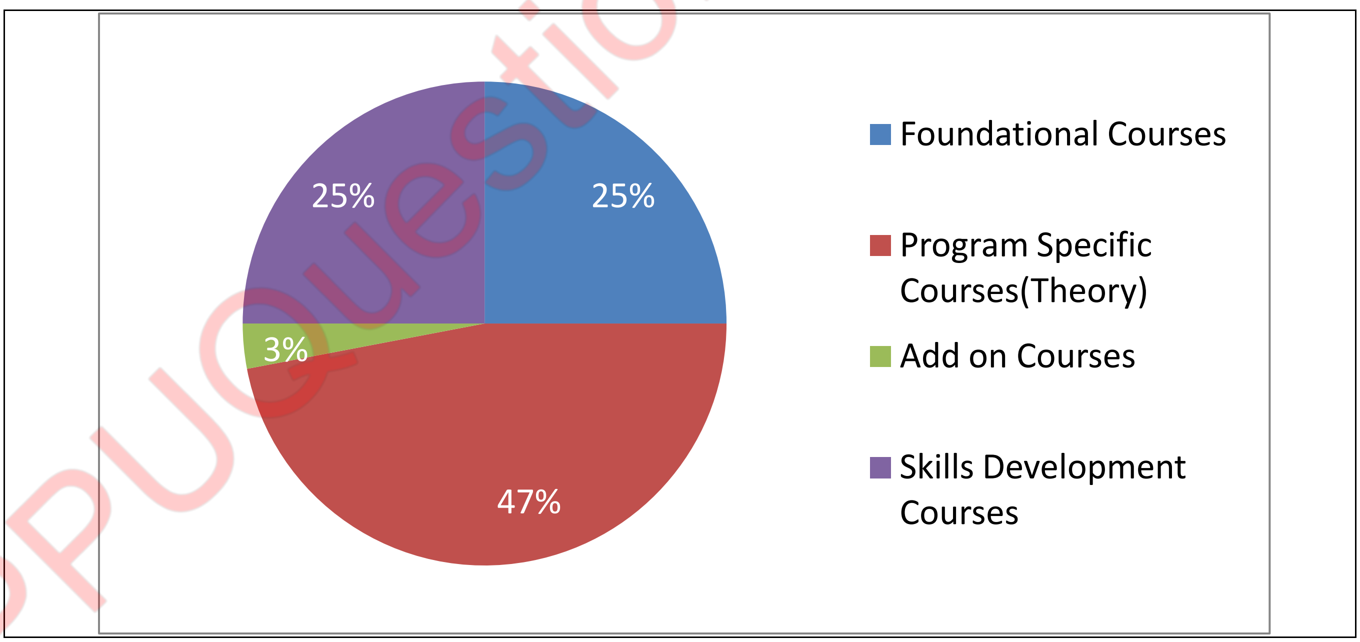
Savitribai Phule Pune University
Bachelor of Computer Engineering (Course 2015)
Total Credits- 190

First Year	Second Year	Third Year	Fourth Year (Proposed)
50 Credit	**50 Credit**	**46 Credit**	**44 Credit**
		Semester I	
FPL I	Discrete Mathematics	Theory of Computation	Parallel Architectures and Concurrent Computing
Engineering Maths I	Digital Electronics and Logic Design	Database Management Systems (DBMS)	Data Analytics
Engineering Physics	Data Structures and Algorithms	Software Engineering & Project Management	Software Testing & Quality Assurance
Basic Electrical Engineering	Computer Organization and Architecture	Information Systems & Engineering Economics	Elective I – • Digital Signal Processing • Advanced Databases, • Artificial Intelligence, • Wireless Sensor Networks
Engineering Graphics I	Object Oriented Programming(OOP)	Computer Networks (CN)	Elective II- • Cloud Computing, • Soft Computing • Software Architecture & Design • Operation Research
Basic Civil and Environmental Engineering	OOP Lab	Skill Development Lab	Lab I
Workshop Practice	Digital Electronics Lab	DBMS Lab	Lab II
Engineering Physics Lab	Data Structures Lab	CN Lab	Project Stage I
---	Soft Skills Lab	Audit Course 3	Audit Course 5
---	Audit Course 1	-----	------
		Semester II	
FPL II	Engineering Mathematics III	Design & Analysis of Algorithms	Distributed Systems
Engineering Maths II	Computer Graphics	Systems Programming & Operating System (SP& OS)	Information Security
Engineering Chemistry	Advanced Data Structures	Embedded Systems & Internet of Things (ES & IoT)	**Elective-III :** • Data Mining & Data Warehouse • Mobile Communication, • Image Processing • Human Computer Interface
Basic Electronics Engineering	Microprocessor	Software Modeling and Design	**Elective-IV :** • Principles of Compiler Design • Embedded & Real Time OS, • Pervasive and Ubiquitous Computing • Open Elective
Basic Mechanical Engineering	Principles of Programming Languages	Web Technology (WT)	Lab III
Engineering Mechanics	Computer Graphics Lab	Seminar & Technical Communication	Lab IV
Engg Graphics II	Advanced Data Structures Lab	Web Technology Lab	Project Work
Engg Chemistry Lab	Microprocessor Lab	ES & IoT Lab	Audit Course 6
-----	Audit Course 2	SP & OS Lab	---=-
----	------	Audit Course 4	-------

Savitribai Phule Pune University
Computer Engineering (2015 Course)
Courses-Credit Share

Sr. No	Category	Comprised of (Total Credit)	% of Credit Share
1	Foundational Courses (47 Credit)	• Mathematics (18) • Engineering Sciences (10) • Fundamentals of Core Engineering Domain (19)	25%
2	Program Specific Courses (Theory) (90 Credit)	Core (40) Advanced (38) Elective + Open Elective (12)	47%
3	Add on Courses (Audit +Credit Courses) (05 Credit)	• Social Awareness • Environmental • Personal Development • Economics (04) • Soft Skills (01)	3%
4	Skills Development Courses (48 Credit)	• Project (major) (08) • Seminar (01) • Labs + Mini-Project (39)	25%

Courses Credit Share



SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS FOR T. E. (ELECTRICAL ENGINEERING)

(2015 course)

WITH EFFECT FROM YEAR 2017-2018

Savitribai Phule Pune University
FACULTY OF ENGINEERING
T.E. Electrical Engineering (2015 Course)
(w.e.f. 2017-2018)

SEMESTER-I

Sr. No	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks	Credit	
			Th.	Pr.	Tu.	PP In Sem	PP End Sem	TW	PR	OR		TH/ TU	PR+OR
1	311121	Industrial and Technology Management	03	--	--	30	70	--	--	--	100	**03**	--
2	303141	Advance Microcontroller and its Applications	04	02	--	30	70	--	--	50	150	**04**	**01**
3	303142	Electrical Machines II	04	02	--	30	70	--	50	--	150	**04**	**01**
4	303143	Power Electronics	04	02	--	30	70	--	50	--	150	**04**	**01**
5	303144	Electrical Installation, Maintenance and Testing	03	02	--	30	70	50	--	--	150	**03**	**01**
6	303145	Seminar and Technical Communication	--	02	--	--	--	50	--	--	50	**--**	**01**
	303152	**Audit Course III**											
TOTAL			**18**	**10**	**--**	**150**	**350**	**100**	**100**	**50**	**750**	**18**	**05**

SEMESTER-II

Sr. No.	Subject Code	Subject Title	Teaching Scheme			Examination Scheme					Total Marks	Credit	
			Th.	Pr.	Tu	PP In Sem	PP End Sem	TW	PR	OR		TH/ TU	PR+OR
1.	303146	Power System II	04	02	--	30	70	--	50	--	150	**04**	**01**
2.	303147	Control System I	04	02	--	30	70	-	--	50	150	**04**	**01**
3.	303148	Utilization of Electrical Energy	03	--	--	30	70	--	--	--	100	**03**	**--**
4.	303149	Design of Electrical Machines	04	02	--	30	70	25	--	50	175	**04**	**01**
5.	303150	**Energy Audit and Management**	03	02	--	30	70	25	--	--	125	**03**	**01**
6.	303151	Electrical Workshop	--	02	--	--	--	50	--	--	50	**--**	**01**
	303153	Audit Course IV											
Total			**18**	**10**	**--**	**150**	**350**	**100**	**50**	**100**	**750**	**18**	**05**

Th: Theory lectures hours/week
Pr: Practical hours/week
Tu: Tutorial hours/week

TW: Term work
PR: Theory
OR: Oral
PP: Paper- In semester and End Semester

Audit Course

- Audit Course: Optional for 1st and 2nd term of TE Electrical Engineering

- 'Audit Courses' means a Course in which the student shall be awarded Pass or Fail only. It is left to the discretion of the respective affiliated institute to offer such courses to the students. Evaluation of audit course will be done at institute level itself.

- Teaching-learning process for these subjects is decided by concern faculty/industry experts appointed by the affiliated Engineering College.

- Marks obtained by student for audit course will not be taken into consideration of SGPA or CGPA.

Audit Course III	**(A) Wind Energy Systems**
	(B) Microcontroller MSP 430 and Applications
Audit Course IV	**(A) Bioenergy Systems**
	(B) Applications of Power Electronics

311121: Industrial And Technology Management

Teaching Scheme	Credits	Examination Scheme [Marks]
Theory: 03 Hrs./Week	03	In Sem. : 30 Marks
		End Sem.:70 Marks

Course Objective:

The course aims to

- Possess knowledge of types of business organizations; explore the fundamentals of economics and Management.
- Understand the basic concepts of Technology management and Quality management.
- Analyse and differentiate between marketing management and financial management.
- Recognize the importance of Motivation, Group dynamics, Team work, leadership skill and entrepreneurship.
- Explain the fundamentals of Human Resource management.
- Identify the importance of Intellectual property rights and understand the concept of patents, copy rights and trademarks.

Course Outcome:

Upon successful completion of this course, the students will be able to

- Differentiate between different types of business organization and discuss the fundamentals of economics and management.
- Explain the importance of technology management and quality management.
- Describe the characteristics of marketing and its types.
- Discuss the qualities of a good leader.

Unit 01: Introduction to managerial and economical demand (06Hrs)

Managerial Economics: Definition of economics, Demand and Supply concept, Law of demand and supply, Elasticity of demand and supply, Demand forecasting: Meaning and methods.

Management: Meaning, scope, function, and importance of management. Difference between administration and management. Types of business ownership: Sole proprietorship, Partnership (Act 1934), LLP (Limited Liability Partnership), (Act2008). Business Organizations: Line organization, Line and Staff organization and Functional Organization. Joint Stock Company: Public Limited and Private Limited, Public Sector Undertaking (PSU)

Unit 2: Technology and Industrial Management (06Hrs)

Introduction to industrial management: Concept, development, application and its scope.

Introduction of Technology Management : Definition of technology, Management and its relation with society, classification of technology, Management of technology at various levels- its importance on National Economy, Ethics in technology management, Critical Factors in technology management.

Unit 3: Quality Management **(06Hrs)**

Definition of Quality Management: Definition of quality, continuous improvement, Types of quality. Quality of design, Assistance Tools: Ishikawa diagram – Pareto Analysis. Pokka Yoke (Mistake Proofing) quality circles, Kaizen. TQM, 5S (Case study of Toyota, descriptive treatment). Six-Sigma, Quality Management Standards (Introductory aspects only) The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004. Environmental Management System Standard.

Unit 4: Marketing and Financial Management **(06Hrs)**

Marketing Management: Market, meaning, characteristics and its types: Perfect Competition, Monopoly, Monopolistic completion and Oligopoly. Marketing and selling, marketing planning. Market survey and market research, online Marketing.

Financial Management: Definition of financial management, cost. Types of costs, and methods of costing, price, capital. Debit, credit, books of accounts and final accounts.

Unit 5: Human Resource Management **(06Hrs)**

Motivation: Introduction to Motivation, theories of work motivation: Maslow Hierarchy of need's theory, Theory X, Theory Y and F. Herzberg's two factor theory. Group dynamics: Types and interactions of groups, stages of group dynamics: Norming, Storming, Forming, Performing and Adjourning. Leadership- Laissez-faire, importance, qualities of good leadership. Human Resource Management- Introduction, importance, scope. HR planning. Recruitment, selection, training and development, Performance management.

Unit 6: Entrepreneurship **(06Hrs)**

Entrepreneurship- Definition, concept, traits, qualities of entrepreneur. Importance and limitations of rational decision making, Decision making under certainty, uncertainty and risk. Incentives for small business development, Government policies and incentives, Case study on Small scale industries in India. Introduction to Intellectual Property Rights (IPR), Meaning of IPR, Different forms of IPR, Patents, Criteria for securing Patents. Patent format and structure, Copy and trademark (Descriptive treatment only).

Text Books:

[T1] O.P. Khanna, industrial engineering and management, Dhanpat Rai and sons, New Delhi.

[T2] E. H. McGrah, S. J. Basic managerial skill for all.

[T3] Tarek Khalil, Management of Technology Tata Mc Graw Hill Publication Pvt. Ltd.

[T4] Prabuddha Ganguli Intellectual Property rights TATA McGraw-Hill Publishing Company

[T5] Management Accounting and financial management by "M. Y. Khan and P. K. Jain", Mcgraw Hill-Tata-ISBN.

Reference Books:

[R1] C. B. Mamoria and V.S.P.Rao- Personnel Management, Himalaya Publishing House, 30th Edition 2014

[R2] Harold Koonlz and O D'onnel – Management.McGrawHill Publication 1980

[R3] Philip Kotler- Marketing Management. Pearson Edition 2008

[R4] Robert Heller, Managing Teams, Dorling Kindersley, London.

[R5] Kelly John M, Total Quality Management, InfoTech Standard, Delhi.

[R6] Joseph M. Juran Juran's Quality Handbook TATA McGraw-Hill.

[R7] Dale H. Besterfield and CarolBesterfield Total Quality Management Prentice Hall of India Pvt. Ltd.

[R8] Shiv Sahai Singh[Editor] The Law of Intellectual Property rights.

[R9] N. R. Subbaram, What Everyone Should Know About Patents, Pharma Book Syndicate, Hyderabad.

[R10] Principles and Practices of Management –Dr. P.C. Shejwalkar, Dr. Anjali Ghanekar, Prof. Deepak Bhivpathki.

[R11] Financial Management by "I M Pandey", Vikas Publishing House Pvt. Ltd., Delhi Philip Kotler- Marketing Management

Unit	Text Books	Reference Books
1	T1	R2,R10
2	T1, T2,T3	R5
3	-	R3,R5,R6
4	T5	R3, R11
5	T1	R1,R2
6	T4	R8

303141: Advance Microcontroller and its Applications

Teaching Scheme		Credit	Examination Scheme[Marks]	
Theory :	04 Hrs./week	04	In Sem. :	30 Marks
Practical :	02 Hrs./week	01	End Sem.:	70 Marks
			Oral :	50 Marks

Prerequisite:

- Knowledge of Number system
- Knowledge of basic logic components.
- Programming skills in C Language,
- Microprocessor and Microcontroller Architecture.

Objectives:

The objectives of this course are

- To provide understanding of architecture of PIC 18F458 microcontroller
- To develop ability to Write and Interpret Assembly and C language programs for PIC 18F458
- To interface various devices with PIC18F458

Course outcomes:

On successful completion of the course the student will be able to

- Explain architecture of PIC18F458 microcontroller, its instructions and the addressing modes.
- Develop and debug program in assembly language or C language for specific applications
- Use of an IDE for simulating the functionalities of PIC microcontroller and its use for software and hardware development.
- Interface a microcontroller to various devices.
- Effectively utilize advance features of microcontroller peripherals.

Unit 01 : PIC Architecture (08 Hrs.)

Comparison of CISC and RISC, RAM and Program memory organization, Program counters, Stack pointer, Bank Select Register, Status register, Data transfer instructions, Arithmetic and logical instructions. Assembly language programs.

Unit 02 : Assembly language programming (08 Hrs.)

Addressing Modes for PIC 18 microcontroller, Branch instruction, CALL, RETURN, Bit addressable instruction. Assembly language programs I/O ports, SFR related to PORTs, I/O port programming.

Unit 03 : Programming of PIC microcontroller in C (08 Hrs.)

Embedded C concepts, Header and source files and pre-processor directives, Data types, data structures, Control loops, functions, bit operations. I/O port programming in C, Delay programming.PIC 18 Timer 0 Programing in C

Unit 04 : Special Hardware features and Programming (08 Hrs.)

Timers required for CCP Applications, CCP module in PIC 18 microcontroller, Applications of CCP mode Generation of waveform using Compare mode of CCP module. Period measurement of a unknown signal using Capture mode in CCP module, Speed control of DC motor using PWM mode of CCP module

Unit 05 : Interrupt programming (08 Hrs.)

Interrupt Programming, Programming of Timer interrupts, Programming of External interrupts, Serial port programming. Interfacing of PIC18F458 8 bit model LCD(16x2)

Unit 06 : Interfacing of PIC Microcontroller (08 Hrs.)

PIC ADC, Programming of ADC using interrupts, Measurement of temperature and voltage Using PIC microcontroller. Interfacing DAC with PIC18F458, Interfacing of Electromechanical Relays and Opto-isolators.

Guidelines for Instructor's Manual

- Commands to be followed in order to operate the PIC18 micro controller kit.
- Detailed connection diagram / Circuit Diagram of the KIT.
- Pin Diagram and PIN layout of PIC 18F458, all supporting ICs.
- Manuals for interfacing kits such as DC motor, DAC.
- User manuals of all the interfacing kits such as stepper motor, DC motor, DAC etc.

Guidelines for Student's Lab Journal

- Title of the program.
- The program has to be written in the following format. Address- Instruction-Comment
- Input data has to be specified.
- Result of the program.
  Flow Chart for each program has to be drawn on separate page.

Guidelines for Laboratory Conduction

- Each student within the group has to enter and execute the program turn wise.
  Staff member has to check the result of all the groups after the execution of the program.
- Each subgroup of students in the laboratory should consist of maximum three numbers.

List of Experiments:

Any six experiments from section (A) and any three experiments from section (B)

Section A.

1. i) Introduction to MPLAB. ii) Programs on Addition, Subtraction and Multiplication
2. Data transfer to ports
3. Timer, Counter, Delay programming
4. Interfacing 18F458 to Switch and LED
5. Interfacing of LCD [16 X 2] with PIC 18F458
6. Generation of square, positive ramp, negative ramp, triangular waveforms using DAC interface
7. Generating PWM waveform using PWM mode of 18F458 timer
8. Driving relay from 18F458 using software and hardware interrupts

Section B.

1. Interfacing DC motor with PIC 18F458
2. Interfacing Stepper motor with PIC 18F458
3. Interfacing LM35 with PIC 18F458 and display temperature on it.
4. Measurement of speed using optical encoder.
5. Measurement of level using sensors and PIC 18F458.

Text Books:

[T1] PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18 by Muhammad Ali Mazidi, Rolind D. McKinley, Danny Causey, Pearson Education.

[T2] Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC by Ramesh Gaonkar, Thomson and Delmar learning, First Edition.

[T3] Programming And Customizing the PIC Microcontroller by MykePredko, TATA McGraw-Hill.

[T4] PIC microcontroller: An introduction to software and Hardware interfacing by Han-Way-Huang Thomson Delmar Learning.

[T5] Microcontroller Theory and Applications with PIC18F, M.Rafiquzzaman, John Wiley and Sons

Reference Books:

[R1] PIC18F458 datasheet

[R2] MPLAB IDE user guides

[R3] MICROCHIP Technical Reference Manual of 18F4520 Embedded Design with PIC 18F452 Microcontroller by John B. Peatman, Prentice Hall

Unit	Text Books	Reference Books
1	T1,T2,T3,T4	R1
2	T1, T2,T3,T4,T5	R1,R2
3	T1,T4,T5	R1
4	T1,T2,T3,T4	R1
5	T1,T2,T3,T4	R1
6	T1,T2,T3,T4	R1,R3

303142: Electrical Machines II

Teaching Scheme			Credits	Examination Scheme [Marks]		
Theory	:	4 Hrs./Week	04	In Sem.	:	30 Marks
Practical	:	2 Hrs./Week	01	End Sem.	:	70 Marks
				Practical	:	50 Marks

Prerequisites:

- Working principle and concepts of electrical machines
- Construction of DC series motor
- Phasor diagram and equivalent circuit of single phase transformer
- Construction and working of three phase induction motor.

Course Objectives:

- Learn construction & working principle of three phase synchronous machines.
- Define regulation of alternator & calculate it by direct and indirect methods.
- Study the methods of starting 3- phase synchronous motor, & its operation under Different conditions.
- Learn Speed control methods of three phase induction motor.
- Develop phasor diagram & circle diagram of a c series motor.
- Develop equivalent circuit of single phase induction motor.

Course Outcomes:

Students will be able to

- Explain construction & working principle of three phase synchronous machines
- Estimate regulation of alternator by direct and indirect methods.
- Demonstrate operation of synchronous motor at constant load and variable excitation (v curves & Λ curves) & constant excitation and variable load.
- Explain Speed control methods of three phase induction motor.
- Plot circle diagram of ac series motor
- Obtain equivalent circuit of single phase induction motor by performing no load & blocked rotor test.

Unit 01: Three phase Synchronous machines. (08Hrs.)

Three phase Synchronous machines: Construction, rotating-field type and rotating-armature type, salient-pole type and non-salient-pole type and their comparison. Excitation Methods.

Three phase Synchronous generator (cylindrical rotor type): Principle of operation. Emf equation and winding factors, rating of generator. Generator on no-load and on balanced load. Armature reaction and its effect under different load power factors. Voltage drop due to armature resistance, leakage flux and synchronous reactance. Per phase equivalent circuit and Phasor diagram. Power - power angle relation.

Three phase Synchronous generator (salient pole type): Armature reaction as per Blondel's two reaction theory for salient-pole machines, Direct-axis and quadrature-axis synchronous reactance's and their determination by slip test. Phasor diagram of Salient-pole generator and calculation of voltage regulation.

Unit 02: Voltage regulation of Three phase Synchronous generator: (08 Hrs.)
Performance of open circuit and short circuit test on synchronous generator, determination of voltage regulation by emf, mmf, and Potier triangle methods. Determination of voltage regulation by direct loading. Short circuit ratio.

Parallel operation of 3-phase alternators: Necessity, conditions, Load sharing between two alternators in parallel. Parallel-Generator theorem. Process of synchronizing alternator with infinite bus-bar by lamp methods and by use of synchroscope. Synchronizing current, power and torque.

Unit 03: Three phase synchronous motor: (08 Hrs.)
Principle of operation. Methods of starting. Equivalent circuit, significance of torque angle, Losses, efficiency and Power flow chart. Operation of 3-phase Synchronous motor with constant excitation and variable load, Operation with constant load and variable excitation ('V' Curves and 'inverted V' curves). Phenomenon of hunting and its remedies. Applications of 3-phase synchronous motors. Introduction to synchronous – induction motor. Comparison of 3 phase synchronous motor with 3-phase induction motor.

Unit 04: 3-ph induction motor, Induction generator and special purpose motors: (08 Hrs.)
Speed control of three phase induction motor by various methods (Stator side and rotor side controls). Action of 3-phase induction motor as induction generator, applications of induction generator. Introduction to Energy Efficient three phase Induction Motor and Super conducting Generator.

Special Purpose Motors (Descriptive Treatment Only): Construction, principle of working, characteristics ratings and applications of Brushless D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.) and linear induction motors.

Unit 05: A.C. series motor (08 Hrs.)
Operation of D.C. series motor on a.c. supply, nature of torque developed, problems associated with AC. operation and remedies.

Plain Series motor: direct and quadrature axis fluxes. Transformer and rotational emfs in the field winding and the armature winding. Approximate Phasor diagram (Ignoring leakage fluxes, magnetizing current and currents in the short-circuited armature coils). Circle diagram, performance characteristics from circle diagram. Drawbacks of plain series motor.

Compensated series motor: Compensating winding, conductively and inductively compensated motor. Use of compoles for improving commutation. Ratings and applications of Compensated Series motors.

Universal motors: ratings, performance and applications, comparison of their performance on A.C. and D.C. supply.

Unit 06: Single phase induction motor **(08 Hrs.)**

Construction of single phase induction motor, double field revolving theory. Equivalent circuit and torque-slip characteristics on the basis of double revolving field theory. Tests to determine the parameters of equivalent circuit and calculation of performance characteristics of motor. Methods of self-starting. Types of single phase induction motors: Split-phase motors (Resistor split-phase motor, Capacitor-start motor, Capacitor start and capacitor run motor and permanent capacitor motor). Shaded pole induction motor: their construction, operation, torque-slip characteristics and applications. Comparison of 1-phase induction motor with 3-phase induction motor.

Guidelines for Instructor's Manual

Prepare 3/4 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges etc.

- **Theory:** Brief theory explaining the experiment
- **Circuit / connection diagram** or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
- **Procedure:** Write down step by step procedure to perform the experiment.
- **Observation table:**
- **Sample calculation:** For obs. number ---
- **Result table:**
- **Nature of graph:**
- **Conclusion:**
- **Questions / Answers**: Write minimum 4 /5, questions / answers based on each experiment.

Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.

   (Use black or blue ink pen for writing.)

Guidelines for Laboratory Conduction

1. Check whether the MCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / main switch.

Write the experiment in the journal and get it checked within week

List of Experiments: To perform any eight experiments from the following list

A) Compulsory experiments:

1. Determination of regulation of cylindrical rotor alternator by following methods
   a) EMF method b) MMF method.
2. Determination of regulation of cylindrical rotor alternator by Potier method.
3. Determination of regulation of salient pole alternator by slip test.
4. V and inverted V curve of synchronous motor at constant load.
5. Speed control of three phase induction motor by V/F method

B) Optional experiments (any Three)

1. Determination of Regulation of alternator by direct loading.
2. Load test on three phase synchronous motor.
3. Load test on Single -phase induction motor.
4. Load test on Single-phase series motor.
5. No load and blocked-rotor test on a single phase Capacitor-start induction motor and Determination of its equivalent circuit parameters.
6. Performance characteristics of single phase series motor using circle diagram.
7. Synchronization of three phase alternator by Lamp and Synchroscope methods.
8. Simulation of three phase induction motor on MATLAB to obtain its performance.
9. Speed control of three phase induction motor by rotor resistance control method.

Text Books:

[T1] Nagrath and Kothari, Electrical Machines, 2nd Ed., Tata McGraw Hill.

[T2] S. K. Bhattacharya, Electrical Machines, Tata McGraw Hill.

[T3] A.S. Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill

[T4] P. S. Bimbhra, Electric Machinery, Khanna Publications.

[T5] B.R. Gupta and Vandana Singhal -Fundamentals of Electric Machines, New Age International (P) Ltd.

[T6] E. Openshaw Taylor, Performance and design of a.c. commutator motors, Wheeler Publishing.

[T7] V. K. Mehta and Rohit Mehta, Principles of Electrical Machines, S Chand Publications

[T8] Krishna Reddy –Electrical Machines vol.II and III, SCITECH publications.

[T9] Ashfaq Husain, Electrical Machines, Dhanpat Rai and Co.

[T10] M V Deshpande, Electrical Machines, Prentice Hall of India

Reference Books:

[R1] M.G. Say, Performance and Design of A.C. Machines (3rd Ed.), ELBS

[R2] J B Gupta - Theory and performance of Electrical Machines, S K Kataria Publications

[R3] Samarjit Ghosh, Electrical Machines, Pearson Publication.

[R4] Bhag S Guru and Huseyin R Hiziroglu, Electrical Machinary and Transformer, 3rd Edition, Oxford University Press.

[R5] E G Janardanan, Special Electrical Machines, Prentice Hall of India.

[R6] Suvarnsingh Kalsi Application of high Temperature super conductors to electric power equipments (Rotating Machines) Wiley publication.

Unit	Text Books	Reference Books
1	T1,T2,T7,T9	R3
2	T4,T7,T9	R2
3	T1,T4,T7	R2,R4
4	T4,T7,T9	R5,R6
5	T4,T6,T3	R1,R2
6	T2,T3,T7,T9	R2,R3

303143: Power Electronics

Teaching Scheme	Credits	Examination Scheme[Marks]	
Lectures : 4hrs/ week	04	In sem	30
Practical 2hrs/week	01	End sem	70
		Practical	50

Prerequisite:

- Knowledge of semiconductor material, basic electronics, diode, BJT,UJT,FET and its characteristics
- Working of Diode based rectifier, concept of rms and average value
- Use square notebooks for notes and plotting of waveforms

Course Objectives:

To enable students to gain knowledge and understanding in the following aspects:

- Fundamentals of power electronic devices and characteristics.
- The concepts and operating principles of power electronics circuits.
- Design procedures and techniques of power electronics systems.

Course Outcomes :

The students will be able to:

- Develop characteristics of different power electronic switching devices
- Reproduce working principle of power electronic converters for different types of loads
- Analyse the performance of power electronic converters

Unit 01: Silicon Controlled Rectifier (08 hrs)

Construction, Static and dynamic Characteristics, specifications/rating of SCR ,Triggering Circuits (R, R-C, UJT), Commutation Circuits (class C&D), Protection (over voltage, over current, and Thermal), Gate Turn Off(GTO) Thyristor (Construction, Working and Application).

Unit 02: Transistor based Devices and DC-DC converter (08 hrs)

Transistor based Devices: MOSFET, IGBT, Construction, working, Static and Dynamic Characteristics, specifications, safe operating area, Latching of IGBT.

DC-DC converter: Principle of operation of chopper, classification on the basis of Operating quadrants (A,B,C,D,E), Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step up Chopper and Numerical with RLE load. Necessity of input filter, Areas of application, Buck Boost Chopper (Descriptive Treatment).

Unit 03: Single Phase AC-DC Converter (08 hrs)

Single phase Converter: Fully controlled converter (rectification and inversion mode), Half controlled converter (Semi- converter), Operation of all converters with R, RL load , derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations, Effect of source inductance on operation of converter, Concept of overlap angle and voltage drop calculation. Single phase dual converter (Descriptive treatment only).

Unit 04: Three Phase Converter and AC Voltage Regulator

(08 hrs)

Three phase converter: Fully controlled converter, rectification and inversion mode, Half controlled converter (Semi-converter), Operation of all converters with R, RL load, derivation of Average and RMS output voltage, power factor, THD, TUF. Numerical based on output voltage and current calculations

AC voltage regulator: DIAC, TRIAC- four mode operation, triggering of TRIAC using DIAC; Single phase AC Voltage regulator principle with R and RL Load, derivation of Average and RMS output voltage, Concept of two stage AC voltage regulator (With R and R-L load).

Unit 05: Single phase DC-AC Converter (Transistor based) (08 hrs)

Full bridge VSC, derivation of output voltage and current, Numericals, current source converter with ideal switches. **PWM techniques:** Single pulse, multiple pulse and sinusoidal pulse modulation with Fourier analysis.

Unit 06: Three phase DC-AC Converter (Transistor based) (08 hrs)

Three phase VSC using 120^0 and 180^0 mode and their comparison, PWM based VSC, voltage control and harmonic elimination techniques (Single Pulse Modulation, Transformer Connection, Multilevel Control, Stepped Wave),Multilevel Converter concept its classification(Neutral Point Clamped Converter, Flying Capacitor Converter, cascaded multilevel converter) comparison between multilevel converters, balancing of dc voltage across capacitor

Guidelines for Instructor's Manual

- Title and circuit diagram of power electronic switching device and converter circuit.
- Working operation and output characteristics / output waveforms of power electronic switching device /converter circuit.
- Procedure to carry out the experiment.

Guidelines for Student's Lab Journal

- Title, aim, circuit diagram, procedure and theory of power electronic switching device or converter circuit.
- Equipments along with the specifications needed to carry out the experiment.
- Circuit diagram, observation table, calculations must be written on left side of the journal and aim, theory related to experiment and procedure must be written on right side.
- Analyse and interpret the experimental results and write the conclusions appropriately.

Guidelines for Laboratory Conduction

- Each group in the lab should have not more than three students.
- All the students in the group must do the connections and perform the practical under the the guidance of the staff member.
- Staff member has to check the result of all the groups.

List of Experiments:

Group A : Hardware Experiments (Any Six)

1. Static VI characteristic of SCR /GTO
2.Static VI characteristic of TRIAC
3. Single phase Half controlled converter with R and RL load
4. Single phase fully controlled converter with R load.
5. Single Phase fully controlled converter with and without Free Wheeling diode with RL load
6. Single phase A.C. voltage regulator with R load
7.Study of DC step down chopper
8. Output and Transfer Characteristic of MOSFET and IGBT (Both)
9. Three phase voltage source converter using 120^0 and 180^0 mode

Group B: Perform any THREE experiments based on Software

1. Three phase AC-DC fully controlled bridge converter R and RL load
2. Three phase voltage source inverter using 120^0 and 180^0 mode
3. Study of DC step down chopper
4. Single phase A.C. voltage regulator R and RL load
5. Study and Design of single phase VSC
6. Design of snubber circuit and verification using simulation

Text Books:

1. M. H. Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
3. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
4. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
6. K. Hari Babu, Power Electronics , Scitech Publication.

Reference Books:

1. Vedam Subramanyam - Power Electronics , New Age International , New Delhi
2. Dubey, Donalda, Joshi,Sinha, Thyristorised Power controllers, Wiely Eastern New Delhi.
3. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
4. Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
5. L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
6. J. Michael Jacob – Power Electronics Principal and Applications.
7. M.H.Rashid - Power Electronics Handbook, Butterworth-Heinemann publication, 3 edition
8. M.S. Jamil Asghar, Power Electronics, PHI.
9. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
10. NPTEL Web course and video course on Power Electronics by Dr.B.G.Fernandis,IIT,Mumbai.

Unit	Text Books	Reference Books
1	T5,T6	R3,R8,R10
2	T4,T5,T6	R3,R5,R6,R9,R10
3	T1,T5	R3,R10
4	T5,T6	R1,R7,R10
5	T1,T2,T3	R3,R10
6	T1,T2,T3	R3,R10

303144: Electrical Installation, Maintenance and Testing

Teaching Scheme			Credits	Examination Scheme [Marks]		
Theory	:	03 Hrs./Week	03	In Sem	:	30 Marks
Practical	:	02 Hrs./Week	01	End Sem	:	70 Marks
				Term work	:	50 Marks

Prerequisites:

- Introduction of Electrical supply system, Typical AC power supply scheme, Classification of Supply systems.
- Single line Diagram of electrical supply system.

Course Objective:

The course aims :-

- To understand the basic concepts, design and estimation of distribution systems & substation
- To enable candidate to design earthing system for residential and industrial premises
- To understand practical aspects of condition monitoring and maintenance of various electrical equipment.
- To learn testing methods of various electrical equipment.

Course Outcome:

Upon successful completion of this course, the students will be able to :-

- Classify distribution systems, its types and substations
- Design of different earthing systems for residential and industrial premises
- Select methods of condition monitoring and testing of various Electrical Equipments
- Estimate and Costing of residential and industrial premises

Unit 01: Distribution Systems: (06 Hrs.)

Classification of supply systems (State Only)

(i)DC, 2-wire system, (ii) Single phase two wire ac system, (iii) Three phase three wire ac supply system, iv) Three phase four wire ac supply system. Comparison between overhead and underground systems (For above mentioned systems) on the basis of volume requirement for conductor. AC Distribution System: Types of primary and secondary distribution systems, calculation of voltage drops in ac distributors (Uniform and Non Uniform Loading) (Numerical) Economics of power transmission: Economic choice of conductor (Kelvin's law) (Derivation and Numerical) Distribution Feeders: Design considerations of distribution feeders; radial and ring types of primary feeder's voltage levels, energy losses in feeders.

Unit 02: Substation and Earthing: (06 Hrs.)

Substation: Classification of substations, Various equipments used in substation with their specifications, Bus bar arrangements in the substation: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

Earthing: Necessity of Earthing, Types of earthing system (Equipment and Neutral), and Maintenance Free Earthing system. Methods of testing earth resistance, Different electrode configurations (Plate and Pipe electrode), Tolerable step and touch voltages, Steps involved in design of substation earthing grid as per IEEE standard 80 – 2000.

Unit 03: Maintenance and Condition Monitoring: (06 Hrs.)

Importance and necessity of maintenance, different maintenance strategies like breakdown maintenance, planned/preventive maintenance and condition based maintenance. Planned and preventive maintenance of transformer, Induction motor and Alternators. Insulation stressing factors, Insulation deterioration, polarization index, dielectric absorption ratio. Concept of condition monitoring of electrical equipments. Advance tools and techniques of condition monitoring, Thermography.

Unit 04: Condition Monitoring and Testing of Electrical Equipment: (06 Hrs.)

Failure modes of transformer, Condition monitoring of oil as per the IS/IEC standards, Filtration/reconditioning of insulating oil, Condition monitoring of transformer bushings, On load tap changer, dissolved gas analysis, degree of polymerization. Induction motor fault diagnostic methods – Vibration Signature Analysis, Motor Current Signature Analysis.

Testing of Power cables – Causes of cable failure, fault location methods and Remedial actions. Testing of Transformer - Type tests and Routine tests.

Unit 05: Estimation and Costing: (06 Hrs.)

Introduction, HT, LT overhead lines and underground cables, cable sizing, price catalogue, labour rates, schedule of rates and estimating data (only theory), Estimation and conductor size calculations of internal wiring for Residential and Commercial (Numericals) installations and estimate for underground LT service lines.

Unit 06: Electrical Safety: (06 Hrs.)

Causes of Accidents, Prevention of Accidents & precautions to be taken. Dangers arising as a result of faulty equipments and tools, chemicals, water, poor joints and insulation strains and moving machines. Contents of first aid box, treatment for cuts, burns and electrical shock. Procedures for first aid (e.g. removing casualty from contact with live wire and administering artificial respiration). Various statutory regulations (Electricity supply regulations, factory acts and Indian electricity rules of Central Electricity Authority (CEA), Classification of hazardous area.

Industrial Visit:

Visit to repair workshop (Any One).

i) Three phase induction motor ii) Transformer iii) Power Cable.

List of Experiments :

Compulsory experiments:

(Drawing sheets for 1 and 2 using AutoCAD or other CAD software)

1. Single Line diagram of 132 or 220 or 400 kV substation (based on actual field visit) Symbols, Plate or Pipe earthing.
2. Estimation for 11 kV feeders and substation.
3. Assignment on design of earthing grid for 132/220 kV substation.

Any **five experiments** are to be performed out of following :

1. Measurement of Dielectric Absorption Ratio and Polarization Index of insulation.
2. Study of troubleshooting of electrical equipment based on actual visit to repair workshop (Any One).i) Three phase induction motor ii) Transformer iii) Power Cable
3. Study of thermograph images and analysis based on these images.
4. Assignment – Construction, working and troubleshooting of any two household Electrical equipments (Fan, Mixer, Electric Iron, Washing Machines, Electric Oven, Microwave - Limited to electrical faults)
5. Study the various types of earthing for electrical appliances/systems, Practice of earthing and Measurement of Earth resistance of Campus premises.
6. Design, Estimation and costing of earthing pit and earthing connection for computer lab, Electrical Machines Lab, HT Substation.
7. Project design and estimation of power circuit of labs/industry.
8. Measurement of insulation resistance of motors and cables

Guidelines for Instructor's Manual Practical Sessions –

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detail specification as per IS code.
- Basic AUTOCAD instructions for drawing the sheet.
- Design / Solving of given problem using data book as a reference.
- Students should be encouraged to visit workshops or small industries of transformer/ induction motor / cables also for repairing of household equipment.
- Students should write the troubleshooting charts and visit report based on visit as mentioned above.
- Few short questions related to design.

Guidelines for Student's Manual Practical Sessions –

The student's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detail specification as per IS code.
- Design/Solve a given problem.
- Students should visit workshops or small industries of transformer/ induction motor / cables also for repairing of household equipment.
- Students should write the troubleshooting charts and visit report based on visit as mentioned above.
- Few short questions related to experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Text Books:

[T1] B. R. Gupta- Power System Analysis and Design, 3rd edition, Wheelers publication.

[T2] S. Rao, Testing Commissioning Operation and Maintenance of Electrical Equipment, Khanna publishers.

[T3] S. L. Uppal - Electrical Power - Khanna Publishers Delhi.

[T4] Hand book of condition monitoring by B. K. N. Rao, Elsevier Advance Tech., Oxford (UK).

[T5] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House.

[T6] B. V. S. Rao – Operation and Maintenance of Electrical Equipment – Asia Publication.

[T7] Hand book on Electrical Safety.

Reference Books:

[R1] P.S. Pabla –Electric Power Distribution, 5th edition, Tata McGraw Hill.

[R2] S. L. Uppal, Electrical Wiring and Costing Estimation, Khanna Publishers, New Delhi.

[R3] Surjit Singh, Electrical wiring, Estimation and Costing, Dhanpat Rai and company, New Delhi.

[R4] Raina K.B. and Bhattacharya S.K., Electrical Design, Estimating and Costing, Tata McGraw Hill, New Delhi

[R5] B.D. Arora-Electrical Wiring, Estimation and Costing,- New Heights, New Delhi.

[R6] M.V. Deshpande, Elements of Power Station design and practice, Wheelers Publication.

[R7] S. Sivanagaraju and S. Satyanarayana, Electric Power Transmission and Distribution, Pearson Publication .

IS/IEEE Standards:

1. IS : 1180 – Distribution Transformer.
2. IS : 2026 – Power Transformer.
3. IS: 4029 – Testing of 3 Phase Induction Motor.
4. IS : 694:1986 – PVC insulated cables for working voltages up to and including 1100 V.
5. IS : 900:1992 – Code of practice for installation and maintenance of Induction Motors.
6. IEEE 80:2000 – IEEE Guide for Safety in AC Substation Grounding.
7. IEEE 142 Guide for Earthing.
8. Indian Electricity Rules.

Unit	Text Books	Reference Books
1	T1	R2, R7
2	T2	R7
3	T3,T4	R6,R1
4	T5,T6	R6,R1
5	-	R3, R4,R5
6	T7	-

303145: Seminar and Technical Communication

Teaching Scheme			Credits	Examination Scheme		
Practical	**:**	**02 Hr/Week**	**01**	**Term work**	**:**	**50 Marks**

Course Objectives:

- Gaining of actual knowledge (terminology, classification, methods and advanced trends)
- Learning fundamental principles, generalization or theories
- Discussion and critical thinking about topics of current intellectual importance
- Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to the course.

Course Outcomes:

At the end of this student will able to

- Relate with the current technologies and innovations in Electrical engineering.
- Improve presentation and documentation skill.
- Apply theoretical knowledge to actual industrial applications and research activity.
- Communicate effectively.

Seminar should be based on a detailed study of any topic related to the advance areas/applications of Electrical Engineering. Topic should be related to Electrical Engineering. However it must not include contents of syllabus of Electrical Engineering.

It is expected that the student should collect the information from journals, internet and reference books in consultation with his/her teacher/mentor, have rounds of discussion with him/her. The report submitted should reveal the students assimilation of the collected information. Mere compilation of information from the internet and any other resources is discouraged.

Format of the Seminar report should be as follows:

1. The report should be neatly typed on white paper. The typing shall be with normal spacing, Times New Roman (12 pt) font and on one side of the paper. (A-4 size).
2. Illustrations downloaded from internet are not acceptable.
3. The report should be submitted with front and back cover of card paper neatly cut and bound together with the text.
4. Front cover: This shall have the following details with Block Capitals
   a. Title of the topic.
   b. The name of the candidate with roll no. and Exam. Seat No. at the middle.
   c. Name of the guide with designation below the candidate's details.
   d. The name of the institute and year of submission on separate lines at the bottom.
5. Certificate from institute as per specimen, Acknowledgement and Contents.
6. The format of the text of the seminar report should be as follows
   I. The introduction should be followed by literature survey.

II. The report of analytical or experimental work done, if any.

III. The discussion and conclusions shall form the last part of the text.

IV. They should be followed by nomenclature and symbols used.

V. The Reference Books are to be given at the end.

7. The total number of typed pages, excluding cover shall from 20 to 25 only.
8. All the pages should be numbered.
9. Two spiral bound copies of the seminar report shall be submitted to the college.
10. Candidate shall present the seminar before the examiners.
11. The total duration of presentation and after-discussion should be about 30 minutes.

The assessment for the subject shall be based on:

1. Report submitted. 2. Presentation 3. Discussion.

Audit Course III

303152 (A): Wind Energy Systems

Course Name: Wind Energy Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:
Lectures 2 h per week
Field Visit: 1 day

Examination Schemes: Audit (P/F)
Written / MCQ /
Term paper

Description:

The following topics may be broadly covered in the classroom. The course will introduce the basics of: wind energy, availability, introduction to wind machines, generators, basics of design of wind electric generators, small and large wind machines, various designs and types of wind machines, grid interaction, advantages and limitations of the technology, environmental impact, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The site visit will be organized to understand the basic operation and system elements.

Details:

- Energy in wind, Basic wind energy conversion
- Introduction to wind turbines, Types of wind energy systems
- Typical construction of various wind energy systems
- Wind electricity generation systems
- Environmental impact of wind electricity generators
- Economics and sustainability of wind electricity
- Introduction go Wind Electricity Generation (WEG) systems
- Wind turbine basics and design
- Generator designs for WEG
- Small and large WEG systems, Site requirements for WEG
- Controllers for WEG systems
- Grid integration of WEG
- Economics of WEG
- Financial modeling of WEG
- Software tools for simulation, validation and economics of WEG
- Operation and maintenance of WEG
- Environmental impact assessment
- Standards and certification for WEG
- Basics of WEG systems, Elements of WEG systems for small and large scale
- Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly, Manufacturing standards
- Quality assurance and standards, Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Site Visit:

- Large-scale wind power plant
- If possible any nearby manufacturing facility for wind machines

Audit Course III

303152(B): Microcontroller MSP 430 and Applications

Teaching Scheme: **Examination Scheme**

Lecture and Practicals: Total 24 Hours **Written/Assignment**

- 16 bit MSP430 microcontroller architecture, Pin diagram, Memory organization of MSP430, special function registers, GPIO control.
- Interrupts and interrupt programming, Watchdog timer. System clocks.
- Programming MSP430 in embedded C, Timers and RTC using MSP430, timer modes and its programming.
- Analog interfacing and data acquisition: ADC and Comparator in MSP430.
- Case study: MSP430 based embedded system applications using ADC & PWM etc.

Text Books:

1. Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880
2. MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN- 13: 978-0750682763
3. Ajay V. Deshmukh, "Microcontrollers, Theory and applications", Tata McGraw-Hill Companies – 2005

Other References:

1. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode
2. http://processors.wiki.ti.com/index.php/MSP430_16-Bit_Ultra-Low_Power_MCU_Training
3. RF430CL330H :
   Datasheet: http://www.ti.com/lit/ds/symlink/rf430cl330h.pdf
4. RF430CL331H:
   Datasheet: http://www.ti.com/lit/ds/symlink/rf430cl331h.pdf
5. Datasheet: RF430FRL15xH:
   Datasheet: http://www.ti.com/lit/ds/symlink/rf430frl152h.pdf
   User Guide: http://www.ti.com/lit/ug/slau506/slau506.pdf
6. CC2538:
   Datasheet: http://www.ti.com/lit/ds/symlink/cc2538.pdf
7. CC256x:
   Datasheet: http://www.ti.com/lit/ds/symlink/cc2560.pdf
8. CC2640:
   Datasheet: http://www.ti.com/lit/ds/symlink/cc2640.pdf
   User Guide: http://www.ti.com/lit/ug/swcu117f/swcu117f.pdf
9. CC3100 and CC3200: http://www.ti.com/lit/ug/swru368a/swru368a.pdf

List of Experiments:

1. Learn and understand how to configure MSP-EXP430G2 Launchpad digital I/O pins. Write a C program for configuration of GPIO ports for MSP430 (blinking LEDs, push buttons interface).

   Exercises:

   a. Modify the delay with which the LED blinks.
   b. Modify the code to make the green LED blink.
   c. Modify the code to make the green and red LEDs blink:
      i. Together
      ii. Alternately
   d. Alter the code to turn the LED ON when the button is pressed and OFF when it is released.
   e. Alter the code to make the green LED stay ON for around 1 second every time the button is pressed.
   f. Alter the code to turn the red LED ON when the button is pressed and the green LED ON when the button is released.

2. Learn and understand GPIO based Interrupt programming. Write a C program and associated GPIO ISR using interrupt programming technique.

   Exercises:

   a) Write the code to enable a Timer interrupt for the pin P1.1.
   b) Write the code to turn on interrupts globally

3. Implement Pulse Width Modulation to control the brightness of the on-board, green LED. This experiment will help you to learn and understand the configuration of PWM and Timer peripherals of the MSP430G2553.

   Exercises:

   a) Observe the PWM waveform on a particular pin using CRO.
   b) What is the maximum resolution of PWM circuitry in MSP430G2 Launchpad?
   c) Change the above code to create a PWM signal of 75% duty cycle on particular PWM pin.

4. The main objective of this experiment is to control the on-board, red LED by the analog input from a potentiometer. This experiment will help you to learn and understand how to configure an ADC to interface with a potentiometer.

   Exercises:

   a) Alter the threshold to 75% of Vcc for the LED to turn on.
   b) Modify the code to change the Reference Voltage from Vcc to 2.5V.

Lab Manual:

1) www.ti.com/lab-maunals
<u>Embedded System Design using MSP430 Launchpad Development Kit - Lab Manual</u>

303146 : Power System II

Teaching Scheme		Credits	Examination Scheme [Marks]
Theory	: 04 Hrs./Week	04	In Sem. : 30 Marks
Practical	: 02 Hrs./Week	01	End Sem. : 70 Marks
			PR : 50 Marks

Prerequisite:

- Constants, circuit representation and generalized constants of short and medium transmission lines.
- Inductance and capacitance for symmetrical and unsymmetrical configuration of transmission lines, Efficiency and line regulation of transmission line.

Course Objective:

The course aims to:-

- Develop analytical ability for Power system.
- Introduce concept of EHVAC and HVDC System.
- Demonstrate different computational methods for solving problems of load flow.
- Analyse the power system under symmetrical and Unsymmetrical fault conditions.

Course Outcome:

Upon successful completion of this course, the students will be able to

- Solve problems involving modelling, design and performance evaluation of HVDC and EHVAC power transmission lines.
- Evaluate power flow in power transmission networks and apply power flow results to solve simple planning problems.
- Calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings.

Unit 01: Performance of Transmission Lines (08 Hrs.)

Evaluation of ABCD constants and equivalent circuit parameters of Long transmission line. Concept of complex power, power flow using generalized constants, receiving end power circle diagram for transmission line (assuming ABCD constants are already given), surge impedance loading, Line efficiency, Regulation and compensation, basic concepts. Numerical based on: ABCD constants of Long transmission line, Power flow, circle diagram.

Unit 02: EHV-AC transmission: (08 Hrs.)

Role of EHV-AC transmission, standard transmission voltages, average values of line parameters, power handling capacity and line losses, phenomenon of corona, disruptive critical voltages, visual critical voltages, corona loss, factors and conditions affecting corona loss, radio and television interference, reduction of interference, Numerical Based on Corona, Corona loss and power handling capacity.

Unit 03: Per unit system and Load Flow Analysis (08 Hrs.)

Per unit system: Single line diagram, Impedance and reactance diagrams and their uses, per unit quantities, relationships, selection of base, change of base, reduction to common base, advantages and application of per unit system. Numerical based on network reduction by using per unit system.

Load Flow Analysis: Network topology, driving point and transfer admittance, concept of Z-bus and formulation of Y-bus matrix using Direct method, singular transformation method, Introduction to load flow analysis, power- flow equations generalization to n bus systems, classification of buses, Newton- Raphson method (using polar coordinates - Descriptive treatment only) Numerical based on Y bus Matrix.

Unit 04: Symmetrical Fault Analysis (08 Hrs.)

3-phase short-circuit analysis of unloaded alternator, sub-transient, transient and steady state current and impedances, D.C. Offset, and effect of the instant of short-circuit on the waveforms, estimation of fault current without pre-fault current for simple power systems, selection of circuit-breakers and current limiting reactors and their location in power system (Descriptive treatment Only) Numerical Based on symmetrical fault analysis

Unit 05: Unsymmetrical Fault Analysis: (08 Hrs.)

Symmetrical components, transformation matrices, sequence components, power in terms of symmetrical components, sequence impedances of transmission line and zero sequence networks of transformer, solution of unbalances by symmetrical components, L-L, L-G, and L-L-G fault analysis of unloaded alternator and simple power systems with and without fault impedance. Numerical based on symmetrical components and unsymmetrical fault calculation.

Unit 06: HVDC Transmission (Descriptive treatment only) **(08 Hrs.)**

Classification and components of HVDC system, advantages and limitations of HVDC transmission, comparison with HVAC system, introduction to HVDC control methods - constant current, constant ignition angle and constant extinction angle control, HVDC systems in India, recent trends in HVDC system.

Industrial Visit: Compulsory visit to EHV-AC substation/ HVDC substation

List of Experiments (Compulsory experiments):

1. Measurement of ABCD parameters of a medium transmission line with magnitude and angle.
2. Measurement of ABCD parameters of a long transmission line with magnitude and angle.
3. Performance study of the effect of VAR compensation using capacitor bank on the transmission line.
4. Formulation and calculation of Y- bus matrix of a given system using software.
5. Static measurement of sub-transient reactance of a salient-pole alternator.
6. Measurement of sequence reactance of a synchronous machine (Negative and zero).

Any **three experiments** are to be performed out of following:

1. Plotting of receiving end circle diagram to evaluate the performance of medium transmission line.
2. Performance study of the effect of VAR compensation on transmission line using synchronous Condenser.
3. Solution of a load flow problem using Newton-Raphson method using software.
4. Simulation of Symmetrical fault of single machine connected to infinite bus.
5. Simulation of Unsymmetrical fault of single machine connected to infinite bus.
6. Simulation of HVDC system.

Guidelines for Instructor's Manual Practical Sessions –

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few questions related to the experiment.

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram.
- Observation table/ simulation waveforms.
- Sample calculations for one/two reading.
- Result table.
- Graph and Conclusions.
- Few short questions related to the experiment.

Guidelines for Lab /TW Assessment

- There should be continuous assessment for the TW.
- Assessment must be based on understanding of theory, attentiveness during practical.
- Session, how efficiently the student is able to do connections and get the results.
- Timely submission of journal.

Text Books:

[T1] I.J. Nagrath and D.P. Kothari – Modern Power System Analysis – Tata McGraw Hill, New Delhi.

[T2] B R Gupta , "Power System Analysis and Design", S.Chand.

[T3] Ashfaq Hussain, "Electrical Power Systems", CBS Publication 5th Edition.

[T4] J.B.Gupta. "A course in power systems" S.K. Kataria Publications.

[T5] P.S.R. Murthy, "Power System Analysis", B.S. Publications

Reference Books :

[R1] H. Hadi Sadat: Power System Analysis, Tata McGraw-Hill New Delhi.

[R2] G. W. Stagg and El- Abiad – Computer Methods in Power System Analysis – Tata McGraw Hill, New Delhi.

[R3] M.E.El-Hawary, Electric Power Systems: Design and Analysis, IEEE Press, New York.

[R4] Rakash Das Begamudre, "Extra High voltage A.C. Transmission Engineering", New age publication.

[R5] M.A.Pai, Computer Techniques in Power System Analysis, Tata McGraw Hill Publication.

[R6] Stevenson W.D. Elements of Power System Analysis (4th Ed.) Tata McGraw Hill, New Delhi.

[R7] K.R.Padiyar: HVDC Transmission Systems, New Age International Publishers Ltd, New Delhi.

[R8] Olle I. Elgard – Electric Energy Systems Theory – Tata McGraw Hill, New Delhi.

[R9] V. K. Chandra, Power Systems, Cyber tech Publications.

[R10] NPTEL Web course and video course on power system analysis.

Unit	Text Books	Reference Books
1	T1, T4	R1, R2, R3, R10
2	T2	R3, R4
3	T1, T3, T4	R1, R2, R3, R5, R8, R10
4	T3, T4	R1, R2, R3, R6, R8, R9, R10
5	T3,	R1, R2, R3, R6, R8, R9, R10
6	T2, T3, T4	R3, R7

303147 : Control System-I

Teaching Scheme			Credits	Examination Scheme [Marks]		
Theory	:	04 Hrs./Week	04	In Sem	:	30 Marks
Practical	:	02 Hrs./Week	01	End Sem	:	70 Marks
				Oral	:	50 Marks

Prerequisite: Laplace Transform, Ordinary differential equations.

Course Objective: The course aims to:-

- To understand basic concepts of the classical control theory.
- To model physical systems mathematically.
- To analyze behavior of system in time and frequency domain.
- To design controller to meet desired specifications.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Model physical system,
- Determine time response of linear system,
- Analyse stability of LTI system,
- Design PID controller for LTI system

Unit 01 : General (10 Hrs)

Basic concepts of control system, classification of control systems. Types of control system: Feedback, tracking, regulator system, feed forward system. Transfer function, Pole and zero concept. Modeling and representation of control system-Basic concept. Mechanical, Electrical and equivalent system, Electromechanical. Block diagram Algebra, signal flow graph, Mason's gain formula.

Unit 02 : Time domain analysis (08 Hrs)

Standard test signal –step, ramp, parabolic and impulse signal, type and order of control system, time response of first and second order systems to unit impulse, unit step input. steady state errors – static error coefficients. Time domain specifications of second order systems. Importance of dominant closed loop poles of higher order systems Derivation of time domain specifications for second-order under-damped system for unit step input.

Unit 03 : Stability analysis and Root Locus (08 Hrs)

Concept of stability- Absolute, Asymptotic, relative and marginal. Nature of system response for various locations of roots in S-plane of characteristics equation. Routh's-Hurwithz criterion. Root Locus: Basic properties of root locus. Construction of root locus. Angle and magnitude condition for stable system.

Unit 04 : Frequency domain analysis-I (08 Hrs)

Introduction, relation between time and frequency response for second order system. Frequency domain specifications, Polar Plot, Nyquist plot, stability analysis using Nyquist plot.

Unit 05 : Frequency domain analysis-II (08Hrs)

Introduction to Bode plot, Asymptotic approximation: Sketching of Bode plot, stability, stability analysis using Bode plot.

Unit 06 : PID controllers (06Hrs)

Basic concept of P, PI, PID controller, Design specifications in time domain and frequency domain. Design of PID controller by Root-Locus. Tuning of PID controllers. Ziegler-Nichol Method.

Control System Components: Working principle and transfer function of Lag network, lead network, potentiometer, AC and DC servo motors. Working principle of synchros.

Guidelines for Instructor's Manual

Instructor's Manual should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram
- Basic MATLAB instructions for control system/ Simulink basics
- Observation table/ Expected simulation results
- Sample calculations for one/two reading
- Result table

Guidelines for Student's Lab Journal

The Student's Lab Journal should contain following related to every experiment –

- Theory related to the experiment
- Apparatus with their detailed specifications.
- Connection diagram /circuit diagram/Simulink diagram/MATLAB program
- Observation table/ simulation results
- Sample calculations for one/two reading
- Result table, Conclusion
- Few short questions related to the experiment.

Guidelines for Laboratory Conduction

- Assessment must be based on understanding of theory, attentiveness during practical session.
- Assessment should be done how efficiently student is able to perform experiment/simulation and get the results. Understanding fundamentals and objective of experiment, timely submission of journal

List of Experiments:

A) Minimum five experiments should be conducted.

1. Experimental determination of DC servo motor parameters for mathematical modeling, transfer function and characteristics.
2. Experimental study of time response characteristics of R-L-C second order system: Validation using simulation.
3. Experimental frequency response of Lag and Lead compensator.
4. PID control of level/Pressure/Temperature control system.
5. Transfer function of any physical systems (AC Servomotor/ Two Tank System/ Temperature control/ Level control)
6. Study of Synchro transmitter receiver.
7. Experimental analysis of D.C. Motor Position control System.

B) Minimum three experiments should be conducted.

1. Stability analysis using a) Bode plot b) Root locus c) Nyquist plot using software.
2. Time response of second order system effect of P,PI, PID on it.
3. Analysis of closed loop DC position control system using PID controller.
4. Effect of addition of pole-zero on root locus of second order system.

Text Books:

[T1] I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th edition, 2007.

[T2] Katsuhiko Ogata, "Modern control system engineering", Prentice Hall, 2010.

[T3] Nise N. S. "Control Systems Engineering", John Wiley & Sons, Incorporated, 2011

Reference Books:

[R1] B. C. Kuo, "Automatic Control System", Wiley India, 8th Edition, 2003.

[R2] Richard C Dorf and Robert H Bishop, "Modern control system", Pearson Education, 12th edition, 2011.

[R3] D. Roy Choudhary, "Modern Control Engineering", PHI Learning Pvt. Ltd., 2005.

Unit	Text Books	Reference Books
1	T1, T2, T3	R1,R2
2	T1, T2, T3	R1, R3
3	T1, T2, T3	R2, R3
4	T1, T2, T3	R1, R3
5	T1, T2, T3	R1
6	T3	

303148 : Utilization of Electrical Energy

Teaching Scheme	Credits	Examination Scheme [Marks]
Theory : 03 Hrs./Week	03	In Sem : 30 Marks
		End Sem : 70 Marks

Prerequisite:

- Basics of Electrical Engineering, Effects of electric current
- Chemical reactions in electrolyte
- Control circuit design basics, awareness about artificial lighting, refrigeration, air conditioning
- Characteristics and application of different electric motors, awareness about traction

Course Objective:

The course aims to:-

- Ensure that the knowledge acquired can be applied in various fields such as electric heating, illumination, chemical processes, and electric traction.
- Make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
- Develop ability amongst the students to design -heating element for resistance furnaces and design- illumination schemes. To develop ability amongst the students to analyze the performance of arc furnaces, electric traction, different sources of light, illumination schemes
- Provide know how about Refrigeration, Air Conditioning
- Provide know about electrochemical processes and applications of these in practical world, modern welding techniques.
- Develop self and lifelong learning skills, introduce professionalism for successful career.

Course Outcome:

Upon successful completion of this course, the students will revise :-

- Get knowledge of principle of electric heating, welding and its applications.
- Design simple resistance furnaces and residential illumination schemes.
- Calculate tractive effort, power, acceleration and velocity of traction.
- Get knowledge of electric braking methods, control of traction motors, train lighting and signaling system.
- Understand collection of technical information and delivery of this technical information through presentations.

Unit 01: Electric Heating (06 Hrs.)

Modes of heat transfer, mathematical expressions

Electric heating: Introduction to electric heating, Advantages of electrical heating

Heating methods: - Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating element materials, temperature control of resistance furnaces, and design of heating element (Numerical).

Applications of resistance heating

Induction heating : Principle, core type and coreless induction furnaces, Ajax Wyatt furnace, Numerical on melting furnaces Applications of induction heating

Electric arc heating – Direct and indirect arc heating, types of arc furnaces, equivalent circuit of arc furnace, condition for maximum output, power factor at maximum output (Numerical), Heat control in arc furnace, Applications of arc heating

Dielectric heating –Principle, choice of voltage and frequency for dielectric heating (Numerical), Applications of dielectric heating

Electric Welding -**Welding m e t h o d s –Electric arc welding and resistance welding, Equivalent circuit of arc furnace (Numerical) Modern welding techniques like ultrasonic welding and laser welding**

Unit 02: Electrochemical Process (04 Hrs.)

Need of electro-deposition. Applications of Faraday's laws in electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting materials, Principle of anodizing and its applications

Electrical Circuits Used in Refrigeration, Air Conditioning

Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in Refrigerator, Air Conditioner

Unit 03: Illumination (04 Hrs.)

Definitions of luminous flux, solid angle, luminous intensity, illumination, luminous efficacy, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination.

Design of illumination schemes-Factors to be considered for design of illumination scheme, Calculation of illumination at different points, considerations involved in simple design problems for indoor installation, illumination schemes, standard illumination level. Natural day light illumination (brief information)

Different sources of light: Incandescent lamp, fluorescent lamp, comparison between them. Incandescent and discharge lamps – their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs Comparison of all above luminaries.

Unit 04: Electric Traction (06 Hrs.)

History of Indian railways.

Traction systems - Steam engine drive, electric drive, diesel electric drive, types of diesel locomotives, Advantages of electric traction, Brief treatment to - Indian railway engine coding terminology, WDM,WDP,WDG series and their capacity . Introduction to metro system, mono rail system.

Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system

Different accessories for track electrification -overhead wires, conductor rail system, current collector-pentograph, catenary

Electric locomotive- Block diagram with description of various equipment and accessories.

Supply system constituents-Layout and description of -Traction substation, feeding post(25kV), feeding and sectioning arrangement, sectioning and paralleling post, neutral section.

Details of major equipment in traction substation-transformer, circuit breaker, interrupter

Unit 05: Traction Mechanics (08 Hrs.)

Types of services- Urban, Sub-urban, Main line Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed (Numerical), Tractive effort. Specific energy consumption. Factors affecting specific energy consumption (Numerical), Mechanics of train movement, coefficient of adhesion (Numerical).

Unit 06: Traction Motors, Control of Traction Motors, Train Lighting (08 Hrs.)

Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor, 3 phase induction motor and linear induction motor for traction. Control of traction motors -Series-parallel control, Shunt and bridge transition (Numerical), Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system.

Railway signalling: - History, necessity, block system route relay interlock and necessity. Metro signalling, Electromechanical system for route relay interlock. Introduction to train tracking system, types. Anti-collision system-brief treatment only.

Industrial Visit: Visit to any one location from the following-

- Railway station (Control room)
- Loco shed
- Traction substation

Text Books:

[T1] E. O. Taylor 'Utilization of Electrical Energy' – Revised in S.I. Units by V.V.L. Rao, Orient Longman

[T2] J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and sons, Delhi

[T3] C. L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', Eastern Wiley Ltd.

[T4] A. Chakraborti, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, 'A text book on Power System Engineering', Dhanpat Rai and Co.(P) Ltd – Delhi

[T5] Clifford F. Bonntt 'Practical Railway Engineering', (Imperial college press)

Reference Books:

[R1] 'Art and science of Utilization of Electrical Energy' by H. Partab, Dhanpat Rai and Co.(P) Ltd –Delhi

[R2] 'Modern Electric Traction' by H. Partb, Dhanpat Rai and Co. (P) Ltd – Delhi

[R3] 'Lamps and lighting' by M. A. Cayless, J.R. Coaton and A. M. Marsden

[R4] 'BIS, IEC standards for Lamps, Lighting Fixtures and Lighting' By Manak Bhavan, New Delhi

[R5] 'Illumination Engineering from Edison's Lamp to the Laser' Joseph B. Murdoch

[R6] 'Two centuries of Railway signalling' by Geoffrey, Kichenside and Alan Willims (Oxford Publishing Co-op)

[R7] 'Generation and Utilization of Electrical Energy' S. Sivanagaraju, M. Balsubba Reddy, D. Srilatha (Pearson)

[R8] 'Electrical Powers' S. L. Uppal, Khanna Publication

NOTE

Assignments can be given on following topics

- Types of Electric Welding- Electric arc welding and resistance welding (accessories involved and working of the system, characteristics of arc welding)
- Modern welding techniques like ultrasonic welding and laser welding
- Study of different types of lamps-Incandescent lamp, fluorescent lamp, their construction and characteristics; mercury vapour lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, neon lamps Electroluminescent lamp-LEDs, types, LASERs
- Comparison of all above luminaries.
- WDM, WDP, WDG series and their capacity. Introduction to metro system, mono rail system.

Unit	Text Books	Reference Books
1	T1,T3,T4	R1,R7, R8
2	T1,T3, T4	R1, R7
3	T1,T3, T4	R1, R3,R4,R5,R7, R8
4	T1,T2,T5, T4	R1, R2,R7, R8
5	T1,T2,T5, T4	R1, R2,R5, R8
6	T1, T2,T5, T4	R1, R2,R6, R8

303149: Design of Electrical Machines

Teaching Scheme	Credits	Examination Scheme [Marks]
Theory : 04 Hrs./Week	04	In Sem : 30 Marks
Practical: 02 Hrs./Week	01	End Sem : 70 Marks
		OR : 50 Marks
		Term work : 25 Marks

Prerequisite:

- Knowledge of various materials used in electrical machines.
- Knowledge of types, construction and working of transformer.
- Knowledge of types, construction and working of three phase induction motor.

Course Objective: The course aims :-

- To design transformer.
- To understand determination of parameters of transformer.
- To understand specifications of transformer.
- To design Induction motor.
- To understand determination of parameters of Induction motor.
- To understand specifications of Induction motor.

Course Outcome:

Upon successful completion of this course, the students will be able to :-

- Calculate main dimensions and Design of single phase and three phase transformer.
- Calculate main dimensions of three phase Induction motor.
- Determine the parameters of transformer.
- Determine parameters of three phase Induction motor.

Unit 01: Transformer (7 Hrs.)

Modes of heat dissipation. Heating and cooling curves. Calculations of heating and cooling time constants. Types and constructional features of core and windings used in transformer. Transformer auxiliaries such as tap changer, pressure release valve, breather and conservator. Specifications of three phase transformers as per IS 2026(Part I).

Unit 02: Transformer Design (8 Hrs.)

Output equation with usual notations, optimum design of transformer for minimum cost and loss. Design of main dimensions, core, yoke and windings of transformer. Methods of cooling and tank design. Estimation of resistance and leakage reactance of transformer.

Unit 03: Performance parameters of Transformer (8 Hrs.)

Estimation of no-load current, losses, efficiency and regulation of transformer. Calculation of mechanical forces developed under short circuit conditions, measures to overcome this effect. Introduction to Computer aided design of transformer, generalized flow chart for design of transformer.

Unit 04: Three phase Induction Motor Design : Part I (9 Hrs.)

Specification and Constructional features. Design of ac windings. Output equation with usual notations, specific electrical and magnetic loadings, ranges of specific loadings, turns per phase, number of stator slots.

Unit 05: Three phase Induction Motor Design : Part II (8 Hrs.)

Suitable combinations of stator and rotor slots .Calculations for main dimensions and stator design parameters. Selection of length of air gap, factors affecting length of air gap, unbalanced magnetic pull. Design of rotor slots, size of bars, end rings for cage rotor and rotor slots, turns and area of cross section of conductor for wound rotor.

Unit 06: Performance parameters of Three Phase Induction motor (8 Hrs.)

Leakage flux and leakage reactance: Slot leakage, tooth top leakage, zig-zag leakage, overhang leakage, leakage reactance calculation for three phase machines. MMF Calculation for air gap, stator teeth, stator core, rotor teeth and rotor core, effect of saturation, effects of ducts on calculations of magnetizing current, calculations of no-load current. Calculations of losses and efficiency. Calculation of short time and continuous rating of electrical machine.

Industrial Visit: Industrial visit to a manufacturing unit of transformer or Induction motor.

Term Work: The term work shall consist of:

1. Details and assembly of three phase transformer with design report.(Sheet in CAD)
2. Details and layout of AC winding with design report.(Sheet in CAD)
3. Assembly of 3- phase induction motor.(Sheet optional CAD or Drawing)
4. Use of Finite Element Analysis(FEA) software for analysis of electrical machines, the report should include:
   a. Schematic diagram (Diagram/FEA model/Layout)
   b. Current/Flux/Force distribution.
   c. Analysis by variation of design parameters.
5. Report based on Industrial visit to a manufacturing unit. (Transformer or Induction motor).

Text Books:

[T1] M.G. Say – Theory and Performance and Design of A.C. Machines, 3rd Edition, ELBS London.

[T2] A.K.Sawhney – A Course in Electrical Machine Design,
10th Edition, - Dhanpat Rai and sons New Delhi.

[T3] K. G. Upadhyay- Design of Electrical Machines, New age publication

[T4] R. K. Agarwal – Principles of Electrical Machine Design, S. K.Katariya and sons.

[T5] Indrajit Dasgupta – Design of Transformers – TMH

Reference Books:

[R1] K.L. Narang , A Text Book of Electrical Engineering Drawings, Reprint Edition : 1993 / 94 – Satya Prakashan, New Delhi.

[R2] A Shanmugasundaram, G. Gangadharan, R. Palani, - Electrical Machine Design Data Book, 3rd Edition, 3rd Reprint 1988 - Wiely Eastern Ltd., - New Delhi

[R3] Vishnu Murti, “Computer Aided Design for Electrical Machines”, B.S. Publications.

[R4] Bharat Heavy Electricals Limited, Transformers - TMH.

Guidelines for Instructor's Manual Practical Sessions-

The instructor's manual should contain following related to every drawing sheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.

Guidelines for Student's Lab Journal-

The Student's Lab Journal should contain following related to every drawing sheet-

1. Brief theory related to the concerned sheet.
2. Apparatus with their detail specification as per IS code.
3. Design as per problem statement.
4. Reference tables used for design purpose.
5. Design parameters details in tabular form.
6. Few short questions related to design.

Guidelines for Lab/TW Assessment

1. There should be continuous assessment for the Lab/TW
2. Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to design as per the problem statement.
3. Timely submission of design report and sheet.

Unit	Text Books	Reference Books
1	T1, T2,T4,T5	R1,R2,R4
2	T1,T2, T4,T5	R1,R4
3	T2,T5	R3,R4
4	T1,T2,T3,T4	R1,R2,R3
5	T2	R3
6	T2	R3

303150 : Energy Audit and Management

Teaching Scheme		Credits	Examination Scheme [Marks]
Theory	: 03 Hrs./Week	03	In Sem. : 30 Marks
Practical	: 02 Hrs./Week	01	End Sem. : 70 Marks
			Term Work : 25 Marks

Prerequisite:

- Concept of power and energy in three phase and single phase
- Various electrical equipments and specifications

Course Objective:

The course aims to:-

- Understand importance of energy Conservation and energy security.
- Understand impact of use energy resources on environment and emission standards.
- Follow format of energy management, energy policy.
- Learn various tools of energy audit and management
- Calculate energy consumption and saving options with economic feasibility.

Course Outcome:

Upon successful completion of this course, the students will be able to:-

- To get knowledge of BEE Energy policies, Electricity Acts.
- Use various energy measurement and audit instruments.
- Carry out preliminary energy audit of various sectors
- Enlist energy conservation and demand side measures for electrical, thermal and utility Systems.
- Solve simple problems on cost benefit analysis.

Unit 01: Energy Scenario (6 Hrs.)

Classification of Energy resources, Commercial and noncommercial sources, primary and secondary sources, commercial energy production, final energy consumption. Energy needs of growing economy, short terms and long terms policies, energy sector reforms, energy security, importance of energy conservation, energy and environmental impacts, emission check standard, salient features of Energy Conservation Act 2001 and Electricity Act 2003. Indian and Global energy scenario. Introduction to IE Rules. Study of Energy Conservation Building Code (ECBC).

Unit 02: Energy Management (6 Hrs.)

Definition and Objective of Energy Management, Principles of Energy management, Energy Management Strategy, Energy Manager Skills, key elements in energy management, force field analysis, energy policy, format and statement of energy policy, Organization setup and energy management. Responsibilities and duties of energy manager under act 2001. Energy Efficiency Programs. Energy monitoring systems.

Unit 03: Demand Management (6 Hrs.)

Supply side management (SSM), Generation system up gradation, constraints on SSM. Demand side management (DSM), advantages and barriers, implementation of DSM. Use of demand side management in agricultural, domestic and commercial consumers. Demand management through tariffs (TOD). Power factor penalties and incentives in tariff for demand control. Apparent energy tariffs. Role of renewable energy sources in energy management, direct use (solar thermal, solar air conditioning, biomass) and indirect use (solar, wind etc.) Introduction to Net Metering.

Unit 04: Energy Audit (6 Hrs.)

Definition, need of energy audits, types of audit, procedures to follow, data and information analysis, energy audit instrumentation, energy consumption – production relationship, pie charts. Sankey diagram, Cusum technique, least square method and numerical based on it. Outcome of energy audit and energy saving potential, action plans for implementation of energy conservation options. Bench- marking energy performance of an industry. Report formats

Unit 05: Energy Conservation in Applications (6 Hrs.)

a) Motive power (motor and drive system). b) Illumination c) Heating systems (boiler and steam systems) d) Ventilation(Fan, Blower and Compressors) and Air Conditioning systems e) Pumping System f) Cogeneration and waste heat recovery systems g) Utility industries (T and D Sector)

Unit 06: Financial analysis (6 Hrs.)

Financial appraisals; criteria, simple payback period, return on investment, net present value method, time value of money, break even analysis, sensitivity analysis and numerical based on it, cost optimization, cost of energy, cost of generation.

Practicals:

Minimum 8 practicals/tutorials to be conducted from following groups:

Group A (Any Two of the following)

1. Study of Clean Development mechanism
2. Study of building codes (green building)
3. Study of energy management tool
4. Study of force field analysis from energy management point of views

Group B (Any three of following)

5. Analysis and interpretation of Electricity Bills
   Students should calculate electricity charges for
   a) Residential consumer
   b) Commercial Consumer (College campus)
6. Assessment and calculations of energy generated by Solar PV or other renewable sources / Diesel generator available in college campus.

7. Use of Power Analyser for measurement of electrical parameters useful for energy audit or power quality audit.
8. Adequacy assessment of Illumination systems by using Lux Meter
9. Use of temperature measuring devices for analysis of heating systems.
10. Use of other transducers (any one)
    a) Assessment of performance of fans and blowers by using Annemo Meter.
    b) Use of Flow Meters for Pumping system analysis.
    c) Use of pressure measuring equipments useful in audit study.
    d) Smart meters and advanced energy meters
11. Execute Preliminary Energy Audit for (Any One)
    (Preferably this activity should be carried out with student group not exceeding 5)
    a) Laboratory
    b) Educational Institute
    c) Commercial Establishment
    d) Small scale industry
    e) Residential Building
    f) Agricultural Equipments
    g) Municipal Corporations
12. Calculation of energy savings for following (Minimum one)
    a) Illumination
    b) Air conditioning System
    c) Pumping Systems
    d) DG Sets
    e) UPS and Inverter Systems
    f) Lifts and elevators
13. Study of energy audit success stories (any one)
    a) Paper and Pulp Industry
    b) Sugar Industry
    c) Steel Industry
    d) Commercial Establishment
    e) Electrical Generation Plant
14. Study of combined heat power system (cogeneration)
15. Study of Ethical Practices in energy audit.

Guidelines for Instructor's Manual

Instructor's Manual shall have

a. Brief relevant theory.
b. Equipment with specifications.
c. Connection diagram/ methodology.
d. Format of observation table and sample results.

Guidelines for Tutorial Reports (Instruction Manual and Journal Guide lines)

1. Report on Tutorial can be written separately for different batches.
2. Report shall be based on actual case studies presented, audit conducted, and conservation
3. Studies executed.
4. Report shall include following points
   a) Objective b) Procedure c) Equipment d) Details of Name/Place/Location
   e) Type and nature of activity f) Result and Calculations if any
   g) Questions for assessment of Tutorial h) Outcome of activity

Guidelines for Practical Assessment

1. There should be continuous assessment for TW.
2. Assessment must be based on understanding level, presentation skills, efficiency and quality of report.
3. Timely submission of act.

Text Books:

[T1] Guide books for National Certification Examination for Energy Managers/Energy Auditors Book , 1-General Aspects (available on line)

[T2] Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 2 – Thermal Utilities (available on line)

[T3] Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 3- Electrical Utilities (available on line)

[T4] Guide books for National Certification Examination for Energy Managers/Energy Auditors Book 4 (available on line)

Reference Books:

[R1] Success stories of Energy Conservation by BEE (www. Bee-india.org)

[R2] Utilization of electrical energy by S.C. Tripathi, Tata McGraw Hill.

[R3] Energy Management by W.R. Murphy and Mackay, B.S. Publication.

[R4] Generation and utilization of Electrical Energy by B.R. Gupta, S. Chand Publication.

[R5] Energy Auditing made simple by Balasubramanian, Bala Consultancy Services.

Websites:

[W1] www.energymanagertraining.com

[W2] www.em-ea.org

[W3] www.bee-india.org

Unit	Text Books	Reference Books/websites
1	T1	W1,W2
2	T1	W1,W2
3		R4
4	T1	R4, R5 W1,W2
5	T1, T2, T3	W1,W2
6	T1, T4	W1,W2

303151: Electrical Workshop

Teaching Scheme		credits	Examination Scheme[Marks]	
Lectures	----		In sem	Nil
Practical	**2 hrs/week**	01	End sem	Nil
			Term Work	50

Objectives:

- To develop hardware skills such as soldering, winding etc.
- To develop debugging skills.
- To increase ability for analysis and testing of circuits.
- To give an exposure to market survey for available components
- To develop an ability for proper documentation of experimentation.
- To enhance employability of a student.
- To prepare students for working on different hardware projects.

Course Outcomes:

After successful completion of the course, student will be able to

- Integrate electrical/electronic circuits for useful applications
- Acquire hardware skills to fabricate circuits designed.
- Read data manuals/data sheets of different items involved in the circuits.
- Test and debug circuits.
- Produce the results of the testing in the form of report.

Instructions:

- The exercises must be carried out in a group of maximum 3 students.
- Minimum 5 exercises must be carried out.
- Students will present the design, procedure observations and conclusion in the form of report which will be evaluated for term work.

Group A (Minimum 2 exercises from this group)

1. Design and fabrication of reactor/ electromagnet for different inductance values.
2. Design and fabrication of single phase Induction/three phase motor stator.
3. Start delta starter wiring for automatic and manual operation.
4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.
5. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3 point starter with NVC connections and overload operation.

Group B (Minimum 2 Exercise from this group)

This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards.

1. Design and development of combined ±12 V, ±5 V regulated power supply.
2. Design and development of SCR based half controlled converter using RC trigerring.
3. D.C. step down chopper.
4. Traffic light controller using time delay circuits.
5. Buck/boost converter using LM2596S.

Group C

(All interfacing circuits for Arduino boards must be assembled on general purpose PCB and tested.)

1. Arduino based temperature measurement and display.
2. Arduino based D.C. Motor speed control.
3. Arduino based ramp, sawtooth waveform generation.
4. Arduino based stepper motor control.

303153(A) : Bioenergy Systems

Course Name: Bioenergy Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:
Lectures 2 h per week
Field Visit: 4 h
Practical: 4 h

Examination Schemes: Audit (P/F)
Written / MCQ /
Term paper

Description:

The following topics may be broadly covered in the classroom: Bioenergy, availability of biomass, methods to convert it to heat and electricity, technologies for biodiesel, biomass gasification, biogas, composting, introduction to organic fertilizers, introduction to design, manufacturing and construction of biogas and biodiesel plants, specific equipment for pre and post processing, characterization, quality assurance, standards, certification and economics. The field visits and practical will be designed for first-hand experience and basic understanding of the system elements.

Details:

- Introduction to Bioenergy
- Biomass availability in India
- Biomass and carbon cycle
- Environment pollution and biomass
- Energy from biomass
- Biomass burning for energy
- Gasification of biomass
- Biomass reforming
- Anaerobic digestion for biogas
- Biogas purification
- Biogas to electricity
- Aerobic composting
- Organic fertilizers
- Biomass to liquid fuel
- Biodiesel
- Biomass refinery
- Segregated organic waste management
- Algae as source of biomass
- Dealing with agricultural residue

Site Visit:

- Biogas plant for segregated solid waste

Practical:

- Biodiesel making

303153 (B) : Applications of Power Electronics

Teaching Scheme:
Lectures/Practicals : 2 hrs Per week
Total hrs: 22

Examination Scheme: Audit (P/F)
Written/MCQ/TERM Paper/Practical

Course Name : Applications of Power Electronics
Prerequisites:

1. Fundamentals of SCR its V-I Characteristics, construction, working principles and applications.
2. Fundamentals of transistor based devices MOSFET, IGBT,DIAC, TRIAC, GTO and their V-I Characteristics, construction, working principles and applications.
3. Study of Single phase DC-DC and AC-DC Convertor(Full convertor and Semi Convertor)
4. Fundamentals of Single phase and Three Phase DC-AC Convertor(Full convertor and Semi Convertor)

Description:

The topics may be broadly covered in the classroom. This course will introduce the hands on learning to understand power supply for real world applications. Students can analyze, simulate and optimize their PMLK Power designs online using WEBENCH Power designer.
The TI lab Kits may be used to investigate the influence of physical parameters and operation conditions of a power supply on its performance.

Broadly the topics needed to be covered are:
Working principle of step down chopper for R-L load (highly inductive) its control strategies. Performance parameters, Study of DC-to-DC converters – buck, boost, buck-boost and cuk; Study of Voltage Regulators and their Circuits using TI Lab Kits. ex: The Buck regulator May be studied using TPS54160, hysteretic buck regulator LM3475, Switching Regulator and characteristics of standard regulator ICs – TPS40200, TPS40210, Low Drop out (LDO) Regulators ICs-TPS 7A4901, TPS7A8300.
Control techniques: CLC, TRC, PWM and FM Techniques. Analysis of Step up Chopper and Numerical with RLE load. Necessity of input filter, Areas of application.

Lab setup requirement:
PMLK Buck Kit, PMLK LDO Kit, DC power supply 0-50V/4A with dynamic voltage mode capability , DC electronic load 20V/10A with dynamic current mode capability, 4 digital multimeters with 4 1/2-digit resolution ,250MHz 4-channels Digital Oscilloscope ,10 MHz Function Generator.

Any three out of the four experiments in lab can be performed:

1. With TPS7A4901 and TPS7A8300, study-

- Impact of capacitor on PSRR
- Impact of output capacitor on load-transient response
- Impact of line and load conditions on drop out voltage
- Impact of line and load conditions on efficiency

2.Study of DC-DC Buck converter

- Investigate how the efficiency of a TPS54160 buck regulator depends on the line and load conditions and on the switching frequency.
- Analyze the influence of switching frequency fs and of capacitance C and resistance ESR of the input and output capacitors on steady-state waveforms of TPS54160 buck regulator.

3. Study of DC-DC Boost Converter

- Analyze the influence of Input voltage, load current and switching frequency on continuous and discontinuous mode of operation of boost converter.
- Analyze the impact of operating conditions and of the operation mode on the power loss and efficiency of boost converter.

4. Analyze how the switching frequency fs, the DC accuracy and the line noise rejection of the hysteretic buck regulator depend on line voltage, the load current, the characteristics of the output capacitor and the impact of speed-up capacitor.

Webench Experiment:
Lab Requirement: PC's with internet service connection.

Any Two out of the three can be performed:
Design Statement 1:
Design a Low cost Boost Converter to derive 12V, 100mA from 5V USB
DESIGN SPECIFICATION

- Vin(min)= 4V Vin(max)=5V
- Vout=12V Iout=100mA
- The Efficiency of the converter must be greater than 80%
- The design should have a WEBENCH® tool options like Thermal solution and Electrical simulation and to export in other software's
- The BOM count should not exceed 10 parts
- The design should not have an automatic shutdown
- Lesser BOM cost is preferable
- The solution must be designed using the IC available in DIP package.

Design Statement 2:
Design a low cost and power efficient Buck Converter that could be used as a USB charger for mobile devices deriving its power from an automotive battery.
DESIGN SPECIFICATION

- Vin(min)= 9V Vin(max)=15V, Vout=5V Iout=500mA
- The Efficiency of the converter must be greater than 85%
- Footprint of the Total BOM components should be minimal
- The design should have maximum WEBENCH® tool options, for eg. Thermal simulation, Electrical simulation, Simulation export etc.
- The BOM count is expected to be within 15 parts
- Lower Shut down current is desired
- Lower BOM cost is preferred

Design Statement 3:
Design a low cost synchronous buck converter.
DESIGN SPECIFICATIONS

- Vin (Max): 15 V, Vout: 5 V, Vin (Min): 10 V, Iout: 1 A, Ambient Temp: 30°C
- IC should operate in advance eco-mode
- The efficiency should be greater than 90%
- Foot print should be less than 130 mm2
- BOM cost should be less than $2 and the solution should have lowest BOM cost
- BOM count should be less than 10
- The design should have maximum WEBENCH® tool options, for eg. Thermal simulation, Electrical simulation, Simulation export etc)
- IC should support a soft start feature
- Design should not exceed 50 Degree Celsius Temperature at IC-Die (use thermal simulation optimization if required)

Text Books:

1. M.H.Rashid - Power Electronics 2nd Edition, Pearson publication
2. Ned Mohan, T.M. Undeland, W.P. Robbins - Power Electronics, 3rd Edition, John Wiley and Sons
3. B.W. Williams: Power Electronics 2nd edition, John Wiley and sons
4. Ashfaq Ahmed- Power Electronics for Technology, LPE Pearson Edition.
5. Dr. P.S. Bimbhra, Power Electronics, Third Edition, Khanna Publication.
6. K. Hari Babu, Power Electronics , Scitech Publication.

Reference Books:

1. Vedam Donalda, Joshi,Sinha, Thyristorised Power controllers, Wiely Eastern New Delhi.
2. M. D. Singh and K. B. Khandchandani, Power Electronics, Tata McGraw Hill
3. Jai P. Agrawal, Power Electronics systems theory and design LPE, Pearson Education, Asia.
4. L. Umanand, Power Electronics – Essentials and Applications Wiley Publication.
5. J. Michael Jacob – Power Electronics Principal and Applications.
6. M.H.Rashid - Power Electronics Handbook, Butterworth-Heinemann publication,3rd edition
7. M.S. Jamil Asghar, Power Electronics, PHI.
8. V.R. Moorthi, Power Electronics Devices, circuits, and Industrial applications, Oxford University Press.
9. NPTEL Web course and video course on Power Electronics
10. PMLK BUCK Lab manual - http://www.ti.com/lit/ug/ssqu007/ssqu007.pdf
11. PMLK LDO Lab manual - http://www.ti.com/lit/ug/ssqu006/ssqu006.pdf
12. WEBENCH – www.ti.com/webench

Other Reference Material:

1. TPS54160: http://www.ti.com/product/TPS54160
2. LM3475: http://www.ti.com/product/LM3475
3. TPS40200: http://www.ti.com/product/TPS40200
4. TPS40210: http://www.ti.com/product/TPS40210
5. TPS7A4901: http://www.ti.com/product/TPS7A4901
6. TPS7A8300: http://www.ti.com/product/TPS7A8300
7. CSD17313Q2Q1: http://www.ti.com/product/ CSD17313Q2Q1
8. CSD25404Q3: http://www.ti.com/product/ CSD25404Q3
9. UCC27511: http://www.ti.com/product/ UCC27511

SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS FOR
T. E. (MECHANICAL ENGINEERING)
(2015 Course)

WITH EFFECT FROM YEAR 2017-2018

Savitribai Phule Pune University
T.E. Mechanical Engineering 2015 – Course
T. E. (Mechanical) (2015 Course) Semester – I

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302041	Design of Machine Elements-I	4	-	2	30@	70@	50	-		150	4	1
302042	Heat Transfer*	4	-	2	30	70		50	-	150	4	1
302043	Theory of Machines-II[$]	3	1		30	70	25	-	25	150	3	1
302044	Turbo Machines	3	-	2	30	70	-	-	25	125	3	1
302045	Metrology and Quality Control[$]	3	-	2	30	70	-	-	25	125	3	1
302046	Skill Development	-	-	2	-	-	25	25	-	50	-	1
Total		17	1	10	150	350	100	75	75	750	17	6
											23	

T. E. (Mechanical) (2015 Course) Semester – II

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302047	Numerical Methods and Optimization*	4	-	2	30	70	-	50	-	150	4	1
302048	Design of Machine Elements-II	4	-	2	30@	70@	25	-	25	150	4	1
302049	Refrigeration and Air Conditioning	3	-	2	30	70	-	-	25	125	3	1
302050	Mechatronics[%]	3	1		30	70	-	-	25	125	3	1
302051	Manufacturing - Process-II[$]	3	-	-	30	70	-	-	-	100	3	-
302052	Machine Shop-II[$]	-	-	2	-	-	50	-	-	50	-	1
302053	Seminar[$]	-	-	2	-	-	25	-	25#	50	-	1
302054	Audit Course*	--	--	--	--	--	-	-	-	-	-	-
Total		17	1	10	150	350	100	50	100	750	17	6
											23	

Though it is under Oral head Internal Panel to be appointed by Principal and HOD. Examination schedule will not be prepared at University level.

* Marked subjects are common with TE (Auto. Engg.) and TE Mech. Sandwich

[$] Marked subjects are common with TE (Auto. Engg.) only

[%] Marked subjects are common with TE Mech. Sandwich only

@ Examination time for Insem examination 1 Hr 30 Min. and Endsem examination 3Hrs.

Savitribai Phule Pune University, Pune
Third Year of Mechanical
(2015 Course)

Course Code: 302041 **Course Name : Design of Machine Elements – I**

Teaching Scheme:	Credits	Examination Scheme:		
TH: -- 4 Hrs/ Week	TH:--04	TH	In-Sem:	-- 30
			End-Sem:	-- 70
PR: - 2 Hrs/ Week	TW:--01		TW:	-- 50

Course Objective:

1. Student shall gain appreciation and understanding of the design function in Mechanical Engineering, different steps involved in designing and the relation of design activity with manufacturing activity.

2. The student shall learn to choose proper materials for different machine elements depending on their physical and mechanical properties. They will learn to apply the knowledge of material science in real life situations.

3. Student shall gain a thorough understanding of the different types of failure modes and criteria. They will be conversant with various failure theories and be able to judge which criterion is to be applied for a particular situation.

4. Student shall gain design knowledge of the different types of elements used in the machine design process, for e.g. fasteners, shafts, couplings etc. and will be able to design these elements for each application.

Course Outcome:

1. Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.
2. Ability to design Shafts, Keys and Coupling for industrial applications.
3. Ability to design machine elements subjected to fluctuating loads.
4. Ability to design Power Screws for various applications.
5. Ability to design fasteners and welded joints subjected to different loading conditions.
6. Ability to design various Springs for strength and stiffness.

Course Contents

UNIT 1: Design of Simple Machine Elements **(10 hrs)**

Machine Design, Design cycle, Design considerations - Strength, Rigidity, Manufacture, Assembly and Cost, Standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint, Levers - hand / foot lever, lever for safety valve, bell crank lever, and components subjected to eccentric loading.

UNIT 2: Design of Shafts, Keys and Couplings **(08 hrs)**

Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design. Transmission shaft:- Theoretical treatment only. Design of keys and splines. Design of Flange Coupling and Flexible Bushed Pin Coupling.

UNIT 3: Design for Fluctuating Load **(08 hrs)**

Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance
limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams, Fatigue design of components under combined stresses:- Theoretical treatment only.

UNIT 4: Power Screws **(06 hrs)**

Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self locking screw, Collar friction torque, Stresses in power screws, design of a C-Clamp. Design of screw jack, Differential and Compound Screw and Re-circulating Ball Screw (Theoretical treatment only).

UNIT 5: Threaded joints and Welded joints s **(10 hrs)**

Basic types of screw fasteners, Bolts of uniform strength, I.S.O. Metric screw threads, Bolts under tension, eccentrically loaded bolted joint in shear, Eccentric load perpendicular and parallel to axis of bolt, Eccentric load on circular base, design of Turn Buckle. Welding symbols, Stresses in butt and fillet welds, Strength of butt, parallel and transverse fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional moments.

UNIT 6: Mechanical Springs **(06 hrs)**

Types, applications and materials for springs, Stress and deflection equations for helical compression Springs, Style of ends, Design of helical compression and tension springs, Springs in series and parallel, Concentric helical springs, Surge in springs, Design of Multi-leaf springs. Helical torsion Spring (Theoretical treatment only).

Books:

Text:

1) Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
2) Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.
3) Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
4) Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons

References:

1) Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
2) Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
3) Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series.
4) C. S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learing Pvt. Ltd.
5) D. K. Aggarwal & P. C. Sharma, Machine Design, S.K Kataria and Sons
6) P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learing Pvt. Ltd.
7) Design Data - P.S.G. College of Technology, Coimbatore.
8) Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
9) K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers.
10) Kanhhia, Design of Machine Elements-1, Scitech Publications

Term-Work

Term work shall consist of

1. **Two design projects on Assemblies covering above syllabus**.

   The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students.

   Project 1 shall be based on any one of the following topics-

   i) Cotter joint/ knucle joint/turn buckle for a specified application.

   ii) Transmission Shaft/Machine tool spindles/coupling for specified application.

   iii) Hand or foot operated levers/lever for safety valve.

   Project 2 shall be based on any one of the following topics-

   i) Bench vice/Machine vice for specified applications.

   ii) Bottle type/toggle jack for vehicles.

   iii) Lead screw for machine tool/other applications.

   Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.

   Drawings of design project should be done manually.

2. **Assignments**

   The assignment shall be internally presented in the form of power point presentation, by a group of three to five students**.** A report of assignment (Max 8 to 10 pages) along with print out of ppt is to be submitted. Each student shall complete any two of the following assignments, with Assignment
   (a) compulsory.

   a. Use of dimensional tolerances, Geometrical tolerances and surface finish symbols in machine component drawings.

   A. Selection of materials using weighted point method.

   B. Selection of manufacturing methods for machine elements designed in any one of the above design projects.

   C. Theories of failures and their applications.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302042 **Course Name : HEAT TRANSFER**

Teaching Scheme:	Credits	Examination Scheme:		
TH: - 4 Hrs/ Week	TH:--04	TH	In-Sem:	-- 30
			End-Sem:	-- 70
PR: - 2 Hrs/ Week	PR:--01		PR:	-- 50

Course Objectives:

1. Identify the important modes of heat transfer and their applications.
2. Formulate and apply the general three dimensional heat conduction equations.
3. Analyze the thermal systems with internal heat generation and lumped heat capacitance.
4. Understand the mechanism of convective heat transfer
5. Determine the radiative heat transfer between surfaces.
6. Describe the various two phase heat transfer phenomenon. Execute the effectiveness and rating of heat exchangers.

Course Outcomes:

CO 1: Analyze the various modes of heat transfer and implement the basic heat conduction equations for steady one dimensional thermal system.

CO 2: Implement the general heat conduction equation to thermal systems with and without internal heat generation and transient heat conduction.

CO 3: Analyze the heat transfer rate in natural and forced convection and evaluate through experimentation investigation.

CO 4: Interpret heat transfer by radiation between objects with simple geometries.

CO 5: Analyze the heat transfer equipment and investigate the performance.

Course Contents

UNIT 1: **(10 hrs)** **Introduction and Basic Concepts:** Application areas of heat transfer, Modes and Laws of heat transfer, Three dimensional heat conduction equation in Cartesian coordinates and its simplified equations, thermal conductivity, Thermal diffusivity, Thermal contact Resistance **Boundary and initial conditions**: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition. **One dimensional steady state heat conduction without heat generation**: Heat conduction in plane wall, composite slab, composite cylinder, composite sphere, electrical analogy, concept of thermal resistance and conductance, three dimensional heat conduction equations in cylindrical and spherical coordinates (no derivation) and its reduction to one dimensional form, critical radius of insulation for cylinders and spheres, economic thickness of insulation.
UNIT 2: **(08 hrs)** **One dimensional steady state heat conduction with heat generation:** Heat conduction with uniform heat generation in plane wall, cylinder & sphere with different boundary conditions. **Heat transfer through extended surface**: Types of fins and its applications, Governing Equation for constant cross sectional area fins, solution for infinitely long & adequately long (with insulated end) fins, efficiency & effectiveness of fins.
UNIT 3: **(06 hrs)** **Thermal Insulation – Types and selection, Economic and cost considerations, Payback period** **Transient heat conduction**: Validity and criteria of lumped system analysis, Biot and Fourier number, Time constant and response of thermocouple, Transient heat analysis using charts.
UNIT4: **(08hrs)** **Convection** **Fundamentals of convection**: Mechanism of natural and forced convection, local and average heat transfer coefficient, concept of velocity & thermal boundary layers. **Forced convection**: Dimensionless numbers and their physical significance, empirical correlations for external & internal flow for both laminar and turbulent flows. **Natural convection**: Introduction, dimensionless numbers and their physical significance, empirical correlations for natural convection.
UNIT 5: Radiation **(08 hrs)** Fundamental concepts, Spectral and total emissive power, real and grey surfaces, Stefan Boltzmann law, Radiation laws – Planks, Wiens, Kirchoff's and Lambart's cosine law with simple applications, Irradiation and radiosity, Electrical analogy in radiation, Radiation shape factor, radiation heat exchange between two black and diffuse gray surfaces, radiation shield.

UNIT 6: Heat Transfer Equipments **(08 hrs)**

Condensation and Boiling: Boiling heat transfer, types of boiling, pool boiling curve and forced boiling phenomenon, condensation heat transfer, film wise and drop wise condensation (simple numerical treatment).

Heat exchangers: Classification and applications, heat exchanger analysis – LMTD for parallel and counter flow heat exchanger, effectiveness– NTU method for parallel and counter flow heat exchanger, cross flow heat exchanger, LMTD correction factor, design criteria for heat exchanger, Introduction to TEMA standards.

Introduction to heat pipe, Introduction to electronic cooling - Discussion on active and passive methods.

Books:

Text:

1. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley.
2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
4. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
6. M. M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
7. V. M. Domkundwar, Heat Transfer,

References:

1. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
2. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
3. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
4. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
5. B.K. Dutta, Heat Transfer-Principles and Applications, PHI.
6. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science.
7. Databook, SPPU provided by the Exam Center

LIST OF EXPERIMENTS

Any eight experiments (1-11) and two assignments (12-14) from the following list

1. Determination of Thermal Conductivity of metal rod
2. Determination of Thermal Conductivity of insulating powder
3. Determination of Thermal Conductivity of Composite wall
4. Determination of Thermal Contact Resistance
5. Determination of heat transfer coefficient in Natural Convection
6. Determination of heat transfer coefficient in Forced Convection
7. Determination of temperature distribution, fin efficiency in Natural / Forced Convection
8. Determination of Emissivity of a Test surface
9. Determination of Stefan Boltzmann Constant
10. Determination of effectiveness of heat exchanger
11. Study of pool boiling phenomenon and determination of critical heat flux
12. Assignment on 1-D transient heat transfer program using finite difference methods.
13. Assignment to solve transient heat transfer problem using Heisler and Grober charts.
14. Assignment on multi-pass / cross-flow heat exchanger using effectiveness charts.

Savitribai Phule Pune University, Pune

TE Mechanical and TE Automobile (2015 course)

Course Code: 302043 **Course Name : Theory of Machine – II**

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH: -- 03 Hrs/week	**TH:--03**	**TH In-Sem: -- 30** **End-Sem: --70**
Tut.:- 01 Hr /week	**TW/OR:--01**	
		OR: -- 25
		TW: -- 25

Course Objectives:

1. To develop competency in understanding of theory of all types of gears.
2. To understand the analysis of gear train.
3. To develop competency in drawing the cam profile.
4. To make the student conversant with synthesis of the mechanism.
5. To understand step-less regulations.
6. To understand mechanisms for system control – Gyroscope.

Course Outcomes:

1. Student will be able to understand fundamentals of gear theory which will be the prerequisite for gear design.
2. Student will be able to perform force analysis of Spur, Helical, Bevel, Worm and Worm gear.
3. The student to analyze speed and torque in epi-cyclic gear trains which will be the prerequisite for gear box design.
4. Student will be able to design cam profile for given follower motions and understand cam Jump phenomenon, advance cam curves.
5. The student will synthesize a four bar mechanism with analytical and graphical methods.
6. *a.* The student will analyze the gyroscopic couple or effect for stabilization of Ship Aeroplane and Four wheeler vehicle.
   b. Student will choose appropriate drive for given application (stepped / step-less).

Course Contents

Unit – I: Spur Gear **(08 hrs)**

Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, interference and under cutting – Methods to avoid interference. Minimum number of teeth on gear and pinion only, Force analysis and Friction in gears.

Unit – II: Helical, Bevel, Worm and Worm Wheel **(06 hrs)**

Helical and Spiral Gears: terminology, geometrical relationships, tooth forces, torque transmitted and efficiency, virtual number of teeth for helical gears
Bevel Gear & Worm and worm wheel: terminology, geometrical relationships, tooth forces, torque transmitted.
Bevel Gear: Theoretical treatment only

Unit – III Gear Trains **(06 hrs)**

Types of Gear Trains, analysis of epicyclic gear trains, Holding torque – Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel epicyclic Gear train.

Unit –IV Cam and Follower **(08 hrs)**

Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, Methods of control: pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (up to 3-4-5 Polynomial cam only)

Unit –V Synthesis of Mechanism **(06 hrs)**

Steps in synthesis process: Type, number and dimensional synthesis. Tasks of Kinematic synthesis: Path, function and motion generation (Body guidance). Precision Positions, Chebychev spacing, Mechanical and structural errors. Three position synthesis of four bar mechanism using Freudenstein's equation. Analytical synthesis using kinematic coefficient in four bar mechanism.

Unit –VI Step–Less-Regulation (Theoretical Treatment only) & Gyroscope **(06 hrs)**

Continuous Variable Transmissions - Geometry, Velocity and torque analysis of Faceplate variators, conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. Gyroscopes, Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four wheel vehicle moving on curved path.

Books:

Text:

1. S. S. Rattan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
2. Bevan T, Theory of Machines, Third Edition, Longman Publication.
3. A. G. Ambekar, Mechanism and Machine Theory, PHI.
4. N. K. Mehta, Machine Tool Design and Numerical Control, Tata McGraw Hill Publication,
5. J. J. Uicker, G. R. Pennock, J. E. Shigley, Theory of Machines and Mechanisms, Third Edition, International Student Edition, OXFORD.

References:

1. Ghosh Malik, Theory of Mechanism and Machines, East-West Pvt. Ltd.
2. Hannah and Stephans, Mechanics of Machines, Edward Arnolde Publication.
3. R L Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
4. Sadhu Singh, Theory of Machines, Pearson
5. D.K. Pal, S.K. Basu, Design of Machine Tools, Oxford & Ibh Publishing Co Pvt. Ltd.
6. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
7. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI.

Tutorial (Term-work) shall consist of

Part A: Compulsory

1. To study manufacturing of gear using gear generation with rack as a cutter and to generate involute profile
2. Kinematic analysis of synchromesh, machine tool gear box, differential gear box (Self Study)
3. Speed and torque analysis of epicyclic gear train to determine holding torque
4. To draw the cam profile and study variation in pressure angle with respect to change in base circle diameter and draw pitch circle for both the cases.(Half imperial drawing sheet)
5. To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points. (Half imperial drawing sheet)
6. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect.
7. Study of Continuous Variable Transmission and Infinite Variable Transmission.

Part B: Any two from the following

1. To draw conjugate profile for any general type of gear tooth. (Half imperial drawing sheet)
2. To verify the cam jump phenomenon for an eccentric cam.
3. Synthesis a four bar mechanism based on Freudenstein's equation using any programming Language.
4. To measure the range of speeds obtained using any one type of continuously variable transmission device.
5. Industrial visit to understand Machines and Mechanisms.

Savitribai Phule Pune University, Pune

T.E Mechanical (2015 course)

Course Code: 302044 **Course Name : Turbo Machines**

Teaching Scheme:	Credits:	Examination Scheme:
TH: -- 03 hrs/week	TH:-- 03	TH In-Sem: -- 30
PR: -- 02 hrs/week	OR:-- 01	End-Sem: -- 70
		OR: -- 25

Course Objectives:

1. To provide the knowledge of basic principles, governing equations and applications of turbo machine.
2. To provide the students with opportunities to apply basic thermo-fluid dynamics flow equations to Turbo machines.
3. To explain construction and working principle and evaluate the performance characteristics of Turbo Machines.

Course Outcomes:

On successful completion of the course, the student will be able to,

1. Apply thermodynamics and kinematics principles to turbo machines.
2. Analyze the performance of turbo machines.
3. Ability to select turbo machine for given application.
4. Predict performance of turbo machine using model analysis.

Course Contents

Unit – I: Introduction to Turbo Machinery (08hrs) Turbo machines (Hydraulic & Thermal), Classification of Turbo machines, Comparison with positive displacement machines, Fundamental equation governing turbo machines, Different losses associated with turbo-machinery, Applications of Turbo machines. **Impact of Jet** Impulse momentum principle and its applications, Force exerted on fixed and moving flat plate, hinged plate, curved vanes, series of flat plates and radial vanes, velocity triangles and their analysis, work done equations, vane efficiency.
Unit –II: Impulse Water Turbines (06hrs) Introduction to Hydro power plant, classification of hydraulic turbines construction, principle of working, velocity diagrams and analysis, design aspects, performance parameters, performance characteristics, specific speed, selection of turbines, multi-jet Pelton wheel.
Unit –III: Reaction Water Turbines (08 hrs) Classifications, Francis, Propeller, Kaplan Turbines, construction features, velocity diagrams and analysis, degree of reaction, performance characteristics. Draft tubes: types and analysis, causes and remedies for cavitation phenomenon Governing of turbines, Similitude and dimensional analysis of hydraulic turbines
Unit –IV: Steam Turbines (08 hrs) **Steam nozzles:** types and applications, Equation for velocity and mass flow rate [No numerical treatment]. **Steam Turbines:** Classifications, construction details, compounding of steam turbines, velocity diagrams and analysis of Impulse and reaction turbines (single & multi stage), governing, dimensional analysis, performance characteristics. Losses in steam turbines, selection of turbines.

Unit –V: Centrifugal Pumps	**(08 hrs)**

Classification of rotodynamic pumps, components of centrifugal pump, types of heads, velocity triangles and their analysis, effect of outlet blade angle, cavitation, NPSH, Thoma's cavitation factor, priming of pumps, installation, specific speed, performance characteristics of centrifugal pump, series and parallel operation of pumps, system resistance curve, selection of pumps.

Dimensional and Model analysis of hydraulic machines

Unit –VI: Centrifugal & Axial Compressor	**(07 hrs)**

Centrifugal compressor: Classification of compressors, Construction, velocity diagram, flow process on T-S Diagram, Euler's work, actual work input, performance characteristics, various losses in centrifugal compressor.

Axial Compressor: Construction, stage velocity triangles and its analysis, enthalpy entropy diagram, stage losses and efficiencies, performance characteristics. [No numerical treatment]

Books:

Text:

1. Turbines, Compressors & Fans, S.M. Yahya, Tata-McGraw Hill
2. Turbomachines, B. U. Pai, Wiley India
3. Fluid mechanics and hydraulic machines, Dr. R.K. Bansal
4. Hydraulic Machines, Dr. J. Lal, Metropolitan Book Co. Pvt. Ltd., Delhi.
5. Hydraulics, Fluid Mechanics and Machinery, Modi P N & Seth S N, Standard Book House ,New Delhi.
6. R. Yadav, Steam and Gas Turbines and Power Plant Engineering, VII edition, Central Publ. house

References:

1. William W. Perg, Fundamentals of Turbomachinery, John Wiley & Sons.
2. Thermal Turbomachines, Dr. Onkar Singh, Wiley India
3. V. P. Vasandani, Theory of Hydraulic Machinary, Khanna Publishers, Delhi.
4. Karassik, Hand Book of Pumps, Tata McGraw Hills Ltd., New Delhi.
5. S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, IV edition, Butterworth-Heinemann Publ., 1966.

Term-Work

List of Experiments

1. Verification of impulse momentum principle
2. Study and trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics
3. Study and trial on any one hydraulic reaction turbine (Francis/Kaplan) and plotting of main and operating characteristics
4. Study and trial on centrifugal pump and plotting operating characteristics
5. Study and trial on centrifugal air compressor and plotting its characteristics
6. Visit to hydro/steam power plant and report to be submitted.
7. Study of different types of nozzles and trial on convergent-divergent air/steam nozzle.
8. Study of axial flow compressors/ centrifugal air blower.
9. Study of multi-staging of steam turbines.
10. Design of pumping system installation using manufacturers' catalogue, specific to housing or industrial application.
11. Visit to pumping station and report to be submitted.

Notes

1. Eight experiments from above list should be performed; out of which at least four trials should be conducted. Data from any one trial performed should be analyzed by using suitable software.
2. One Experiment out of Expt. no. 10 and 11 is compulsory.
3. Visit to Hydro or Steam power plant is compulsory.

Savitribai Phule Pune University, Pune

TE Mechanical and TE Automobile (2015 course)

Course Code: 302045 **Course Name : Metrology And Quality Control**

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH: 03 Hrs/week	**TH:--03**	**TH In-Sem: -- 30**
		End-Sem: -- 70
PR: 02 Hrs/week	**OR:--01**	
		OR: -- 25

Course Objectives:

Students are expected to –

1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
2. Calibrate measuring instruments and also design inspection gauges.
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.
4. Select and apply appropriate Quality Control Technique for given application.
5. Select and Apply appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).

Course Outcomes:

The student should be able to –

1. Understand the methods of measurement, selection of measuring instruments / standards of measurement, carryout data collection and its analysis.
2. Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design
3. Understand and use/apply Quality Control Techniques/ Statistical Tools appropriately.
4. Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.

Course Contents

Unit – I Measurement standards and Design of gauges (06 hrs)

Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability,

Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate.

Design of Gauges: Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).

Unit –II Comparators, Thread and Gear Metrology, Surface Roughness Measurement (08 hrs)

Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT).

Measurement of Thread form: Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle and Pitch, Floating Carriage Micrometer (Numerical).

Gear Metrology: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications

Surface Roughness Measurement: Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf.

Unit – III Advances in Metrology (06 hrs)

Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes
Machine Vision Systems: vision system measurement – Multisensory systems.
Interferometer: Principle, NPL Interferometer
Laser Metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications

Unit – IV Introduction to Quality and Quality Tools (06 hrs) **Concept of Quality:** Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old New Seven Tools, Quality Circles. **Importance of Quality deployment at Design and Manufacturing Engineering:** Opportunities for improvement product design, Importance of– initial planning for quality, concept of controllability: self-controls – defining quality responsibilities on the factory flow – self inspection.
Unit –V Statistical quality control (08 hrs) **Statistical quality control**: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (**X & R** Chart) & Attribute (**P & C** Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production Part Approval Method (PPAP). **Acceptance Sampling:** Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)
Unit –VI Total Quality Management (06 hrs) **TQM**: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications. **Quality Management System** Need for quality management system – design of quality management system - quality management system requirements – ISO 9001, TS-16949, ISO-14000, Quality Audit.
Books:
Text: 1. Jain R.K., Engineering Metrology, Khanna Publication. 2. I. C. Gupta, Engineering Metrology, Dhanpath Rai. 3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication. 4. Juran J. M., Quality Handbook, McGraw Hill Publications. 5. Grant S.P., Statistical Quality Control, Tata McGraw hill Publication.

References:

1. Narayana K.L., Engineering Metrology.

2. Galyer J.F & Shotbolt C.R., Metrology for engineers

3. Gupta I.C., Engineering Metrology, Dhanpatrai Publiartions

4. Judge A.W., Engineering Precision Measurements, Chapman and Hall

5. Francis T. Farago, Mark A. Curtis, Handbook of dimensional measurement.

6. ASTME, Handbook of Industrial Metrology, Prentice Hall of India Ltd.

7. Connie Dotson, Fundamentals of Dimensional Metrology, Thamson Publn., 4th Edition.

8. Basterfield D. H., Quality control, Pearson Education India, 2004.

9. Kulkarni V. A. and Bewoor A. K., Quality Control, John Wiley Publication.

10. Harrison M. Wordsworth, Stefeen Godfrey, Modern Methods for Quality control and Improvement, Willy Publication.

Online Education resources: viz. NPTEL web site:

(1) nptel.ac.in/courses/112106179;

(2) www.nptelvideos.in/2012/12/mechanical-measurements-and-metrology.html;

(3) www.me.iitb.ac.in/~ramesh/courses/ME338/metrology6.pdf; nptel.ac.in/courses/110101010/;

(4) freevideolectures.com › Mechanical › IIT Madras

(5) nptel.ac.in/courses/112107143/37;

Term-Work

LIST OF EXPERIMENTS

Part: A] Experiment no. 1, 4 and 6 are mandatory. Perform any three from experiment no. 2 to 5 & any three from experiment no. 7 to 10.

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part, (MSA: Gauge R & R).
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
7. Determination of geometry and dimensions of given composite object / single point tool, using profile projector and tool maker's microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

Part: B] Statistical Quality Control (SQC) (Any Two)
Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application. Submission of these assignments USING STANDAED FORMATS.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

Part: C] Industrial visit to:

Calibration lab /Quality control lab / CMM Lab / Gear Inspection Unit

OR

QA/QC Unit of Automotive Industry / Engineering Industry.

Savitribai Phule Pune University, Pune
Third Year of Mechanical
(2015 Course)

Course Code: 302046 **Course Name: Skill Development**

Teaching Scheme:	Credits	Examination Scheme:
PR: -- 2 Hrs/ Week	TW/PR:--01	
		TW:-- 25
		PR:-- 25

COURSE OBJECTIVES

1. To develop the skill for required in shop floor working.
2. To have knowledge of the different tools and tackles used in machine assembly shop.
3. Use of theoretical knowledge in practice.
4. Practical aspect of the each component in the assembly of the machine.

Course Contents

List of Experiments

1. Tail stock assembly
2. Valve Assembly (PRV, Sluice valve, Steam stop valve)
3. IC engine of Two Wheeler (4 stroke single cylinder)
4. Hermetically sealed compressor
5. Hydraulic actuator
6. Industrial Gear box
7. Sheet drawing (Sheet will be given per group and a group consist of 04 students. The sheet will be drawn manually by every student)

Note: 1-6 experiments are for assembly and disassembly only

Term-Work

1. Sheet drawing of assembly, which should contain the display of Geometric tolerances, Limits, Fits, BOM, Dimensional measurements techniques. Special Operations.. Students should make process sheet of each assembly. (One topic per four students group will be given for sheet drawing and each student should draw the sheet manually)

Practical Examination

Practical examination will be based on opening and closing of any assembly. In addition to this some questioning will be asked to the student based on assembly drawing, GD&T Sequencing and tools and tackles. For this the assemblies and their drawings should be provided to students for examination

Note: Term work will carry 25 Marks and practical examination will carry 25 marks.

A. The assessment has to be carried out based on close monitoring of involvement and intellectual contribution of student.
B. The student should maintain the record of work in the form of diary and has to be submitted at the end of semester.
C. The batch teacher should assess the concerned student

SEM-II

Savitribai Phule Pune University, Pune

TE Mechanical, Mechanical Sandwich and Automobile (2015 course)

Course Code: 302047 **Course Name : Numerical Methods and Optimization**

Teaching Scheme:	Credits	Examination Scheme:
TH: -04 hrs/week	TH:--04	TH In-Sem: -- 30
		End-Sem: --70
PR: 02 hrs /week	PR:--01	PR: -- 50

Course Objectives:
Students are expected to –
1 Recognize the difference between analytical and Numerical Methods.
2 Effectively use Numerical Techniques for solving complex Mechanical engineering Problems.
3 Prepare base for understanding engineering analysis software.
4 Develop logical sequencing for solution procedure and skills in soft computing.
5 Optimize the solution for different real life problems with available constraints.
6 Build the foundation for engineering research.

Course Outcomes:
The student should be able to –
1. Use appropriate Numerical Methods to solve complex mechanical engineering problems.
2. Formulate algorithms and programming.
3. Use Mathematical Solver.
4. Generate Solutions for real life problem using optimization techniques.
5. Analyze the research problem

Course Contents

Unit – I: Roots of Equation and Error Approximations (08 hrs.)

Roots of Equation
Bisection Method, Newton Raphson method and Successive approximation method.
Error Approximations
Types of Errors: Absolute, Relative, Algorithmic, Truncation, Round off Error, Error Propagation, Concept of convergence-relevance to numerical methods.

Unit – II: Simultaneous Equations (08 hrs.)

Gauss Elimination Method with Partial pivoting, Gauss-Seidal method and Thomas algorithm for Tri-diagonal Matrix, Jacob iteration method.

Unit – III: Optimization (08 hrs.)

Introduction to optimization, Classification, Constrained optimization (maximum two constrains): Graphical and Simplex method, One Dimensional unconstrained optimization: Newton's Method. Modern Optimization Techniques: Genetic Algorithm (GA), Simulated Annealing (SA).

Unit – IV: Numerical Solutions of Differential Equations (10 hrs.)

Ordinary Differential Equations [ODE]

Taylor series method, Euler Method, Runge-Kutta fourth order, Simultaneous equations using RungeKutta2nd order method.

Partial Differential Equations [PDE]: Finite Difference methods

Introduction to finite difference method, Simple Laplace method, PDEs- Parabolic explicit solution, Elliptic-explicit solution.

Unit – V: Curve Fitting and Regression Analysis (08 hrs.)

Curve Fitting

Least square technique- Straight line, Power equation, Exponential equation and Quadratic equation.

Regression Analysis

Introduction to multi regression analysis, Lagrange's Interpolation, Newton's Forward interpolation, Inverse interpolation (Lagrange's method only).

Unit – VI: Numerical Integration (06 hrs.)

Numerical Integration (1D only)

Trapezoidal rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule, Gauss Quadrature 2 point and 3 point method.

Double Integration

Trapezoidal rule, Simpson's 1/3rd Rule.

Books:

Text:

1. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, 4/e, Tata McGraw Hill Editions

2. Dr. B. S. Garewal, Numerical Methods in Engineering and Science, Khanna Publishers,.

3. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientist, Tata Mc-Graw Hill Publishing Co-Ltd

4. Rao V. Dukkipati, Applied Numerical Methods using Matlab, New Age International Publishers

References:

1. Gerald and Wheatley, Applied Numerical Analysis, Pearson Education Asia

2. E. Balagurusamy, Numerical Methods, Tata McGraw Hill

3. P. Thangaraj, Computer Oriented Numerical Methods, PHI

4. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI.

Term-Work

1. Program on Roots of Equation (Validation by suitable solver, all three compulsory)
a) Bisection Method, b) Newton Raphson method c) Successive approximation method

2. Program on Simultaneous Equations (Validation by suitable solver, all three compulsory)
a) Gauss Elimination Method, b) Thomas algorithm for tridiagonal matrix, c) Gauss-Seidal method.

3. Demonstration of optimization technique using suitable solver.

4. Program on ODE(Validation by suitable solver, all three compulsory)
a) Euler Method, b) Runge-Kutta Methods- fourth order, c) Simultaneous equations.(Runge-Kutta 2nd order: *One step only*).Simple pendulum equation or Spring mass damper equation

5. Program on PDE(Validation by suitable solver): Laplace equation

6. Program on Curve Fitting using Least square technique (Validation by suitable solver, all four compulsory)
a) Straight line, b) Power equation, c) Exponential equation, d) Quadratic equation

7. Program on Interpolation(Validation by suitable solver, all three compulsory)
a) Lagrange's Interpolation, b) Newton's Forward interpolation,

8. Program on Numerical Integration(Validation by suitable solver, all four compulsory)
a) Trapezoidal rule, b) Simpson's Rules (1/3rd, 3/8th) [In one program only], c) Gauss Quadrature Method- 2 point, 3 point. [In one program only], d) Double integration: Trapezoidal rule

NOTE:

1. Solver is compulsory for all above programs and compared with actual solution.
2. Manual solution for each problem.
3. Algorithms and Flowcharts are compulsory for all programs.

GUIDELINES TO CONDUCT PRACTICAL EXAMINATION

Any one program from each set A & B with flowchart and solver: **Duration: 2 hrs.**

Set A: (Weightage – 60 %)
a) Simultaneous Equation, b) Partial Differential Equation (Laplace equation with solver)
c) Interpolation: Lagrange's interpolation, Newton's Forward interpolation (Any one)

Set B: (Weightage – 40 %)
a) Roots of Equations, b) Curve Fitting, c) Ordinary Differential Equations, d) Integration

Savitribai Phule Pune University, Pune
Third Year of Mechanical (2015 Course)

Course Code: 302048 **Course Name : Design of Machine Elements – II**

Teaching Scheme:	Credits	Examination Scheme:		
TH: -- 4 Hrs/ Week	TH:--04	TH:	In-Sem:	-- 30
			End-Sem:	-- 70
PR: - 2 Hrs/ Week	TW/OR:--01		TW:	-- 25
			OR:	-- 25

Course Objective:

1. Enable students to attain the basic knowledge required to understand, analyze, design and select machine elements required in transmission systems.
2. Reinforce the philosophy that real engineering design problems are open-ended and challenging
3. Impart design skills to the students to apply these skills for the problems in real life industrial applications
4. Inculcate an attitude of team work, critical thinking, communication, planning and scheduling through design projects
5. Create awareness amongst students about safety, ethical, legal, and other societal constraints in execution of their design projects
6. Develop an holistic design approach to find out pragmatic solutions to realistic domestic and industrial problems

Course Outcome:

The student should be able to –

CO 1: To understand and apply principles of gear design to spur gears and industrial spur gear boxes.

CO 2 : To become proficient in Design of Helical and Bevel Gear

CO 3: To develop capability to analyse Rolling contact bearing and its selection from manufacturer's Catalogue.

CO 4: To learn a skill to design worm gear box for various industrial applications.

CO 5: To inculcate an ability to design belt drives and selection of belt, rope and chain drives.

CO 6: To achieve an expertise in design of Sliding contact bearing in industrial applications.

Course Contents

Unit –I Spur Gears **(08 hrs)**

Introduction to gears: Gear Selection, material selection, Basic modes of tooth failure, Gear Lubrication Methods.

Spur Gears: Number of teeth and face width, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation**.**

Unit –I Helical and Bevel Gears **(08 hrs)**

Types of helical and Bevel gears, Terminology, Virtual number of teeth**,** and force analysis of Helical and Straight Bevel Gear. Design of Helical and Straight Bevel Gear based on Beam Strength, Wear strength and estimation of effective load based on Velocity factor (Barth factor) and Buckingham's equation. Mountings of Bevel Gear**. (No numerical on force analysis of helical & Bevel Gear)**

Unit – III Rolling Contact Bearings **(08 hrs)**

Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation,

Equivalent bearing load, Load- life relationship, Selection of bearing life Selection of rolling contact bearings from manufacturer's catalog, Design for cyclic loads and speed, bearing with probability of survival other than 90%

Taper roller bearing: Force analysis and selection criteria. (Theoretical Treatment only)

Unit - IV:

Worm and worm gear terminology and proportions of worm and worm gears, Force analysis of worm gear drives, Friction in Worm gears, efficiency of worm gears, Worm and worm gear material, Strength and wear ratings of worm gears (Bending stress factor, speed factor, surface stress factor, zone factor) IS 1443-1974, Thermal consideration in worm gear drive, Types of failures in worm gear drives, Methods of lubrication

Unit - V:

Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition,

Selection of Flat and V-belts from manufacturer's catalog, belt tensioning methods, relative advantages and limitations of Flat and V- belts, construction and applications of timing belts.

Wire Ropes (Theoretical Treatment Only): Construction of wire ropes, lay of wire rope, stresses in wire rope, selection of wire ropes, rope drums construction and design.

Chain Drives (Theoretical Treatment Only): Types of chains and its Geometry, selection criteria for chain drive, Polygon effect of chain, Modes of failure for chain, Lubrication of chains

UNIT VI:

Classification of sliding contact bearing.

Lubricating oils: Properties, additives, selection of lubricating oils, Properties & selection of bearing materials.

Hydrodynamic Lubrication: Theory of Hydrodynamic Lubrication, Pressure Development in oil film, 2DBasic Reynolds Equation, Somerfield number, Raimondi and Boyd method, Thermal considerations, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness.

Books:

Text:

1) Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
2) Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.
3) Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
4) Juvinal R.C, Fundamentals of Machine Components Design, John Wiley and Sons.

References:

1. Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
2. Willium C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
3. Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum's Outline Series
4. C.S. Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learing Pvt. Ltd.
5. D. K. Aggarwal & P.C. Sharma, Machine Design, S.K Kataria and Sons
6. P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learing Pvt. Ltd.
7. Design Data - P.S.G. College of Technology, Coimbatore.
8. Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.
9. K. Mahadevan, K. Balveera Reddy, Design Data Handbook for Mechanical Engineers, CBS Publishers

Term-Work

Term work shall consist of

1. One design project based on either Design of a Two Stage Gear Box (the two stages having different types of gear pair) or single stage worm gear box.

The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components.

Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components

Note:

1. Design project should be assigned to group of 5 to 7 students.
2. Assembly drawing of project should be drawn using any CAD software.
3. Detailed parts of project should be drawn manually.

Design projects should be practical oriented, below is the list of practical applications:

i) Design of gearbox for wind mill application
ii) Design of gearbox for sluice gate application.
iii) Design of gearbox for machine tool applications like Lathe, Drilling, Milling machines etc.
iv) Design of in-line gearbox for Automobile application.
v) Design of gearbox for building Elevator
vi) Design of gearbox for Hoist.
vii) Design of gearbox for 2 wheeler .
viii) Design of gearbox for Tumbling barrel (Mixer).
ix) Design of gearbox for Cannon adjustment mechanism (Military application).
x) Design of gearbox for Worm gear box for Sugar Industry.

2. Presentation (PPT/slides) (on following topics (Any Two):
    i) Application of belt drive and its selection method for Industrial application. (By using Manufacturer's Catalog).
    ii) Application of chain drive and its selection method for Automobile application. (By using Manufacturer's Catalog).
    iii) Mounting of machine elements on transmission shaft (like Bearings, gears, Pulley, Sprocket, etc).
    iv) Selection of Bearing from Manufacturer's Catalog.
    v) Construction and details of Gears.

Savitribai Phule Pune University, Pune

TE Mechanical (2015 course)

Course Code: 302049 Course Name : Refrigeration and Air Conditioning

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 03 hrs/week	**TH:-- 03**	**TH In-Sem: -- 30**
		End-Sem: -- 70
PR : 02 hrs/ week	**OR:- 01**	**OR: -- 25**

Prerequisites:

Basic Thermodynamics- Laws of thermodynamics, Ideal gas processes, Thermodynamic cycles, Properties of pure substance, Mollier Charts, Basic Psychrometry terms and process, Fluid properties, Fluid dynamics, Modes of heat transfer, Governing Equations in Heat Transfer, Extended Surfaces, Condensation and Boiling, Heat Exchangers.

Course Objectives:

- Learning the fundamental principles and different methods of refrigeration and air conditioning.
- Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
- Comparative study of different refrigerants with respect to properties, applications and environmental issues.
- Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
- Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Course Outcomes:

At the end of this course the students should be able to

- Illustrate the fundamental principles and applications of refrigeration and air conditioning system
- Obtain cooling capacity and coefficient of performance by conducting test on vapour compression refrigeration systems
- Present the properties, applications and environmental issues of different refrigerants
- Calculate cooling load for air conditioning systems used for various
- Operate and analyze the refrigeration and air conditioning systems.

Course Contents

Unit I: Applications of Refrigeration and Air Conditioning and Refrigerants [8 hrs]

Applications

Domestic Refrigerator, Domestic Air Conditioners, Automotive Air Conditioners, Evaporative coolers, water coolers, Commercial Refrigeration- Dairy, Cold storage, Ice plant, Commercial Air Conditioning-Multiplex, Hospitals.

Refrigerants

Classification of refrigerants, Designation of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zeotropes and Azeotropes, refrigerant: recovery reclaims, recycle and recharge.

Unit II: Vapour Refrigeration Systems [8 hrs]

Vapour compression systems

Working of simple vapour compression system, representation of vapour compression cycle (VCC) on T-s and P-h diagram, COP, EER, SEER, IPLV, NPLV, effect of operating parameters on performance of VCC, actual VCC, methods of improving COP using flash chamber, sub-cooling, liquid vapour heat exchanger, comparison of VCC with Reverse Carnot cycle.

Vapour absorption systems

Introduction, Working of simple vapour absorption system (VAS), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAS (simple numerical treatment), actual VAS, Li-Br absorption system, three fluid system (Electrolux refrigeration), applications of VAS, comparison between VCC and VAC

Unit III: Multiple pressure Refrigeration Systems [8 hrs]

Introduction, need of multistage system, Intermediate pressure, two stage compression with flash gas removal and liquid intercooler, single compressor with multiple evaporator: individual and multiple expansion valves, individual compressors, cascade system: application and numerical(numerical only by using p-h chart),

Introduction to cryogenics (Linde - Hampson cycle) and applications (no numerical treatment)

Unit IV: Psychrometry and Air conditioning load estimation **[8 hrs]** **Psychrometry** Basic Psychrometry and processes, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Factors contributing to cooling load, Numerical based on load analysis **Human Comfort** Thermodynamics of human body, comfort and comfort chart, factors affecting human comfort, concept of infiltration and ventilation, indoor air quality requirements,
Unit V: Air Conditioning Systems **[8 hrs]** **Air Conditioning Systems** Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning. **Components of refrigeration and air conditioning systems** Working of reciprocating, screw and scroll compressors, working of air cooled, water cooled and evaporative condensers, working of DX, Flooded, Forced feed evaporators, Expansion devices – Capillary tube, TXV, EXV, operating and safety controls.
Unit VI **[8 hrs]** **Air Distribution Systems** **Part A] Ducts** Classification of ducts, duct material, pressure in ducts, flow through duct, pressure losses in duct (friction losses, dynamic losses), air flow through simple duct system, equivalent diameter, Methods of duct system design: equal friction, velocity reduction, static regain method (numerical on duct system design) **Part B] Air handling unit** Air handling unit, Fan coil unit, types of fans used air conditioning applications, fan laws, filters, supply and return grills, sensors (humidity, temperature, smoke).
Books:
Text: 1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw-Hill 2. Manohar Prasad, Refrigeration and Air Conditioning, Willey Eastern Ltd, 1983 3. McQuiston, ― Heating Ventilating and air Conditioning: Analysis and Design‖ 6th Edition, Wiley India 4. Arora and Domkundwar, Refrigeration & Air Conditioning, Dhanpatrai & Company, New Delhi 5. Khurmi R.S. and Gupta J.K., Refrigeration and Air conditioning, Eurasia Publishing House Pvt. Ltd, New Delhi,1994. 6. Ballaney P.L., Refrigeration and Air conditioning, Khanna Publishers, New Delhi, 1992

References:

1. Dossat Ray J, Principles of refrigeration, S.I. version, Willey Eastern Ltd, 2000
2. Stockers W.F and Jones J.W., Refrigeration and Air conditioning, McGraw Hill International editions 1982.
3. Threlkeld J.L, Thermal Environmental Engineering, Prentice Hall Inc., New Delhi4. Aanatnarayan, Basics of refrigeration and Air Conditioning, Tata McGraw Hill Publications
5. Roger Legg, Air Conditioning System Design, Commissioning and Maintenance
6. ASHRAE & ISHRAE handbook

Term-Work

The term work shall consist of minimum eight experiments out of the following (It should include the visit to clod storage plant or central air-condition plant) :

1. Test on Domestic Refrigerator for evaluation of EER
2. Test on vapour compression test rig
3. Test on air conditioning test rig
4. Test on ice plant test rig
5. Test on Heat Pump test rig
6. Test/visit on Vapour absorption refrigeration test rig
7. Estimation of cooling load of simple air conditioning system (case study)
8. Visit to cold storage plant.
9. Visit to any air conditioning plant
10. Thermal analysis of refrigeration cycle using suitable software
11. Installation and servicing of split air conditioner.

Savitribai Phule Pune University, Pune

TE Mechanical and Mechanical Sandwich (2015 course)

Course Code: 302050		**Course Name : Mechatronics**
Teaching Scheme:	**Credits**	**Examination Scheme:**
TH: -- 03 hrs/week	**TH:--03**	**TH In-Sem: -- 30** **End-Sem: --70**
Tut.: - 01 hr/week	**OR:- 01**	
		OR: --25

Course Objectives:

- Understand key elements of Mechatronics system, representation into block diagram
- Understand concept of transfer function, reduction and analysis
- Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
- Understand the system modeling and analysis in time domain and frequency domain.
- Understand control actions such as Proportional, derivative and integral and study its significance in industrial applications

Course Outcomes:

On completion of the course, students will be able to –

- Identification of key elements of mechatronics system and its representation in terms of block diagram
- Understanding the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
- Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
- Time and Frequency domain analysis of system model (for control application)
- PID control implementation on real time systems
- Development of PLC ladder programming and implementation of real life system.

Course Contents
UNIT 1: Introduction to Mechatronics, Sensors & Actuators (08 Hrs) Introduction to Mechatronics and its Applications; Measurement Characteristics: Static and Dynamic; Sensors: Position sensors- Potentiometer, LVDT, incremental Encoder; Proximity sensors-Optical, Inductive, Capacitive; Temperature sensor-RTD, Thermocouples; Force / Pressure Sensors-Strain gauges; Flow sensors-Electromagnetic; Actuators: Stepper motor, Servo motor, Solenoids; Selection of Sensor & Actuator.
UNIT 2: Block Diagram Representation (08 Hrs) Introduction to Mechatronic System Design; Identification of key elements of Mechatronics systems and represent into Block Diagram; Open and Closed loop Control System; Concept of Transfer Function; Block Diagram & Reduction principles; Applications of Mechatronic systems: Household, Automotive, Industrial shop floor.
UNIT 3: Data Acquisition (08 Hrs) Introduction to Signal Communication & Types-Synchronous, Asynchronous, Serial, Parallel; Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency; Interfacing of Sensors / Actuators to Data Acquisition system; 4 bit Successive Approximation type ADC; 4 bit R-2R type DAC; Current and Voltage Amplifier.
UNIT 4: Programmable Logic Control (08 Hrs) Introduction to PLC; Architecture of PLC; Selection of PLC; Ladder Logic programming for different types of logic gates; Latching; Timers, Counter; Practical examples of Ladder Programming.
UNIT 5: Frequency Domain Modelling and Analysis (08 Hrs) Transfer Function based modeling of Mechanical, Thermal and Fluid system; concept of Poles & Zeros; Stability Analysis using Routh Hurwitz Criterion; Bode Plots: Introduction to Bode Plot, Gain Margin, Phase Margin, Relative Stability Analysis, Frequency Domain Parameters-Natural Frequency, Damping Frequency and Damping Factor; Mapping of Pole Zero plot with damping factor, natural frequency and unit step response.
UNIT VI: Control System (08 Hrs) Proportional (P), Integral (I) and Derivative (D) control actions; PI, PD and PID control systems in parallel form; Unit step Response analysis via Transient response specifications: Percentage overshoot, Rise time, Delay time, Steady state error; Manual tuning of PID control; Linear Quadratic Control (LQR).
Books:
Text: • K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008 • Bolton, Mechatronics - A Multidisciplinary approach, 4th Edition, Prentice Hall, 2009.

References:

- Alciatore & Histand, Introduction to Mechatronics and Measurement system, 4th Edition, Mc-Graw Hill publication, 2011
- Bishop (Editor), Mechatronics – An Introduction, CRC Press, 2006
- Mahalik, Mechatronics – Principles, concepts and applications, Tata Mc-Graw Hill publication, New Delhi
- C. D. Johnson, Process Control Instrumentation Technology, Prentice Hall, New Delhi

Term Work shall consist of following assignments:

The common minimum submission mentioned in point 1 and 2 should comprise of the following. From the table below: Submission No. 04, 05, 10, 11 and 12 are mandatory; any one from 01 to 03, any one from 06 or 07, any one from 08 or 09.

Submission No	Title
01	Measurement of Load / Force using a suitable sensor
02	Measurement of Temperature using a suitable sensor
03	Measurement of Position using a suitable sensor
04	Demonstration of **any one** of the following applications: • Water Level Indicator • Bottle Filling Plant • Pick and Place Robot • Any other suitable application which comprises of components of Mechatronic system
05	Interfacing of suitable sensor with Data Acquisition system
06	Ladder Diagram simulation, using suitable software, for logic gates
07	Real time application of PLC using Ladder logic
08	Real time control of Temperature / Flow using PID control
09	Real time control of speed of DC motor using PID control
10	PID control Design, Tuning using suitable Simulation Software
11	Study of Modeling and Analysis of a typical Mechanical System (Estimation of poles, zeros, % overshoot, natural frequency, damping frequency, rise time, settling time)
12	Case Study: Design of Mechatronic System (to be performed in a group of 4)

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302051 **Course Name : MANUFATCURING PROCESS – II**

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH: -- 3 Hrs/ Week	**TH:03**	**TH In-Sem: -- 30** **End-Sem: -- 70**

Course Objective:

1. To analyze and understand the metal cutting phenomena.
2. To select process parameter and tools for obtaining desired machining characteristic
3. To understand principles of manufacturing processes.

Course Outcome:

1. Student should be able to apply the knowledge of various manufacturing processes.
2. Student should be able to identify various process parameters and their effect on processes.
3. Student should be able to figure out application of modern machining.
4. Students should get the knowledge of Jigs and Fixtures for variety of operations.

Course Contents

Unit – I Theory of Metal cutting **(07hrs)**

Single point cutting tool: Tool geometry, Mechanics of shearing (orthogonal and oblique), Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on machining.

Merchant's circle of forces (analytical) Estimation of shear force, Normal shear force, Friction force, Normal friction force, Material Removal Rate (MRR), Cutting power estimation, Calculation of Total power and Specific energy. Introduction to tool dynamometers.

Machinability - Factors affecting machinability, Tool life, Tool wear, Types of tool wear and remedial actions, Cutting fluid and their types, Effect of process parameters on tool life, Taylor's tool life equation (Derivation along with numerical).

Unit – II Machine tools and their application **(07 hrs)**

Drilling machine: Types of drills and operations. Twist drill geometry, Types of drilling machine, Tool holder. Machining time calculations.

Milling machine: Types of milling machines, Cutter-types and geometry and their applications. Universal dividing head, Methods of Indexing: Simple, Compound, Differential. (Numericals based on simple and compound Indexing).Machining time calculations

Broaching: Introduction to broaching, Broach tool geometry, Planner and Boring Machines: Introduction.

Unit – III Finishing processes **(07hrs)**

Grinding machines

Introduction: Types and Operations of grinding machines.

Grinding wheel – Shapes, Designation and selection, Mounting, Balancing and Dressing of grinding wheels, Machining time calculation for cylindrical and plunge grinding.

Super-finishing processes – Introduction to Honing, Lapping, Buffing and Burnishing. (Construction, working and controlling parameters)

Unit – IV Advanced Machining Processes **(07 hrs)**

Introduction, classification of advanced machining processes.

Principles, Working, Process Parameters, Advantages, Limitations and Application for following processes:

Electric Discharge Machining (EDM), LASER Beam Machining (LBM), Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM) and Electro Chemical Machining (ECM)

Introduction to micro machining.

Unit –V CNC Technology **(07 hrs)**

Introduction, Classification, Construction and working of NC, CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC)

CNC Programming: Word address format (WAF) –ISO Standards, G & M codes, Type of CNC Control systems, Manual part programming (plain milling and Turning), Subroutine, Canned cycles.

Unit –VI Jigs and fixtures **(07 hrs)**

Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs and fixtures, advantages of jig and fixtures

Jigs: Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch type jig.

Fixtures: Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Introduction to Assembly and Inspection fixtures. Indexing fixtures.

Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures.

Books:

Text:

1. S. K Hajra Choudhury , Elements of workshop technology – Vol. II,, Media Promoters And Publishers, Mumbai
2. Amitabh Ghosh and Asok kumar Mallik, Manufacturing science, Ellis Horwood Ltd
3. Mikell. P. Grover, Fundamentals of Modern Manufacturing, Pearson Publications
4. P. C. Sharma, Production Engineering, S. Chand Publication.

References:

1. Production technology –HMT, Tata McGraw Hill publication
2. Lindberg, Roy A., Processes and materials of manufacture, P H I Learning
3. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson Education, Fourth Edition.
4. G. K Lal, Fundamentals of Design and Manufacturing, Alpha Science International Ltd(2005)
5. M.C Shaw, Metal Cutting Principles, Oxford university press
6. Yoram Koren , Numerical Control of Machine Tools Khanna Publication
7. P. K Mishra, Non- conventional machining, Narosa Publishing House
8. V. K Jain, Advanced machining processes , Allied Publisher, New Delhi
9. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS
10. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill
11. P. N. Rao, CAD/CAM Principles and Applications, McGraw Hill Education, Third Edition.
12. Cyrll Donaldson, George H. LeCain and V. C. Goold, Tool design, Tata McGraw- Hill. Third Edition

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302052 **Course Name : MACHINE SHOP – II**

Credits	Examination Scheme:
PR: -2 Hrs/ Week TW:-01	TW: 50

Course Objective:

1. To set the manufacturing set–up appropriately and study the corresponding set up parameters.
2. To select appropriate process parameter for obtaining desired characteristic on work piece.
3. To understand the operational problems and suggest remedial solution for adopted manufacturing process.

Course Outcome:

1. Ability to develop knowledge about the working and programming techniques for various machines and tools

Term-Work

Each student must complete and submit following term work:

I. **Jobs (Both the following jobs should be completed individually)**
   a. Any one marketable assembly consisting of at least three components with tolerance involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement.
   b. Development and execution of one simple turning job on CNC (Trainer) machine.

II. **Journal consisting of following assignments.**
   a. Two views of at least one jig and one fixture designed, for a component on a half imperial sheet.(manual drafting)
   b. Process planning sheets for job 1.a and 1.b.
   c. Report based on industrial visit to manufacturing plant.

Note: - Practical are to be performed under the guidance of concerned faculty member.
Job drawing essentially consisting of Geometric Dimensioning and Tolerance

Savitribai Phule Pune University, Pune
Third Year of Mechanical & Automobile
(2015 Course)

Course Code: 302053	**Course Name : SEMINAR**

Teaching Scheme:	**Credits**	**Examination Scheme:**
PR:-- 2 Hrs/Week	**OR:--01**	**TH In-Sem: --** **End-Sem: --** **TW: -- 25** **OR: -- 25**

Prerequisites:

Course Objective:

1. Identify and compare technical and practical issues related to the area of course specialization.
2. Outline annotated bibliography of research demonstrating scholarly skills.
3. Prepare a well organized report employing elements of technical writing and critical thinking.
4. Demonstrate the ability to describe, interpret and analyze technical issues and develop competence in presenting.

Course Outcome:

With this seminar report and presentation, the student is expected to learn/achieve the following:

- Establish motivation for any topic of interest and develop a thought process for technical presentation.
- Organize a detailed literature survey and build a document with respect to technical publications.
- Analysis and comprehension of proof-of-concept and related data.
- Effective presentation and improve soft skills.
- Make use of new and recent technology (e.g. Latex) for creating technical reports

Course Contents:

The evaluation of the seminar report is proposed with the following stages.

Stage-I

In this stage the student is expected to deliver the following:

1. Topic selection
2. Literature review
3. State of the art related to the topic of interest

Stage-II

1. Problem statement
2. Methodology
3. Scope and objectives

A review of the student's progress should be made after In-Sem examination, within a week. During this review, the student is expected to complete Stage-1 and Stage-2.

Stage-III

1. Quantification of results
2. Concluding remarks or summary

Stage-IV

3. Final report
4. Final presentation/viva

The final presentation/viva will be assessed by a committee including an expert (preferably from industry with minimum 5 years experience) and an internal panel. The internal panel will consist of the seminar guide and two subject experts, approved by the HOD and the principal of the institute.

Examination schedule will be prepared at institute level (and not at University level), though it is under Oral head. The appointment of the internal panel and the external (industrial) expert will be taken care by the respective institute. The seminar presentation will be help after the term end and before university external viva

Contents of the Seminar report

The contents of the seminar report as mentioned in section-3 are expected to include the following:

- Abstract/Summary
- Introduction: Scope and Methodology
- Literature review: The review should be conducted from at least five research papers published during last five year.
- Case study
- References

Instructions for seminar report writing

It is important that the procedures listed below be carefully followed by all the students.

1. Prepare two spiral bound copies of your Seminar report.

2. Limit your seminar report to preferably 20 to 25 pages only.

3. Header For e.g. Title of the seminar.

4. The footer For e.g. page numbers

5. Institute Name, Mechanical Engineering and centrally aligned.

6. The report shall be prepared using LateX preferably (default font througout) with double spacing throughout on A4 page.

Page	Left margin	Right margin	Top margin	Bottom margin
A-4 (8.5 11 inch)	1.5"	1"	1"	1"

7. Section titles should be bold typed in all capital letters and should be left aligned.
8. Sub-Section headings should be aligning at the left, bold and Title Case (the first letter of each word is to be capitalized).
9. Figure No. and Title at bottom with 10 pt; Legends below the title in 10 pt
10. Please use SI system of units only.
11. References should be either in order as they appear in the report or in alphabetical order by last name of first author.
12. Symbols and notations if any should be included in nomenclature section only

The report will be made in the following order:

1. Cover page and Front page as per specimen on separate sheet
2. Certificate from Institute as per specimen on separate sheet
3. Acknowledgement
4. List of Figures
5. List of Tables
6. Nomenclature
7. Contents
8. All section headings and subheadings should be numbered. For sections use numbers 1, 2, 3, ... and for subheadings 1.1, 1.2, ... etc and section subheadings 2.1.1, 2.1.2, ... etc.
9. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If figures and tables are taken from any reference then indicate source of it. Please follow the following procedure for references

Reference Books: Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3 rd ed., Oxford University Press, UK, 1996, pp. 110 112.

Papers from Journal or Transactions:

1. Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, ASHRAE Trans, 1991, 97 (1), pp. 90 98.
2. Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, Int. Journal of Refrigeration, 1996, 19 (8), pp.497 505.

Papers from Conference Proceedings:

1. Colbourne, D. and Ritter, T. J., Quantitative assessment of flammable refrigerants in room air conditioners, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 40.

Reports, Handbooks etc.

1. United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

Patent: Patent no, Country (in parenthesis), date of application, title, year.

Web-links: www.(Site) [Give full length URL]

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054 **Course Name : Audit Course I :- Fire & Safety Technology**

Teaching Scheme:	**Credits**	**Examination Scheme:** Audit (P/F) Written and MCQ
PR:	**Th/Tut:--**	**TH In-Sem: --**
		End-Sem: --
Tut:	**TW:**	**PR: --**
		OR: --

Description:

To generate, develop and sustain a voluntary movement on Fire & Safety Engineering at the National Level aimed at educating and influencing society to adopt appropriate policies, practices and procedures that prevent and mitigate human suffering and economic loss arising from all types of accidents.

Course Objective:

On completion of this Basic Fire Safety Course, participants will be able to:-

- Describe the chemistry of fire
- Identify fire hazards in the workplace
- Follow evacuation procedures
- Select and use appropriate firefighting equipment

Course Outcome:

• **Students will be able**

1. To create and sustain a community of learning in which students acquire knowledge in fire, safety and hazard management and learn to apply it professionally with due consideration for ethical, human life & property safety issues.
2. To pursue research and development in fire safety engineering, hazard management and disseminate its findings.
3. To meet the challenges of today and tomorrow in the most effective, efficient and contemporary educational manner.
4. To help in building national capabilities in fire safety engineering, disaster management, hazard management, industrial safety education through practical training to ensure a fire safe nation.

Course Contents:

1. **Fire & Safety Overview**

   Fire & safety legislation, Safety Personnel Supplier for construction sites/commissioning of plants. Understanding the physics and chemistry of fire. Development and spread of fire. Action in the event of fire

2. **Fire Fighting Techniques**

   Means of raising alarm, means of summoning the fire brigade, action on hearing the fire alarm Evacuation procedures Practical demonstration in the use of foam and CO_2 fire extinguishers using our state of the art gas fired training system.

3. **Fundamentals of Fire Engineering Science**

Fire Tech & Design, Fire Risk Assessment, Fire Control Technology, Fire Fighting Drills, Fire Tender with Crew on Hire. Fire & Safety Audit. Fire & Safety Consultancy Services.

4. **Industrial Aspects of Fire & Safety**

   Industrial Training on Fire & Safety and Disaster Management. Repair of all kinds of Fire Equipment including Flooding System. Repair of Fire Tender including Pump and power take-off systems.

5. **Maintenance of Fire Safety Equipments**

   AMC of Fire System. Refilling of Fire Extinguishers. Ultrasonic Thickness Test of Extinguishers, Vessels and Pipe lines. Hydro Testing of Fire Extinguishers, Vessels and Pipe Lines. Supply of Fire & Safety Equipment and Spares.

Case Study & Group Work:

- Identification of fire & safety technology
- To study the Fire Fighting Properties of Foam Concentrate
- Case Studies of Salvage operations in different types of occupancy
- Design and drawing of parts contained in the syllabus
- Compilation of Results & Presentation
- Case Study on the projects (products or processes) carried out by your institution or an organization in your vicinity, for safety.

Books:

References:

1. Accident Prevention manual for Industrial Operations, NSC, Chicago 1982.
2. The manual of fire ship – 6 – A by HMSO
3. Electricity Fire Risks – G.S. Hodges
4. Fire Pumps and Hydraulics: I.E. Ditts and T. M. Harris.
5. Fire Service Manual (Volume 2) Fire Service Operations – Petrochemical Incidents
6. The Principles and Practice of Fire Salvage Operation by Fire Salvage association.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054 **Course Name : Audit Course II - Entrepreneurship Development**

Teaching Scheme:	**Credits**	**Examination Scheme:** Audit (P/F) Written and MCQ
PR:	**Th/Tut:--**	**TH** **In-Sem:** -- **End-Sem:** --
Tut:	**TW:**	**PR:** -- **OR:** --

Description:

EDP is a program meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

This course will help in developing the awareness and interest in entrepreneurship and create employment for others. Students get familiar with the characteristics and motivation of successful entrepreneurs. Students learn how to identify and refine market opportunities, how to secure financing, how to develop and evaluate business plans and manage strategic partnerships. Students learn various concepts including the basics of management, leadership, motivation, decision-making, conflict management, human resource development, marketing and sustaining an organization. Students also get basic knowledge of accounting practices and finance. The core course in Entrepreneurship Development & Management equips students with skills and knowledge required to start and sustain their own business.

Course Objective: • To impart basis managerial knowledge and understanding; • Develop and strengthen entrepreneurial quality, i.e., motivation or need for achievement. • To analyze environmental set up relating to small industry and promoting it. • Collect and use the information to prepare project report for business venture. • Understand the process and procedure involved in setting up small units. • Develop awareness about enterprise management.
Course Outcome: **The students will be able to** • Appreciate the concept of Entrepreneurship • Identify entrepreneurship opportunity. • Develop winning business plans

Course Contents:

Entrepreneurship- Definition; Growth of small scale industries in developing countries and their positions large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries Government policy for small scale industry; stages in starting a small scale industry, requirements to be an entrepreneur, SWOT Analysis.

Projects: Identification and Selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Market Assessment and Product feasibility

Marketing -Concept and Importance Market Identification,

Customer needs assessment, Market Survey Product feasibility analysis

Business Finance & Accounts

Business Finance: Costing basics, Sources of Finance, Break Even Analysis,

Business Accounts: Preparation of balance sheets and assessment of economic viability, decision, making, expected costs, planning and production control, quality control, marketing, Book Keeping, Financial Statements, Financial Ratios and its importance, Concept of Audit.

Project Planning and control:

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.

Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations, E-Commerce: Concept and process, government policies for small scale enterprises.

Case Study & Group Work:

- Assess yourself-are you an entrepreneur?
- Prepare a Project Report for starting a small scale business.
- An Interview with an Entrepreneur.

Books:
References: 1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi 2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd. 3. Khanka, S. S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi 4. Badhai, B 'Entrepreneurship for Engineers', Dhanpat Rai & co. (p) Ltd. 5. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002. 6. Gupta and Srinivasan, 'Entrepreneurial Development', S. Chand & Sons, New Delhi.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054 **Course Name : Audit Course III - Intellectual Property Right**

Teaching Scheme:	**Credits**	**Examination Scheme:** Audit (P/F) Written and MCQ
PR:	**Th/Tut:--**	**TH** **In-Sem:** -- **End-Sem:** --
Tut:	**TW:**	**PR:** -- **OR:** --

Objective:

Intellectual property refers to the rights which are attached to the creation of the mind and which take the form of a property. Though intangible in nature, intellectual property has become the driving force of many companies today. Fortune 500+ companies undoubtedly are the best examples of what a company can achieve through the proper understanding and management of IPR.

Thus the study of intellectual property rights is inevitable for managers, considering the fact that India is fast emerging as an economy with considerable investment in cutting-edge research and development. India is also emerging as an economy where foreign companies propose to invest considerably, both technically and financially, provided proper protection is guaranteed to their intangible assets which form the cornerstone of their business.

Topics:

1. Introduction
    - Concepts of IPR
    - The history behind development of IPR
    - Necessity of IPR and steps to create awareness of IPR

2. IP Management
    - Concept of IP Management
    - Intellectual Property and Marketing
    - IP asset valuation

3. Patent Law
    - Introduction to Patents
    - Procedure for obtaining a Patent
    - Licensing and Assignment of Patents
      Software Licensing
      General public Licensing
      Compulsory Licensing
    - Infringement of Patents
    - Software patent US and Indian scenario

4. Copyrights
    - Concept of Copyright Right
    - Assignment of Copyrights
    - Registration procedure of Copyrights
    - Infringement (piracy) of Copyrights and Remedies
    - Copyrights over software and hardware

5. Designs
    - Concept of Industrial Designs
    - Registration of Designs
    - Piracy of registered designs and remedies

6. Trademark Law
    - Concept of trademarks
    - Importance of brands and the generation of “goodwill”
    - Trademark registration procedure
    - Infringement of trademarks and Remedies available
    - Assignment and Licensing of Trademarks

Case Study & Group Work:

• Identify the projects (products or processes) carried out by your institution or an organization in your vicinity, which have been patented.

• A case study on significance of patents for a developing nation like India.

• Group discussion on creative / novel ideas and the feasibility of converting the idea into product or process.

• Discussion on Correlation between IPR and Entrepreneurship in the backdrop of Make in India Initiative.

References:

1. Ganguli Prabuddha, 'Intellectual Property Rights: Unleashing the knowledge economy', Tata McGraw Hill, New Delhi

2. Wadehra R. L., 'Law Relating to patents, trademarks, copyrights, designs and geographical indicators – 2nd', Universal Law Publishing.

3. Narayan P. S. 'Intellectual Property Law in India', Asia Law House Hyderabad.

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054 **Course Name : Audit Course IV - Lean Management**

Teaching Scheme:	**Credits**	**Examination Scheme:** Audit (P/F) Written and MCQ
PR:	**Th/Tut:--**	**TH In-Sem: --** **End-Sem: --**
Tut:	**TW:**	**PR: --** **OR: --**

Course Objective:
- To learn Lean Thinking and its applications
- To get knowledge of Tools & Techniques used in Lean Management
- To understand Business Impact of Lean Management

Course Outcome: Students
- Will be able to do practice Lean Management at the workplace
- Will be able to contribute in Continuous Improvement program of the Organization

Course Contents:

- Brief History of Lean Thinking
- Toyota Production System
- Five Steps to Lean
- Seven Types of MUDA – Waste in Manufacturing
- MURA – Unevenness / Fluctuation
- MURI – Overburden, Physical Strain
- Lean Tools & Techniques
- Value Stream Mapping
- Five 'S'
- Visual Management
- Plan-Do-Check-Act (PDCA)
- Kanban
- Lean Distribution
- Various Lean Management Systems
- Just In Time Production
- Total Quality Management (TQM)
- Total Productive Maintenance (TPM)
- Problem Solving Techniques
- A3 Reporting Technique

Books:
References: 1. Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Second Edition James P. Womack and Daniel T. Jones, Free Press, June 2003, ISBN: 0743249275 2. Learning to See: Value Stream Mapping to Create Value and Eliminate Muda Mike Rother and John Shook, Lean Enterprise Institute, June 2003, ISBN: 0966784308 3.Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Second Edition Pascal Dennis, Productivity Press Inc, September 2007, ISBN: 9781563273568 4. Gemba Kaizen: A Commonsense, Low-Cost Approach to Management Masaaki Imai, McGraw-Hill, March 1997, ISBN: 0070314462 5. World of Kaizen : By Shyam Talawadekar Paperback Publisher: Kaizen Publisher; 4 th edition (2016) ISBN-10: 819326780X ISBN-13: 978-8193267806

Savitribai Phule Pune University, Pune
Third Year of Mechanical, Mechanical Sandwich & Automobile
(2015 Course)

Course Code: 302054	**Course Name : Audit Course V - Smart Manufacturing**	
Teaching Scheme:	**Credits**	**Examination Scheme:** Audit(P/F) Written and MCQ
PR:	**Th/Tut:--**	**TH In-Sem: --** **End-Sem: --**
Tut:	**TW:**	**PR: --** **OR: --**

Description:

Smart Manufacturing is an amalgamation of Information Technology, Cloud Computing & traditional Mechanical, Production Engineering towards achieving excellence in manufacturing. Maximum results with minimum resources being used. The course will introduce the concepts of Smart Manufacturing, how various technologies can be leveraged to achieve minimum breakdowns, First Time Right Production, 100% Delivery on Time with minimum turnaround time. Nine Pillars of Smart Manufacturing will be explained to the Students.

The course will make the students aware of developments in Technology those are going to alter the Traditional Manufacturing scenario. The following topics may be broadly covered in the classroom. The practical will be in the form of Group Discussion based on Case Study.

Course Objective:

- To know more about Smart Manufacturing & Industry 4.0
- To get knowledge of various converging Technologies
- To prepare ourselves for the ever changing Manufacturing Techniques

Course Outcome: The students will be

- Comfortable with terminology and practices in Smart Manufacturing
- Able to face the challenges in Industry & also contribute towards advancement.
- Active part of Industry 4.0 (Fourth Industrial Revolution)

Course Contents:

- Introduction to Industry 4.0
- Historical Background
- Nine Pillars of Smart Manufacturing
- Big Data & analytics
- Autonomous Robots
- Simulation
- Universal System Integration
- IIOT – Industrial Internet of Things
- 3 D Printing – Additive Manufacturing
- Cloud Computing
- Augmented Reality
- Convergence of Nine Pillars
- Business Propositions delivered with Smart Manufacturing
- Adding Smartness to Manufacturing – Adoption & Scaling
- Economic Aspects
- Ecosystem Required for Smart Manufacturing
- Skill set Required for Smart Manufacturing
- Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing

References:

1. Smart Manufacturing by Shoukat Ali; Publisher: LAP LAMBERT Academic Publishing (10 August 2016)Language: EnglishISBN-10: 3659933554ISBN-13: 978-3659933554

2. Industry 4.0: The Industrial Internet of Things 2016by Alasdair Gilchrist (Author)
Publisher: Apress; 1st ed. edition (30 July 2016)
Language: English
ISBN-10: 1484220463
ISBN-13: 978-1484220467

3. Industry 4.0 Data Analytics31 July 2016 by Rajesh Agnihotri and Samuel New
Publisher: CreateSpace Independent Publishing Platform (31 July 2016)
Language: English
ISBN-10: 1534778284
ISBN-13: 978-1534778283

4. 3D Printing: The Next Industrial Revolution4 May 2013by Christopher Barnatt
Publisher: Createspace Independent Publishing Platform (4 May 2013)
Language: English
ISBN-10: 148418176X
ISBN-13: 978-1484181768

5. Augmented Reality: Principles and Practice by Dieter Schmalstieg and Tobias Hollerer
Publisher: Pearson Education; First edition (5 October 2016)
Language: English
ISBN-10: 9332578494
ISBN-13: 978-9332578494

LIST OF EXPERIMENTS / CASE STUDIES

Case Study & Group Work:

- Identification of areas where Smart Manufacturing can flourish
- Business Goals achieved through Smart Manufacturing
- Compilation of Results & Presentation

Savitribai Phule Pune University
S.E. (Civil Engineering) 2015 Course

Semester I												
Course Code	**Course**	**Teaching Scheme Hours / Week**			**Semester Examination Scheme of Marks**						**Credit**	
		Theory (TH)	**Tutorials (TUT)**	**Practical (PR)**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH / TUT**	**PR/OR/ TW**
201001	Building Technology and Materials	04	--	02	50	50	50	--	--	150	04	01
207001	Engineering Mathematics III	04	01	--	50	50	50	--	--	150	05	
201006	Surveying	04	--	02	50	50	--	50	--	150	04	01
201002	Strength of Materials	04	--	02	50	50	--	--	50	150	04	01
201003	Geotechnical Engineering	04	--	02	50	50	--	--	50	150	04	01
	Audit Course 1 Awareness to Civil Engineering Practices	--	--	--	--	--	--	--	--	--	Grade	
Total		**20**	**01**	**08**	**250**	**250**	**100**	**50**	**100**	**750**	**25**	

Note: For audit courses students are given certificate by the institutes based on the assignment submitted by them.

Abbreviations: TW: Term Work, **OR:** Oral, **PP:** Passed (Only for non credit courses), **NP:** Not Passed (Only for non credit courses).

Savitribai Phule Pune University
S.E. (Civil Engineering) 2015 Course

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory (TH)	Tutorials (TUT)	Practical (PR)	In-Sem	End-Sem	TW	PR	OR	Total	TH / TUT	PR/OR/ TW
201004	Fluid Mechanics I	04	--	02	50	50	--	--	50	150	04	01
201005	Architectural Planning and Design of Buildings	04	--	02	50	50	--	50	--	150	04	01
201008	Structural Analysis I	03	01	--	50	50	--	--	--	100	04	--
207009	Engineering Geology	04	--	02	50	50	50	--	--	150	04	01
201007	Concrete Technology	04	--	02	50	50	--	--	50	150	04	01
201010	Soft Skill	--		02	--	--	50	--	--	50	--	01
	Audit Course 2 Road Safety Management	--	--	--	--	--	--	--	--	--	Grade	
		19	**01**	**10**	**250**	**250**	**100**	**50**	**100**	**750**	**25**	

Note: For audit courses students are given certificate by the institutes based on the assignment submitted by them.

Abbreviations: TW: Term Work, **OR:** Oral, **PP:** Passed (Only for non credit courses), **NP:** Not Passed (Only for non credit courses).

Savitribai Phule Pune University, Pune
S.E. (Civil Engineering) 2015 Course

201001: Building Technology and Materials
Credits: 04+01

Teaching Scheme:	**Examination Scheme:**
Theory : 04 hrs/week	**In-Semester (Online) : 50 Marks**
Practical : 02 hrs/week	**End-Semester : 50 Marks**
	Term Work : 50 Marks

Prerequisites: Fundamentals of Basic Civil Engineering and Engineering Graphics.

Course Objectives:

1) To enumerate different types of structure and their requirement as building components.
2) To describe all basic activities of construction from foundation to finishing.
3) To study different types of materials used in construction for civil engineering projects.

Course Outcomes:

On completion of the course, learner will be able to:

1) Identify types of building and basic requirements of building components.
2) Explain types of masonry, formwork, casting procedure and necessity of underpinning and scaffolding.
3) Elucidate different types of flooring and roofing materials.
4) Describe types of doors, windows, arches and lintel.
5) Illuminate means of vertical circulation and protective coatings.
6) Explain different materials especially eco-friendly materials and safety measures to be adopted at any construction site.

Course Contents

Unit I: Introduction to Building Construction and Masonry. (08 Hrs) **a) Introduction to building construction**– definition, types of building as per National Building Code. Building components and their basic requirements i.e substructure and superstructure requirements. Superstructure: Concept and advantages of a framed structure, types: light framed structures, Timber framed, RCC framed structures. Substructure - shallow and deep foundations and their suitability. General procedure in foundation design, Failure of foundation and its causes, Foundation in black cotton soil, Foundations near existing adjacent old structures. Damp Proof Course, plinth filling and soling. **b) Masonry**– Stone masonry: Principal terms, types of stone masonry. Brick masonry: characteristics of good building bricks, IS specification and tests, classification of bricks: silica, refractory, fire and fly ash bricks. Brick work, types of bonds: English, Flemish, Header, Stretcher, construction procedure, supervision.
Unit II: Block Masonry and Form work (08 Hrs) **a) Block Masonry –** Cellular lightweight concrete blocks, hollow blocks, concrete blocks, glass blocks, solid blocks, cavity wall construction. Requirement of a good partition wall: metal partitions, asbestos cement partition, wooden partition. Reinforced brick masonry: applications, advantages, materials required and construction procedure. Composite masonry: types, advantages, applications, materials required and construction procedure. b) Form work and casting procedure for reinforced concrete columns, R.C.C. beams and girders, R.C.C. slabs, curing methods, precast and pre-stressed concrete construction and joints in concrete work. Slip form work: component parts- design criteria, underpinning, Scaffolding: purpose, types and suitability.
Unit III: Flooring and Roofing Materials. (08 Hrs) **a) Flooring and Flooring Materials –** Functional requirement of flooring, types of floor finishes and their suitability, construction details for concrete, tiles and stone flooring. Types of flooring: timber flooring, cement concrete flooring, mosaic flooring, ceramic flooring, terrazzo flooring, tiled flooring, rubber flooring, cork flooring, epoxy asphalt flooring, hollow block and rib floors, Industrial flooring: tremix or Vacuum Dewatered Flooring (VDF). **b) Roofing Materials –** galvanized iron pre-coated aluminum sheets, fiber sheets, and Mangalore tiles. Roof construction: types and their suitability, method of construction, types of trusses, types of shell structure:dome, translation shells, space and frame structure: pneumatic structures, grain storage structures, prefabricated structures, fixing details of roof covering.

Unit IV: Doors, Windows, Arches and Lintels. (08 Hrs)

a) Doors and Windows – definition of technical terms, installation of doors and window frames and their size specifications, fixtures and fastenings. Types of doors: glazed or sash doors, plastic doors, flush doors, louvered doors, collapsible doors, revolving doors, rolling steel doors, sliding doors, swing doors, folding doors. Types of windows: casement window, double hung window, pivoted window, sliding windows, louvered or venetian window, metal window, sash or glazed window, bay window, corner window, dormer window, gable window, skylight window, circular window, mosquito proof window, curtain wall window. Ventilators: purpose and types.

b) Arches and Lintels – principle of arch action, types of arches, method of arch construction, centering and removal of centering. Lintels: necessity and types, chajja or weather shade necessity and types.

Unit V:Vertical Circulation and Protective Coatings (08 Hrs)

a) Vertical Circulation – Consideration in planning, design considerations, Staircase: types, and details of ramps. Ladders, lifts, and escalator. Types of staircase: straight stairs, open well stairs, quarter turn stairs, half turn stairs, turning stairs, dog-legged stairs, circular stairs, geometrical stairs, bifurcated stairs, and spiral stairs.

b) Protective Coatings – plastering types : lime plaster, cement plaster, gypsum plaster used in spray fire proofing, plaster of Paris and application, pointing: purpose & types, mortar preparation and types, painting and varnishing, types and application, white washing, distempering, oil paints. Wall cladding: materials, method, wall papering and glazing work.

Unit VI: Miscellaneous Materials and Safety in Construction (08 Hrs)

a) Miscellaneous Materials – Properties, types and uses of following materials: lime, polymers, plastic types, mastic, gypsum, clay tiles and glazed wares, Timber: types and properties, advantages and applications of aluminum, stainless steel, fibrous, laminated, particulate, combinations of composite materials: laminated fiber reinforced polymers. Glass: uses, types and properties, application and ingredients, market forms, glass claddings, aluminum composite panel cladding. Ceramic products: ceramic sanitary application, water closet, urinals, washes basins, their common sizes, pipes and fittings. Eco-friendly materials: eco-friendly decorating materials, eco-friendly flooring, thatch, bamboo, linoleum, cork.

b) Safety in Construction – safety on site, storage of materials, construction safety, prevention of accidents, fire proof construction. Repairs and maintenance: addition, and alteration, strutting and shoring.

Books:

Text:

1. Building Construction by B.C. Punmia, Laxmi Publications.
2. Building Materials by S.V.Deodhar, Khanna Publication.
3. Building Construction by Bindra and Arora, Dhanpat Rai Publications.
4. Civil Engineering Materials by Neil Jackson & Ravindra K. Dhir, Palgrave Macmillan.

Reference:

1. Building Materials by S. K. Duggal, New Age International Publishers.
2. Civil Engineering Materials by TTTI Chandigrah, Tata McGraw Hill Publications.
3. Materials of construction by D.N Ghose, Tata McGraw Hill.
4. Building Construction by S.C. Rangwala, Charotdar Publications.
5. National Building Code of India 2005.
6. The construction of buildings; seventh edition, Vol.1 & Vol.2 by R. Barry, Oxford: Blackwell Science.
7. Building Materials Technology by Ruth T. Brantley & L. Reed Brantley, Tata McGraw Hill.
8. Properties of Concrete by A. M. Neville, Pearson Education Limited.
9. Mitchell's Advanced Building Construction: The Structure by J. Stroud Foster

e-Resources:

1. http://nptel.ac.in/syllabus/105102088/
2. http://www.theconstructioncivil.org/types-of-brick-bonds
3. http://theconstructor.org/building/types-of-partition-walls/3754
4. https://www.osha.gov/Publications/OSHA3252/3252.html
5. http://www.engineerwing.com/2012/10/tremix-flooring.html
6. http://nptel.ac.in/courses/Webcourse.../Composite%20Materials/.../LNm1.pdf
7. https://en.wikipedia.org/wiki/Fibre-reinforced_plastic.
8. https://cdn.intechopen.com/pdfs-wm/41941.pdf.
9. http://home.iitk.ac.in/~mohite/Composite_introduction.pdf
10. http://www.vdfflooring.in/faqs.html.
11. http://theconstructor.org/building/buildings/eco-friendly-building-materials/720.
12. http://nptel.ac.in/courses/105103093/21.

List of Laboratory Assignments

It shall consist of the following exercises and seminar.

A) Measurement drawing exercise of an existing residential building (G+1)

Draw a detailed plan, elevation and section using suitable scale on same sheet.

Following sketches pertaining to the above plan (with Standard Dimensions).

a. Door- Panelled door

b. Window

c. Stair.

B) Students should prepare working drawing of Foundation Plan (on tracing paper) for the above Residential Building Plan. It should contain detailed foundation plan with foundation details. (Use suitable scale 1:50 or 1:100).

C) Draw sketches using computer software of the following:

1. Details of the shallow footings.
2. Details of arch showing different components

D) Two site visits and technical report on the visit.

1. Site visit based on existing residential building (G+1) as noted in part A above.
2. Any on-going Construction Site (visit report should contain: details of the project, stage of construction, sketches of components with cross section & dimensions, materials used and site plan, etc.)

E) 1. Collection of advertisements of modern construction materials and tools used in construction.

2. Visit to a construction related exhibition.

Term work: Based on above syllabus.

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

207001: Engineering Mathematics III

Credits: 04+01

Teaching Scheme:	Examination Scheme:
Theory : 04 hrs/week	In-Semester (Online) : 50 Marks
Tutorials : 02 hrs/week	End-Semester : 50 Marks
	Term Work : 50 Marks

Prerequisites : Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of central tendency and dispersion, Vector algebra.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1) Ordinary and Partial differential equations applied to structural analysis and fluid dynamics in civil engineering.
2) Numerical methods for analyzing problems in hydraulics, geotechnics and structures in civil engineering.
3) Statistical methods such as correlation, regression analysis and probability theory for experimental data to quantify risk and safety in their designs.
4) Vector differentiation and integration applied to problems in fluid mechanics.

Course Outcomes:

On completion of the course, learner will be able to

1) Solve higher order linear differential equations and apply to civil engineering problems such as bending of beams and whirling of shafts.
2) Solve system of linear equations using direct and iterative numerical techniques and develop solutions to ordinary differential equations using single step and multistep methods applied to structural systems.
3) Apply statistical methods like correlation, regression analysis in analyzing and interpreting experimental data and probability theory applied to construction management.
4) Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.
5) Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents

Unit I: Linear Differential Equations (LDE) and Applications (09 Hrs)

LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's Differential Equations, Simultaneous & Symmetric simultaneous Differential Equations. Modeling of problems on bending of beams, whirling of shafts and mass spring systems.

Unit II: Numerical Methods (09 Hrs)

Numerical solutions of (i) System of linear equations by Gauss elimination method, Cholesky and Gauss-Seidel methods (ii) Ordinary differential equations by Euler's, Modified Euler's, Runge-Kutta 4^{th} order and Predictor-Corrector methods.

Unit III: Statistics and Probability (09 Hrs)

Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.
Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergometric, Test of hypothesis: Chi-square test.

Unit IV: Vector Differential Calculus (09 Hrs)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09 Hrs)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) (09Hrs)

Basic concepts, modeling of Vibrating String, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Applications of PDE to problems of Civil and allied Engineering.

Books:

Text:

1. Advanced Engineering Mathematics, Ninth edition, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, seventh edition, by Peter V. O'Neil (Cengage Learning).

Reference:

1. Advanced Engineering Mathematics, second edition, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, second edition, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Term work: Based on above syllabus.

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

201006: Surveying

Credits: 04+01

Teaching Scheme:		**Examination Scheme :**	
Theory :	**04 hrs/week**	**In-Semester (Online)**	**: 50 Marks**
Practical :	**02 hrs/week**	**End-Semester**	**: 50 Marks**
		Practical	**: 50 Marks**

Prerequisites: Fundamentals of Basic Civil Engineering and Engineering Mathematics.

Course Objectives:

1) To learn the basics of plane surveying and different types of instruments used for plane surveying.
2) To learn different methods of surveying.
3) To understand advancements in plane surveying such as electronic instruments and softwares.

Course Outcomes:

On completion of the course, learner will be able to

1) Operate and use surveying equipment.
2) Draw plan or map of the existing permanent features on the ground.
3) Classify the ground features from the map or plan.
4) Analyze temporary adjustments and check permanent adjustments of the Theodolite.

Course Contents

Unit I: Compass and Plane Table Surveying. (08 Hrs)

a) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Concept of bearing, meridian and their types, construction and use of prismatic compass, local attraction and correction for local attraction, dip, declination and calculation of true bearings.

b) Equipment required for plane table surveying and their uses, advantages and disadvantages, methods of plane table survey: Radiation, intersection, traversing.

Unit II: Levelling and Contouring. (08 Hrs)

a) Introduction to leveling, Types of leveling, Types of bench marks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principle axes of dumpy level, testing and permanent adjustments, reciprocal leveling, curvature and refraction corrections, distance to the visible horizon.

b) Contouring – direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications.

Unit III: Theodolite Surveying. (08 Hrs)

a) Study of vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

b) Theodolite traversing – computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

Unit IV: Tacheometry& Electronic Measurement Techniques. (08 Hrs)

a) Tacheometry – application and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring.

b) Surveying using total station – Study and use of Electronic Tacheometer (Total station) types, functions (remote elevation measurements, remote distance measurements, area measurement).

Unit V: Curves. (08 Hrs)

Introduction to horizontal and vertical curves (no numerical and derivations to be asked on vertical curves and reverse curves), different types and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), Transition curves: necessity and types.

Unit VI: Construction Survey & Space Based Positioning System (SBPS) (08 Hrs)

a) Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals).

b) Introduction to SBPS, SBPS systems - GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

Books:

Text:

1. Surveying and Levelling Vol. I and Vol. II by T. P. Kanetkar and S.V.Kulkarni , Pune Vidyarthi Griha Prakashan.
2. Surveying and Levelling by Subramanian, Oxford University Press.
3. Surveying, Vol. I & II by Dr. B. C. Punmia, Ashok K. Jain, ArunK.Jain , Laxmi Publications.
4. Textbook of Surveying by C. Venkatramaiah , University Press.
5. Surveying for Engineers by John Uren & Bill Price, Palgrave Macmillan.
6. Surveying, Vol. I & II by S. K. Duggal, TataMc-Graw Hill.

Reference:

1. Plane Surveying by A. M. Chandra, New Age International Publishers.
2. Surveying and Levelling by N. N. Basak , Tata McGraw Hill.
3. Surveying Vol. I & II by Dr. K. R. Arora , Standard Book House.
4. Surveying: Theory and Practice by James M. Anderson, Edward M. Mikhail, Tata McGraw Hill.
5. Surveying theory and practices by Devis R. E., Foot F. S.
6. Plane and Geodetic surveying for Engineers. Vol. I by David Clark, Constable.
7. Principles of Surveying. Vol. I by J. G. Olliver, J. Clendinning - Van Nostrand Reinhold.

Codes:

1. IRC: SP: 19 -Manual for Survey, Investigation and Preparation of Road Projects
2. IRC: SP: 35 - Guidelines for Inspection and Maintenance of Bridges
3. IRC: SP: 54 - Project Preparation Manual for Bridges
4. IRC: SP: 42 - Guidelines on Road Drainage
5. IRC: SP: 50 - Guidelines on Urban Drainage
6. IRC: 73 - Geometric Design Standards for Rural (Non-Urban) Highways
7. IRC: 86 - Geometric Design Standards for Urban Roads in Plains
8. IRC: 38 - Design Tables for Horizontal Curves for Highways
9. IRC SP: 23 - Vertical Curves for Highways

e-Resources:

1. http://www.bis.org.in/sf/wrd/p_449.pdf
2. http://www.bis.org.in/sf/wrd/WRD10(491).pdf
3. http://www.bis.org.in/sf/wrd/WRD10(491).pdf
4. http://sbq.com.au/member/board-publications/code-of-practice/
5. http://usa.autodesk.com/adsk/servlet/pc/index?id=3091031&siteID=123112
6. http://www.cadacademynoida.com/?page=civileng3
7. http://www.sitetopo.com

List of Laboratory Assignments

Perform any five out of 1 to 7 and All projects are mandatory:

1. Measurement of magnetic bearings of sides of a triangle or polygon, correction for local attraction and calculations of true bearings using prismatic compass.
2. Plane table survey by Intersection method.
3. Finding horizontal and vertical distance using Tacheometer.
4. Simple and differential levelling with at least three change points using digital level.
5. Measurement of horizontal angles (by repetition method) using Vernier Transit Theodolite.
6. Setting out a circular curve by Rankine's method of deflection angles.
7. Setting out a building from a given foundation plan (minimum six co-ordinates).

Project I : Road project using Auto level for a minimum length of 100 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-sections).
Project II: Tachometric contouring project on hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours using software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).
Project III: Traversing using a total station (up to 2 acres area).

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

201002: Strength of Materials

Credits : 04+01

Teaching Scheme:		**Examination Scheme:**	
Theory :	**04 hrs/week**	**In-Semester (Online)**	**: 50 Marks**
Practical :	**02 hrs/week**	**End-Semester**	**: 50 Marks**
		Oral	**: 50 Marks**

Prerequisites : Fundamentals of Physics, Mathematics and Engineering Mechanics.

Course Objectives:

1) To study the different types of stresses due to load, temperature, etc.
2) To learn concept of Shear Force and Bending Moment Diagram for determinate beams.

Course Outcomes:

On completion of the course, learner will be able to

1) Compute different type of stresses in determinate, indeterminate, homogeneous and composite structures.
2) Develop bending and shear stress diagram.
3) Determine the torsional stresses and stresses due to strain energy for different loading conditions.
4) Explain the concept of principal stresses due to combined loading and able to compare the values of analytical and graphical (Mohr's circle) method.
5) Plot loading diagram, Shear Force Diagram (SFD) and Bending Moment Diagram (BMD).
6) Analyze axially and eccentrically loaded column

Course Contents

Unit I: Simple Stresses and Strains. (08 Hrs)

a) Materials used in construction and their nature, Hook's Law, Stress-Strain Diagram for elastic , plastic materials and brittle material, Idealized stress-strain diagram , Concept of axial stresses (compression, tension), strain s(linear, lateral, shear and volumetric), Elastic constants and their relations. Stresses and strains due to change in temperature.

b) Stresses, strains and deformations in determinate and indeterminate structures for homogeneous and composite structures under concentrated loads and temperature changes.

Unit II: Bending and Shear Stresses. (08 Hrs) a) Concept and determination of Moment of Inertia for various cross-sections. Stress due to bending: theory of simple or pure bending, Assumptions, derivation of flexure formula, bending stress distribution diagrams, Moment of Resistance of cross-section. b) Shear stresses in beams: concept of shear, complimentary shear, derivation of shear stress formula, shear stress distribution for various cross sections, maximum and average shear stress for circular and rectangular sections and shear connectors.
Unit III: Torsion and Strain Energy. (08 Hrs) a) Torsion of circular shafts: theory of torsion, assumptions, derivation of torsion formula. Stresses, strains and deformations in determinate and indeterminate shafts of hollow, solid, homogeneous and composite cross-sections subjected to twisting moments. Power transmitted by shafts, twisting moment diagrams b) Strain energy and impact: concept of strain energy, expression of strain energy for axially loaded member under gradual, sudden and impact loads. Strain energy due to self-weight.
Unit IV: Principal Stresses and Strains. (08 Hrs) a) Principal stresses and strains: concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude and orientation of principal stresses and maximum shear stress. b) Combined effect of axial stress, bending moment, shear and torsion. Theories of failure: maximum normal stress, maximum shear stress and maximum strain theory
Unit V: Shear Force and Bending Moment Diagram. (08 Hrs) a) Concept of shear force and bending moment. Relation between shear force, bending moment and intensity of loading. Shear force and bending moment diagrams for cantilevers, simple and compound beams due to concentrated, uniformly distributed, uniformly varying loads and couples in determinate beams. b) Bending moment and loading diagram from given shear force diagram. Shear force and loading diagram from given bending moment diagram
Unit VI: Axially and Eccentrically Loaded Columns. (08 Hrs) a) Axially loaded columns: concept of critical load and buckling, Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions, Rankine's formula, safe load on column and limitations of Euler's formula. b) Direct and bending stresses for eccentrically loaded short column and other structural components such as retaining walls, dams, chimneys, etc. Effect of lateral force and self-weight. Resultant stress diagrams due to axial loads, uni-axial, and bi-axial bending. Concept of core of section for solid and hollow rectangular and circular sections.
Books:

Text:

1. Mechanics of Structures Vol. II by S. B. Junnarkar and Dr. H. J. Shah, Twenty second edition, Charotar Publishing House Pvt Ltd.
2. Strength of Materials by D. Ghosh A. K. Datta, New Age International Publishers
3. Strength of Materials by R. Subramanian, Oxford University Press.
4. Strength of Materials by S. S. Ratan, Tata McGraw Hill.
5. Mechanics of solids by R Vaidynathan, P Perumal and S Lingedwari, Scitech Publication (India) Pvt Ltd.

Reference:

1. Elements of Strength of Materials by Timoshenko and Young, East-West Press Ltd.
2. Strength of Materials by F.L. Singer and Andrew Pytel , Harper and Row Publication.
3. Mechanics of Materials by Beer and Johnston, McGraw Hill Publication.
4. Introduction to Mechanics of Solids by E.P. Popov, Prantice Hall Publication.
5. Mechanics of Materials by Gere & Timoshenko, CBC publisher.

List of Laboratory Experiments

Sr. No.	Group A
1	**Metals** 1. Tension test on mild and TMT steel. 2. Shear (Single & Double)test on mild steel. 3. Torsion test on mild steel. 4. Impact (I & C) test on mild steel, aluminum, brass.
	Group B
2	**Timber & Ply wood** 1. Compression test on timber (Parallel & Perpendicular) 2. Bending test on timber and plywood.
	Group C
3	**Bricks &Tiles** 1. Field tests, Water absorption and efflorescence test on bricks. 2. Compressive strength test on bricks 3. Flexural strength of flooring tiles. 4. Abrasion test of flooring tiles.

Term Work : Based on above syllabus

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

201003: Geotechnical Engineering

Credits: 04+01

Teaching Scheme:		**Examination Scheme:**	
Theory :	**04 hrs/week**	**In-Semester**	**: 50 Marks**
Practical :	**02 hrs/week**	**End-Semester**	**: 50 Marks**
		Oral	**: 50 Marks**

Prerequisites : Fundamentals of Engineering Mathematics and Engineering Mechanics.

Course Objectives:

1) To describe soil properties, classification and its behavior under stress.
2) To learn methods for measurements and determination of index & properties of soil.
3) To study the interaction between water and soil and the effects of static vs flowing water on soil strength.

Course Outcomes:

On completion of the course, learner will be able to

1) Differentiate the different types of soil and their engineering properties and classify them;
2) Determine the soil properties in laboratory and develop a proficiency in handling experimental data;
3) Understand of the concept of effective stress and its influence on soil behavior.
4) Develop an understanding of the influence of water flow on the engineering behaviour of soils.
5) Analyze engineering properties like compaction, permeability, soil shear strength.
6) Compute the lateral thrust due to backfill on the retaining walls.
7) Classify soil slopes and identify their modes of failure.

Course Contents

Unit I: Introduction and Index Properties. (08 Hrs)

a) Introduction to Geotechnical Engineering and its applications to Civil Engineering, Types of soil structure, major soil deposits of India, Field identification of soils. Introduction to soil exploration: objective and purpose.

b) Three phase soil system, weight – volume relationships, Index properties of soil: Methods of determination and their significance. IS and Unified Soil classification systems.

Unit II: Permeability and Seepage. **(08 Hrs)** a) Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. Laboratory measurement of permeability: Constant head method and Falling head method as per IS 2720. Field test for determination of permeability- Pumping in test and Pumping out test as per IS 5529 Part-I. Permeability of stratified soil deposits.	
b) Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation), Flow Net, properties and application, Flow Net construction for flow under sheet pile and earthen dam.	
Unit III: Compaction and Stress Distribution. **(08 Hrs)** **a) Compaction –** Introduction, Comparison between compaction and consolidation, compaction tests- Standard Proctor test, Modified Proctor test, Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. Field compaction methods and compaction equipment for different types of soil, Placement water content, Field compaction control- use of compaction test result, Proctor needle in field compaction control. **b) Stress Distribution in Soils –** Geostatic stress, Boussinesq's theory with assumptions for point load and circular load (with numerical), Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method, Approximate stress distribution method.	
Unit IV: Shear Strength of Soil. **(08 Hrs)** **a) Introduction –** Shear strength an Engineering Property. Mohr's stress circle, Mohr-Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. Peak and Residual shear strength, factors affecting shear strength. Stress-strain behavior of sands and clays. **b) Measurement of Shear Strength –** Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. Their suitability for different types of soils, advantages and disadvantages. Different drainage conditions for shear tests. Sensitivity and thixotropy of cohesive soils.	
Unit V: Earth Pressure. **(08 Hrs)** **a) Earth Pressure –** Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. Rankine's Theory : Earth pressure on Retaining wall due to submerged backfill. b) Backfill with uniform surcharge, backfill with sloping surface, layered backfill. Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure.	

Unit VI: Stability of Slopes and Introduction to Geo-environmental engineering.(08Hrs)

a) Stability of Slopes – Classification of slopes and their modes of failure, Taylor's stability number, Infinite Slopes in cohesive and cohesion less soil, Landslides- Causes and remedial measures.

b) Introduction to Geo-environmental engineering, subsurface contamination, contaminant transport, effects of subsurface contamination, Control and remediation, Soil- A geochemical trap, detection of polluted zones, Monitoring effectiveness of designed facilities.

Books:

Text:

1. Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Laxmi Publications.
2. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill.
3. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers.
4. Geotechnical Engineering by Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan.

Reference:

1. Geotechnical Engineering by C. Venkatramaiah, New Age International Publishers.
2. Principles of Geotechnical Engineering by Braj M.Das, Cengage Learning.
3. Geotechnical Engineering by P Purushothma Raj , Tata McGraw Hill.
4. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education.
5. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International.
6. Physical and Geotechnical Properties of Soils by Joseph E. Bowles, International Students Edition.

e- Resources:

1. http://ascelibrary.org/page/books/s-gsp.
2. http://accessengineeringlibrary.com/browse/geotechnical-engineers-portable-handbook-second-edition.
3. http://nptel.ac.in/courses/105101084/
4. http://nptel.ac.in/courses/105106142/

List of Laboratory Experiments / Assignments

The term work shall consist of a journal giving details of at least 11 out of 13 of the following experiments. Assignments - Sr. No 14 and 15 are compulsory.

1. Water content determination by any two methods a) Oven drying method, b) Infrared moisture method, c) calcium carbide method
2. Specific gravity determination by Pycnometer /density bottle.
3. Sieve analysis, particle size determination and IS classification as per I.S. Codes.
4. Determination of Consistency limits and their use in soil classification as per I.S. Codes.
5. Field density test by a) Core cutter b) Sand Replacement and c) Clod method
6. Determination of coefficient of permeability by a) Constant head and b) Variable head method.
7. Direct shear test.
8. Unconfined compression test.
9. Vane Shear test.
10. Standard Proctor test / Modified Proctor test.
11. Differential free swell test.
12. Triaxial test
13. Swelling Pressure test
14. Collection of sample soil investigation report for any construction project and write report about interpretation of index properties of soil.
15. Assignments on the following topics:
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.
    c) Flow net construction for sheet pile or earthen dam.

Note: Performance based oral examination on the above Term Work.

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

Awareness to Civil Engineering Practices

Audit Course

(Certificate to be issued by institute based on performance assessment)

Civil Engineering is the oldest engineering profession comprising of a variety of sub-disciplines such as structural engineering, geotechnical, water resources, environmental engineering, construction, transportation etc. Undergraduate programmes are designed with different theoretical approaches on the application of basic sciences to solve different societal problems by engineering knowledge. However, there is a need to make the students aware about how the Civil Engineering industry operates and how theories taught in different courses are applied in practice. The students can learn from the experience gained from different workplaces such civil engineering consultancies, contracting companies, construction sites etc. The course aims to provide insight of the different practices followed by the industry such use of different contracts in civil engineering practice, local by-laws, duties and responsibilities of the Engineers, site records and diaries, Health and Safety practices on site, etc.

Course Objectives:

1) To provide basic overview of functioning of different civil engineering related industries / firms.
2) To provide awareness on application of different drawings, contract documents in civil engineering.
3) To provide insight of code of ethics, duties and responsibilities as a Civil Engineer.

Course Outcomes:

On completion of the course, learner will be able to understand

1) Different types of civil engineering industries and their functioning.
2) Applications of different documents, drawings, regulations in Civil Engineering industries.
3) Code of ethics to be practiced by a Civil Engineer and understand duties and responsibilities as a Civil Engineer
4) Different safety practices on the site.

Course Contents

1. Awareness lectures by professionals.
2. Visit to construction site/ architectural firms/ structural engineering firms etc.
3. Discuss on issues such as sustainability, eco-friendly techniques, use of locally available materials etc. directly related to techno economic development of society.

Guidelines for assessment

1. Presentation
2. Visit report
3. Group discussion

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

201004: Fluid Mechanics-I

Credits: 04+01

Teaching Scheme:		Examination Scheme :	
Theory	: 04 hrs/week	In-Semester (Online)	: 50 Marks
Practical	: 02 hrs/week	End-Semester	: 50 Marks
		Oral	: 50 Marks

Prerequisites : Fundamentals of Engineering Mechanics, Engineering Mathematics and Engineering Physics.

Course Objectives:

1) To study basics of Fluid Mechanics, Fluid properties and concept of submerged & floating structure in a static fluid.
2) To make use of principles of continuity, momentum, and energy as applied to fluid motions.
3) To apply fundamental principles of fluid mechanics for the solution of practical civil engineering problems.

Course Outcomes:

On completion of the course, learners will be able to:

1) Use fluid properties, dimensional analysis for solving problems of fluid flow.
2) Solve fluid statics problems.
3) Measure fluid pressure.
4) Calibrate discharge measuring instrument like ventrurimeter, orifice meter.
5) Distinguish between various types of fluid flows and find the fluid velocity using principles of Kinematics and Dynamics.
6) Design pipes to carry particular amount of discharge.

Course Contents

UNIT I: Properties of Fluids & Dimensional Analysis (08 Hrs) a) Definition of fluid and fluid mechanics: examples and practical applications involving fluids at rest and in motion, physical properties of fluids: density, specific weight, specific volume, relative density and viscosity. Newton's law of viscosity, classification of fluids, rheological diagram, Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure, problems involving use of above fluid properties. b) Dimensions of physical quantities, dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric kinematic and dynamic similarity, important dimensionless parameters (Reynolds No., Froude No., Euler No., Mach no. and Weber No) and their significance , Model Laws (Froude's Law and Reynold's law)	
UNIT II: Fluid Statics, Buoyancy (08 Hrs) a) The basic equation of hydrostatics, concept of pressure head, measurement of pressure (absolute, gauge), application of the basic equation of hydrostatics, Pressure measuring devices (simple manometers, differential manometers: U tube, inclined, Mechanical gauges and precision manometers, pressure transducers and their types), Centre of pressure, total pressure on plane and curved surfaces, practical applications. b) Principle of floatation and buoyancy, equilibrium of floating and submerged bodies, stability of floating and submerged bodies. Metacentre and metacentric height and its determination (experimental & analytical methods).	
UNIT III: Fluid Kinematics (08 Hrs) a) Methods of describing the motion of fluid, velocity and acceleration, and their components in Cartesian co-ordinates, stream line, stream tube, path line, and streak line, control volume. Classification of flow: steady and unsteady; uniform and non-uniform; laminar and turbulent; One, two, and three-dimensional flows; compressible and incompressible; rotational and irrotational; critical, sub critical and supercritical flows. b) Equation of continuity for three dimensional flow in Cartesian co-ordinates, equation of continuity for one-dimensional flow along a streamline, types of motion, rotational and irrotational motion, velocity potential, stream function and flow net, methods of drawing flow net (graphical and electrical analogy), uses and limitations of flow net.	
UNIT IV: Fluid dynamics, Bernoulli's equation (08 Hrs) a) Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration, assumptions of Bernoulli's equation, Modified Bernoulli's equation, its applications and limitations, Hydraulic grade line and total energy line. Linear momentum equation and kinetic energy correction factor, momentum correction factor (Only information). b) Venturimeter, Orifice and orifice meter, Rotameter, Flow through sharp edged circular orifice discharging free, Hydraulic coefficients for orifice, Pitot tube.	

UNIT V: Laminar flow & boundary layer theory (08 Hrs)

a) Reynolds experiment, laminar flow through a circular pipe, flow between two fixed parallel plates: Couette flow (only introduction), methods of measurement of viscosity (Newton's Law of Viscosity: Rotating cylinder viscometer:, Stokes' law: Falling sphere viscometer, Hagen Poiseuille Equation : Redwood Viscometer), Darcy's law, Transition from laminar to turbulent flow.

b) Concept of boundary layer, development of boundary layer on a flat plate, nominal, displacement, momentum, energy thicknesses, laminar, transitional and turbulent boundary layer, laminar sub layer, Local and mean drag coefficients, hydrodynamically smooth and rough boundaries. Boundary Layer separation and its control.

Unit VI : Turbulent flow & Flow through Pipes (08 Hrs)

a) Characteristics of flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory.

b) Flow through pipes: energy losses in pipe flow (major losses and minor losses), Darcy Weisbach Equation, variation of friction factor for laminar flow and for turbulent flow, Nikuradse's experiments on artificially roughened pipes, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram, flow through pipes such as simple, compound, series parallel, Dupits equations, branched pipes, Three reservoir and pipe net work analysis: only theory, flow through siphon.

Books:

Text:

1. Hydraulics & Fluid Mechanics by Dr. P. N. Modi and Dr. S. M. Seth, Standard Book House.
2. Fluid Mechanics and Hydraulic Machines by McGraw Hill Education (India).

Reference:

1. Fluid Mechanics by Yunus Cengel, Jhon Cimbala, Tata Macgraw Hill,New Delhi.
2. Fluid Mechanics by R. J. Garde, A.J Mirajgaonkar, SCITECH Publication.
3. Fluid Mechanics by Streeter & Wylie, Tata McGraw Hill.
4. Fluid Mechanics by Dr. A. K. Jain, Khanna Publishers.
5. Fluid Mechanics by K. Subramanya, McGraw Hill.
6. Fluid Mechanics by Frank White, McGraw Hill.
7. Fluid Mechanics and Fluid Machinery by R. K. Bansal, Laxmi Publications.

Hand books:

1. http://www.engmatl.com/home/viewdownload/10-engineering-handbooks-pocket-books/123- fluid-mechanics-handbook
2. http://www.springer.com/materials/mechanics/book/978-3-540-25141-5.

e-Resourses:

1. http://nptel.iitm.ac.in/courses.php
2. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/FLUID MECHANICS /ui/ Course_home-3.htm

List of Laboratory Experiments / Assignments

The term work shall consist of a journal giving details of a minimum 8 out of the following experiments. **First Six experiments are compulsory.**

1. Measurement of viscosity by Redwood viscometer.
2. Measurement of pressures using different pressure measuring devices (including transducers /state of arts digital instruments also).
3. Determination of stability of floating bodies using ship models.
4. Experimental verification of Bernoulli's theorem with reference to loss of energy
5. Calibration of Venturimeter / Orifice meter.
6. Drawing flow net by electrical analogy for flow below weir (with & without sheet pile)
7. Plotting the pattern of laminar flow using Reynolds apparatus or Heleshaw's apparatus.
8. Transition of Laminar and turbulent flow through pipes.
9. Determination of, minor loss in a pipe system/friction factor for a given pipe.
10. Measurement of surface tension.
11. Demonstration of fluid flow through appropriate VCD/Audio visual / PPT's.

Assignments: any two of the following

1. Solve three reservoir problem / pipe network analysis using Excel or any programming language.
2. Determination of friction factor for a pipe using any programming language.
3. Application of any fluid mechanics software to analyze the problem.
4. Developing a demo model related to any fluid flow phenomenon (physical model/ soft model).
5. Assignment on drawing of flow net graphically.

Note: Performance based oral examination on the above Term Work.

Savitribai Phule Pune University, Pune
S.E. (Civil Engineering) 2015 Course

201005: Architectural Planning and Design of Buildings
Credits: 04+01

Teaching Scheme:	**Examination Scheme:**
Theory : 04 hrs/week	**In-Semester (Online) : 50 Marks**
Practical : 02 hrs/week	**End-Semester : 50 Marks**
	Practical : 50 Marks

Prerequisites : Basic Civil Engineering, Building Technology and Materials, National Building Code-2005, Developing Control Rules and Green building concepts.

Course Objectives:

1) To understand necessity of Town planning, principles of planning, principles of architecture and byelaws.
2) To study the planning for building services such as noise and acoustics, ventilation, lighting, plumbing work and safety practices.
3) To develop the plan, elevation and section of load bearing and framed structures.

Course Outcomes:

On completion of the course, learner will be able to:

1) Make use of principles of planning and principles of architectural Planning.
2) Analyze the available primary or secondary data and plan different types of structures considering futuristic need of an area.
3) Improve the status of existing structures by proposing appropriate green measures.
4) Plan effectively various types of buildings according to their utility with reference to different codes.
5) Understand and resolve contemporary issues at multi-dimensional functional levels.

Course Contents

Unit I: Town planning and legal aspects. (08 Hrs)

a) Town Planning : Necessity and evolution of town planning in India. Development plan and its importance, Objectives and Contents of DP, Land use zoning, Introduction to different zones of land in town planning, Requirements of various zones, Height zoning and Density zoning.

b) Legal Aspects : Role of Plan sanctioning authority, 7/12 abstract, meaning of different terms of 7/12 abstract, Form 6 and its types, Concept of TDR, List of documents to be submitted to local authority, Procedure for seeking Commencement and Occupancy Certificate, Various NOCs required.

Unit II: Architectural Planning , Building bye laws and introduction to Green Buildings (08 Hrs)

a) Principles of Architectural design relation between form and function, utility, aesthetics. Necessity of bye-laws, plot sizes, road width, open spaces, floor area ratio (F.A.R.), concept of V.P.R. Marginal distances, building line : control line, height regulations, room sizes, Area calculations (built-up area, carpet area etc.), Rules for ventilation, lighting, Vertical circulation, Sanitation and Parking of vehicles.

b) Green buildings: salient features, benefits, planning concepts (site selection, orientation, sun path and wind diagram etc.), Rating systems (LEED, GRIHA etc.)

Unit III: Architectural Drawing and Safety Aspects (08 Hrs)

a) Introduction to Architectural drawing : i) Line plan, ii) Developed Plan, iii) Elevation, iv) Section, Selection of scales for various drawings, dimensioning, abbreviations and conventions as per IS 962, Elements of perspective drawings, parallel and angular perspective of small building elements.

b) Safety Aspects: Fire load, grading of occupancies by fire loads, Evacuation Time, fire escape elements, Need for earthquake resistant structures, planning considerations, disaster management.

Unit IV: Building Services (08 Hrs)

a) Noise and Acoustics – Sound insulation, Acoustical defects, Reverberation time, Sabine's formula, sound absorbents, planning for good acoustics.

b) Ventilation – Necessity of Ventilation, Natural ventilation: stack effect and wind effect, Thermal Insulation, Mechanical ventilation and its types, air conditioning systems.

c) Lighting – Principles of day lighting, design of windows, artificial illumination, SC, ERC, IRC, Daylight factor, Solar energy systems for lighting (BIPV).

d) Plumbing – Water storage tanks at ground level and on terrace (capacity), Plumbing systems, various types of traps, Fixtures and Fittings, Rain Water Harvesting etc.

e) Other services – Telecommunication, Electrical, Smart services and Waste management etc.

Unit V: Planning of Residential Buildings (08 Hrs)

a) Functional requirements of Bungalows, Twin bungalows, Row houses, Ownership flats, and Apartments.

b) Developed Plan, Elevation and Sectional Elevation of above mentioned categories.

Unit VI: Planning of Public Buildings **(08 Hrs)**

a) Functional requirements and planning of industrial buildings, commercial buildings, School, Colleges , Hostel, Auditorium, Restaurant/ Hotel building, Primary Health Center/ Hospital, Shopping complex, Sports complex, Vegetable market, Post office, Bank buildings etc .

b) Dimensioned line plans of above public buildings.

Books:

Text:

1. Building Drawings with an integrated Approach to Built-Environment by M. G. Shah, C. M. Kale and S. Y. Patki, New Delhi, Tata McGraw Hill. (5th edition.)
2. Building science and planning by Dr. S. V. Deodhar, Khanna Publishers.
3. Building Services Engineering by David V. Chadderton, sixth edition, London & New York.
4. Drawing for Civil Engineering by Jan A. Van Der Westhuizen

Reference:

1. National Building Code (latest).
2. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
3. Times Saver standards of Architectural Design Data by Callender, Tata McGaw Hill.
4. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings.
5. Development plan and DCP Rules of urban local body, New Delhi, Volume 12.
6. Model building bye laws by MoUD, GoI.

e-Resources :

1. http://www.grihaindia.org/
2. http://new.usgbc.org/
3. http://www.hcd.ca.gov/hpd/green_build.pdf
4. http://ncict.net/Examples/Examples1.aspx
5. http://www.igbc.in/site/igbc

List of Laboratory Assignments

Students shall prepare working drawings of any type of building from the list given in Unit V or Unit VI (**Individual project to be planned and manually drafted to suitable scale*):***

1. Layout/ Site plan indicating water supply and drainage line (with area statement).
2. Floor Plan/ Typical floor plan (with construction notes, schedule of openings).
3. Elevation and Sectional Elevation (preferably to be drawn on same sheet).
4. Developing measurement drawing exercise done in BTM course using CAD and Printout of the same.
5. Perspective drawing of a small building element.
6. Report file: It shall consist of data given for the project, Planning considerations and line plans, Design calculations.

Practical examination will be based on above syllabus and exercises mentioned in the list.
It will consist of :

i) Planning exercise on development of line plan or drawing the line plan using suitable Software or manual drafting.

ii) Exercise on D.C. Rules / numerical thereon or perspective drawing.

Assessment criteria: Line work, Planning/ designing abilities, Presentation and Understanding based on oral examination of relevant exercises.

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

201008: Structural Analysis I

Credits : 04

Teaching Scheme:	**Examination Scheme :**
Theory : 03 hrs/week	**In-Semester (Online) : 50 Marks**
Tutorial : 01 hrs/week	**End-Semester : 50 Marks**

Prerequisites : Fundamentals of Physics, Mathematics, Engineering Mechanics and Strength of Materials.

Course Objectives:

1) To understand the basics configuration and classification of structures.
2) To analyze the determinate and indeterminate structures.

Course Outcomes:

On completion of the course, learner will be able to:

1) Understand the basic concept of static and kinematic indeterminacy, slope and deflection of determinate and indeterminate beams for analysis of structures.
2) Analyze indeterminate beams structures and frames.
3) Evaluate determinate and indeterminate trusses and its application in the field.
4) Apply influence line diagrams for the analysis of structures under moving load.
5) Analyze two and three hinged arches and its application.
6) Apply plastic analysis for indeterminate steel structures by limits state method.

Course Contents

Unit I: Fundamentals of Structure, Slope and Defection (08 Hrs)

a) Types and classification of structures based on structural forms, concept of indeterminacy, static and kinematics degree of indeterminacy.

b) Slope and deflection of determinate beams by Macaulay's method, concept of moment area method and conjugate beam method and its application.

c) Strain energy, Castigliano's first theorem, application to determine slope and deflection of determinate beams and frames.

Unit II: Analysis of Indeterminate Beams and Frames. (08 Hrs)

a) Propped cantilever and fixed beams by strain energy method, analysis of continuous beams by three moment theorem (Clapeyron theorem) up to three unknowns.

b) Castigliano's second theorem, analysis of beams and rectangular portal frames with indeterminacy up to second degrees.

Unit III: Analysis of Pin Jointed Plane Trusses. (08 Hrs)

a) Joint displacement of determinate trusses by Castigliano's first theorem.

b) Analysis of redundant trusses by Castigliano's second theorem, lack of fit, sinking of support, temperature changes (indeterminacy up to second degrees).

Unit IV: Influence Line Diagram. (08 Hrs)

a) Basic concept, Muller: Braslau's principle, influence line diagram for reaction, shear and moment to simply supported and overhanging beams, application of influence line diagram to determine reaction, shear and moment in beams.

b) Influence line diagram for axial force in trusses, application of influence line diagram to determine of axial forces in the members of plane determinate trusses under dead load and live load.

Unit V: Analysis of Arches (08 Hrs)

a) Three hinged arches – Concepts, types of arches, analysis of parabolic arch with supports at same and different levels, semicircular arches with support at same level, determination of horizontal thrust, radial shear and normal thrust for parabolic and circular arch.(04 hours)

b) Two hinged arches – analysis of parabolic and semicircular arches with supports at same level, determination of horizontal thrust, radial shear and normal thrust.

Unit VI: Plastic Analysis of Structure. (08 Hrs)

a) True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, statical and kinematical method of analysis, upper, lower bound and uniqueness theorem.

b) Plastic analysis of determinate and indeterminate beams, single bay single storied portal frame

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Books:

Text:

1. Structural Analysis: A matrix approach by G.S. Pandit and S. P. Gupta, Tata Mc Graw Hill.
2. Analysis Structures: Strength and behavior by T. S. Thandavamoorthy, Oxford University Press.
3. Mechanics of solids and Structures Volume I by R. Vaidynathan, P. Perumal and S Lingedwari, Scitech Publication (India) Pvt Ltd.
4. Structural Analysis Vol-1, third edition, By S S Bhavikatti, Vikas publishing House, PVT, LTD.

Reference:

1. Mechanics of Structures Vol. II by S B Junnarkar and Dr. H J Shah, Twenty second edition, Charotar Publishing House Pvt. Ltd.
2. Basic Structural Analysis by C. S. Reddy, Second Edition, Tata Mc Graw Hill.
3. Structural Analysis by R. C. Hibbler, sixth edition, Pearson Education.
4. Plastic Methods of Structural Analysis by B. G. Neal, Champman and Hall.
5. Elementary Structural Analysis by Senol Utku, Charles Head Norris, John Benson Wilbur, TMH.
6. Intermediate Structural Analysis by C K Wang, Tata McGraw Hill.

Savitribai Phule Pune University, Pune

S.E. (Civil Engineering) 2015 Course

207009: Engineering Geology

Credits: 04+01

Teaching Scheme:		Examination Scheme:	
Theory	: 04 hrs/week	In-Semester (Online)	: 50 Marks
Practical	: 02 hrs/week	End-Semester	: 50 Marks
		Term Work	: 50 Marks

Prerequisites : Fundamentals of Basic Civil Engineering, Building Technology and Materials, Geotechnical Engineering.

Course Objectives:

1. To study basic of engineering geology and introductory part of the earth science.
2. To understand the utility and application of geological principles in various phases of civil engineering activities.
3. To describe the sources, and characterization of common Building materials.
4. To learn the basic aspects occur due to structural features like folds and faults.
5. To explain various natural hazards and their implications on structures and effects on society.

Course Outcomes:

After completing this course students of civil engineering will be able to:

1. Explain the basic concepts of engineering geology.
2. Differentiate between the different rock types, their inherent characteristics and their application in civil engineering.
3. Understand physical properties, mechanical properties of the minerals and their application in civil engineering. .
4. Identify favourable and unfavourable conditions for the buildings, roads, dam, tunneling etc through the rocks.
5. Explain mass wasting processes, effects of mass wasting process on the civil engineering structures and remedial measures.
6. Interpret geohydrological characters of the rocks present at the foundations of the dams, percolation tanks, tunnels.
7. Understand Seismic activities and its effect on the civil engineering construction.
8. Identify geological hazards and presence of ground water.

Course Contents

Unit I: Mineralogy, Petrology and General Geology. (08 Hrs) **a) Introduction to the subject, scope and sub divisions**. **b) Introduction to mineralogy**: Properties of Minerals, Classification of Minerals. **c) Introduction to petrology:** Rock Cycle, broad classification of rocks. **Igneous Petrology:** Plutonic, Hypabyssal and Volcanic rocks, Structure, Texture and Classification of Igneous rocks. Study of common rock types prescribed in practical work and their engineering applications.
Sedimentary Petrology: Rock weathering, Genetic classification of secondary rocks and grain size classification and Textures, Sedimentary Structures, Digenesis Process. Study of common rock types prescribed in practical work and their engineering applications. **Metamorphic Petrology:** Agents, Types of metamorphism, Texture and structures. Study of common rock types prescribed in practical work and their engineering applications.
Unit II: Plate Tectonics and Structural Geology. (08 Hrs) **a) Introduction to plate tectonics and Mountain building activity.** **b) Structural geology:** Out crop, dip and strike, conformable series, unconformity and overlap, faults and their types, folds and their types, inliers and outlier. **c) Structures:** Structural features resulted due to igneous intrusions, concordant and discordant igneous Intrusions, joints and their types, stratification and lamination.
Unit III: Geomorphology and Historical Geology. (08 Hrs) **a) Geomorphology:** Geological action of river, Coastal Geology. **b) Historical geology:** General principles of Stratigraphy, geological time scale, physiographic divisions of India, significance of their structural characters in major civil engineering activities.
Unit IV: Preliminary Geological Studies and Remote Sensing. (08 Hrs) **a) Preliminary geological explorations:** reconnaissance survey, Desk Study, surface and subsurface Geological Investigation: methods, significance and limitations. b) Techniques of correlation for surface and subsurface exploration, engineering significance of geological structures and relevant case studies. **c) Remote sensing (RS):** Elements of remote sensing for Visual interpretation and geographical information system (GIS), application of remote sensing and geographical information system in Civil Engineering.

Unit V: Role of Engineering Geology in Reservoirs, Dams and Tunneling. (08 Hrs) **a) Geology of dams & Reservoir:** Strength, stability and water tightness of foundation rocks, influence of geological conditions on the choice and type of dam, preliminary geological work on dam and reservoir sites, precaution to be taken to counteract unsuitable conditions and their relevant treatments with case studies. **b) Tunneling:** Preliminary geological investigations, important geological considerations while choosing alignment, difficulties during tunneling as encountered due to various geological conditions, role of groundwater, and suitability of common rock types for excavation and tunneling and case studies.
Unit VI: Geological Hazards, Ground Water and Building Stones. (08 Hrs) **a) Geological hazards:** Volcanism, Earthquakes & Seismic zones of India, Landslides and stability of hill slopes and preventive measures **b) Groundwater:** Types of ground water, water table and depth zones, influence of hydrogeological properties of rocks, geological work of groundwater, types of aquifers, fluctuations in water table levels, effects of dams and canals, effect of pumping, cone of depression, circle of influence, conservation of groundwater, artesian wells, its geological conditions, artificial recharge of groundwater.
c) Building stones: Requirements of good building stone: strength, durability, ease of dressing, appearance, mineral composition, textures and field structures, suitability of common rocks as building stone.
Books:
Text: 1. Text Book of Engineering Geology by R.B. Gupte , 2001, P.V.G. Publications, Pune. 2. A Text Book of Engineering Geology by N. Chenna Kesavulu. 2010, Mc Millan India Ltd. 3. Principles of Engineering Geology by S.K.Garg.1999, Khanna Publ, New Delhi. 4. Principles of Engineering Geology by D. Venkat Reddy. 2010, Vikas Publishers. 5. Geology and Engineering by K. V. G. K. Gokhale and D. M. Rao, Tata McGraw-Hill.
Reference: 1. Physical Geology by P. K. Mukarjee, World Press, 2013. 2. Physical Geology by Arthur Holmes, ELBS Publication. 3. Principles of Engineering Geology and Geotechniques by D. P. Krynine & W. R. Judd. CBS Publishers, New Delhi. 4. Engineering Geology by F. G. H Blyth and De Frietus,2006, Reed Elsevier India Ltd.

IS Codes:

Sr. No	No. of the IS code	Title of the IS Code
1	IS 1123:1998	Method of identification of Natural building stone.
2	IS 4078:1967	Code of Practice for Indexing and Storage of drill cores
3	IS 4453: 1967	Code of Practice for exploration by Pits, Trenches, Shafts and Drafts
4	IS 5313: 1969	Guide lines for core drilling observations
5	IS 6926: 1973	Code of Practice for diamond core drilling for site investigations for river valley projects
6	Handbook	PWD Handbook Ch No. 6 Part II: 1980 published By Govt. of Maharashtra
7	IS 7779 (Part II 1,2,3):1979	Schedule of properties and availability of stones for construction purposes
8	IS 13030:1991	Method of test for lab determination of Water Content, Porosity, Density and related properties of rock material
9	IS 9143:1996	Method of determination of Unconfined Compressive Strength of rock material
10	IS 1124: 1998	Method of test for determination of Water absorption, Apparent Sp. Gravity and porosity of natural building stone
11	IS1122: 1998	Method of test for determination of Sp. Gravity of natural building stone
12	IS 2386 Part VIII	Methods of test for Petrographic Examination
13	Code No. 653	An Introduction to Earthquake Hazards: AICTE handbook
14	IRC Sec. 2400	Surface and Subsurface Geotechnical Explorations

List of Laboratory Assignments

Following experiments are to be compulsorily performed. Term work shall consist of journal giving details of the experiments performed.

1. Megascopic identification of following mineral specimens (around 50).
Rock Forming Minerals, Economic Minerals and Ore Minerals such as:
Rock Crystal, Rosy Quartz, Transparant Quartz, Milky Quartz, Smoky Quartz, Amethyst, Chalcedoney, different varieties of Agate, Jasper Banded Hematite Jasper, Orthoclase, Microcline, Plagioclase, Muscovite, Biotite, Olivine , Apophyllite, Stilbite, different varieties of Calcite, Gypsum Tourmaline, Chromite, Limonite, Asbestos, Laterite, Kyanite, Graphite, Haematite, Pyrite, Hornblende, Diopside, Hypersthene, Micaceous Haematite, Garnet,

2. Megascopic identification of following different rock specimens (around 50).

a) **Igneous Petrology: Plutonic, Hypabyssal, Volcanic Rock** Muscovite Granite, Granite porphyry, Hornblende Granite, Syenite, Syenite porphyry, Diorite, Epidiorite, Gabbro, Pegmatite, Picrite, Graphic Granite, Tourmaline Pegmatite, Dolerite, Rhyolite, Andesite, Pumice, Trachyte, Compact Basalt, HT. altered A.B, Giant Phenocryst Basalt (GPB),Amygdaloidal Basalt, Pipe A.B, Volcanic Breccia, Tuff breccia,

b) **Sedimentary Rock: Rudaceous, Areanceous, Argillaceous, Chemical and Organic Deposits:** Laterite, Bauxite, Conglomerate, Secondary Breccia, Sandstone (Red), Sandstone with Ripple marks, Sandstone (White), Sandstone (weathered), Sandstone (Micaceous), Sandstone (Motteled), Sandstone (Current Bedding), Shahabad Limestone, Red Limestone, Black Limestone, Stalactite Limestone, Oolitic limestone, Shelly Limestone, Chert Breccia, Secondary Quartzite, Mudstone, Grit, Arkose sandstone, Shale (White), Shale (Yellow), Shale (Black)

c) **Metamorphic Petrology: Contact Metamorphic rocks, Dynamothermal Metamorphic rocks**: Kyanite Quartzite Marble, Serpentine Marble, Phyllite, Slate, Augen Gneisse, Hornblende Biotite Gneisse, Hornblende Gneisse, Mica Schist, Biotite Schist With Garnet, Muscovite Schist, Chlorite Schist With Magnetite, Hornblende Schist, Chlorite Schist, Talc Schist, Talc Chlorite Schist, Talc Mica Schist, Talc Actinolite Schist, Quartz Sericite, Schist, Graphite Schist, Khondalite, Charnockite, Amphibolite,

3. Interpretation and construction of geological sections from contoured geological maps (Total 8).

4. Solution of engineering geological problems such as alignment of dams, tunnels, roads, canals, bridges, etc. based on geological maps (Total 3). #(From A. G. Series 8 maps and 2 maps constructed by the faculty members)

5. Logging of drill core and interpretation of drilling data with graphical representation of bore log.

6. Two site visits are desirable to study various geological features And their application, covering details from sections I and II.

7. GRAM++ software and ARC GIS software may be optional to perform.

Savitribai Phule Pune University, Pune
S.E. (Civil Engineering) 2015 Course

201007: Concrete Technology
Credits: 04+01

Teaching Scheme:		**Examination Scheme :**	
Theory : 04 hrs/week		**In-Semester (Online)**	**: 50 Marks**
Practical : 02 hrs/week		**End-Semester**	**: 50 Marks**
		Oral	**: 50 Marks**

Prerequisites : Fundamentals of Basic Civil Engineering, Engineering chemistry.

Course Objectives:

1) To know properties of various ingredients of concrete and concept of mix design.
2) To learn the behavior of concrete at its fresh and hardened state.
3) To understand special concrete and their application.
4) To explain deterioration of concrete and study methods of repair.

Course Outcomes:

On completion of the course, learner will be able to:

1) Understand chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2) Prepare and test the fresh concrete
3) Test hardened concrete with destructive and nondestructive testing instruments
4) Get acquainted to concrete handling equipments and different special concrete types.
5) Design concrete mix of desired grade
6) Predict deteriorations in concrete and repair it with appropriate methods and techniques.

Course Contents

Unit I: Introduction to Concrete as a Construction Material: General Perspective Ingredients of Concrete. (08Hrs)

a) Cement – Manufacture of Portland cement, basic chemistry of cement, hydration of cement, classification of cement, types of cement, tests on cement: field tests & laboratory tests.

b) Aggregate and water – Different classifications, Fine aggregate, coarse aggregate, mechanical properties, physical properties, deleterious materials, soundness, alkali-aggregate reaction, sieve analysis: Fineness and gradation tests on aggregates, artificial and recycled aggregate, mixing water, curing water, tests on water.

Admixtures: functions, classification, types: mineral and chemical, IS: specifications (9103 and 456), compatibility of admixtures.

Unit II: Properties, Production and testing of fresh concrete (08Hrs)

a) Fresh concrete: Workability – factors affecting workability, cohesion and segregation, Bleeding, Laitance, mixing, handling, placing and compaction of concrete, Influence of temperature, maturity rule.

b) Tests of fresh concrete – Workability by Slump cone, Compaction factor, Vee Bee consistometer and flow table test, Marsh cone test.

Unit III: Properties and tests on hardened concrete and Special Concretes (08Hrs)

a) Hardened concrete – Strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, other strength properties, relation between tensile and compression strength, impact strength, abrasion resistance, elasticity and creep, shrinkage and swelling.

b) Testing of hardened concrete – Compression test on cube and cylinder, flexural test, indirect tensile strength, core test. Non destructive testing: Rebound hammer, Ultrasonic pulse velocity, Pullout test and Impact echo test, Rebar locator.

Unit IV: Concreting equipments, techniques and Special concretes (08Hrs)

a) Introduction to concrete related equipments – Batching plants, hauling, pumps, Types of concrete mixers: Tilting, Non tilting and Reversible drum mixer, Types of vibrators Special concreting techniques: pumping of concrete, under water concreting, ready mix concrete, roller compacted concrete Cold weather concreting, hot weather concreting.

b) Special concretes – Light weight concrete, Cellular light weight concrete-Form concrete and autoclave C.L.C, polymer concrete, types of fibers, fiber reinforced Concrete, high density concrete, self compacting concrete and applications. Ferrocement: Definition, Basic concepts in forming ferrocement composites, Methods of casting.

Unit V: Concrete Mix Design (08Hrs)

Concepts of Mix Design, Factors for proportioning of concrete. Factors to be considered, Statistical quality control, Laboratory trial mixes and guidelines to improve mix , methods of Mix Design for M25 and above grades by IS (10262-2009, 456) and DOE methods with and without fly ash, Demonstration and application of concrete mix design software.

Unit VI: Deterioration and repairs. (08Hrs)

a) Deterioration – Permeability and durability, chemical attack and sulphate attack by seawater, acid attack, chloride attack, carbonation of concrete and its determination, corrosion of reinforcement.

b) Repairs – Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects, common types of repairs, shotcrete, Introduction of retrofitting by using FRP, Corrosion monitoring techniques & preventive measures.

Books:

Text:

1. Concrete Technology by M. S. Shetty, S Chand, New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.

Reference:

1. Properties of concrete by A. M. Neville, Longman Publishers.
2. Concrete Technology by R.S. Varshney, Oxford and IBH.
3. Concrete technology by A. M. Neville, J.J. Brooks, Pearson.
4. Ferrocement Construction Manual by Dr. D. B. Divekar-1030,Shivaji Nagar, Model Colony, Pune.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
6. Learning from Failures: Deficiencies in Design, Construction and Service, R& D Center, 1987.

IS Codes :

IS 456, IS 383, IS 9103, IS 10262 Latest revised editions.

List of Laboratory Assignments

The term work shall consist of a journal giving details of all the following experiments.

1. Fineness and standard consistency of cement.
2. Initial and final setting time and soundness of cement.
3. Compressive strength of cement.
4. Fineness of fly ash
5. Moisture content, silt content, density and Specific gravity of fine aggregate
6. Fineness modulus by sieve analysis of fine aggregate.
7. Moisture content , water absorption, density and Specific gravity of coarse aggregate
8. Fineness modulus by sieve analysis and gradation of fine aggregates.
9. Workability of concrete by slump test, compaction factor, Vee Bee test, effect of admixture and retarders on setting time concrete.
10. Compressive strength test of concrete by crushing and Rebound hammer.
11. Indirect tensile strength and flexural strength of hardened concrete
12. Concrete mix design by IS code method.
13. Site visit to RMC plant

Oral: Based on above syllabus and term work.

Savitribai Phule Pune University, Pune
S.E. (Civil Engineering) 2015 Course

201010: Soft Skill
Credits: 01

Teaching Scheme:	**Examination Scheme:**
Practical: 02 hrs/week	**Term Work : 50 Marks**

Prerequisites: Basic communication and writing skills in English.

Course Objectives:

1) To help the students in building interpersonal skills.
2) To develop skill to communicate clearly.
3) To enhance team building and time management skills.
4) To learn active listening and responding skills.

Course Outcomes:

On completion of the course, learner will be able to:

1) Make use of techniques for self-awareness and self-development.
2) Apply the conceptual understanding of communication into everyday practice.
3) Understand the importance of teamwork and group discussions skills.
4) Develop time management and stress management.
5) Apply business etiquette skills effectively an engineer requires.

Course Contents

UNIT I: Self Awareness & self Development (04 hrs)

a) Self Awareness: Self Assessment, Self Appraisal, SWOT, Goal setting: Personal & career: Self Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self appraisal, Personal Goal setting.

b) Self Development: Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting, prioritization.

UNIT II: Communication Skill **(06 hrs)**

a) Communication: Importance, types, barriers of communication, effective communication.

b) Speaking Skills: Public Speaking, Presentation skills, Group discussion: Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

c) Listening Skills: Law of nature: you have 2 ears and 1 tongue so listen twice and speak once is the best policy, Empathic listening, and Avoid selective listening.

d) Group Discussion: characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

e) Presentation skills: planning, preparation, organization, delivery.

f) Written Skills: Formal & Informal letter writing, Report writing, Resume writing: Sentence structure, sentence coherence, emphasis. Paragraph writing. Letter writing skills: form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc.

UNIT III: Corporate / Business Etiquettes **(02 hrs)**

a) Corporate / Business Etiquettes: Corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting: Understand the importance of professional behaviour at the work place, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting.

b) Importance of first impression, Grooming, Wardrobe, Body language, Meeting etiquettes (targeted at young professionals who are just entering business environment) , Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

UNIT IV: Interpersonal relationship **(04 hrs)**

a) Team work: Team effectiveness, Group discussion, Decision making : Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.

b) Group Discussion (GD): Preparation for a GD, Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD , Conflict management, Do's and Don'ts in GD.

UNIT V: Leadership skills (02 hrs)

a) Leadership: Leaders' role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules.

b) Leadership Qualities: Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example, effective feedback.

UNIT VI: Other skills (02 hrs)

a) Time management: The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to prioritise using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions , to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individualized plan of action.

b) Stress management: understanding the stress & its impact, techniques of handling stress

c) Skills: Problem solving skill, Confidence building Problem solving skill, Confidence building.

Books:

Text:

1. Communication Skills by Sanjay Kumar and Pushpa Lata, Oxford University Press.
2. Developing Communication Skill by Krishna Mohan, Meera Banerji, McMillan India Ltd.
3. English for Business Communication by Simon Sweeney, Cambridge University Press.

Reference:

1. Ethics in Engineering Practice and Research by Caroline & Whitbeck, Cambridge University Press.
2. NASSCOM-Global Business Foundation Skills: Accenture, Convergys, Dell et.al. Foundation Books: Cambridge University Press.
3. Basic Managerial Skills by E. H. McGrath, Eastern Economy Edition, Prentice hall India.
4. Personality Development and Group Discussions by Barun K. Mitra, Oxford University Press.
5. Group Discussions and Interview Skills by Priyadarshi Patnaik , Foundation Books , Cambridge University Press.
6. Thinks and Grow Rich by Napoleon Hill, Ebury Publishing, ISBN 9781407029252.
7. Awaken the Giant Within by Tony Robbins HarperCollins Publishers, ISBN-139780743409384.
8. Change Your Thoughts; Change Your Life by Wayne Dyer, Hay House India, ISBN-139788189988050.
9. The Power of Your Subconscious Mind by Dr Joseph Murphy Maanu Graphics , ISBN-13 9789381529560.
10. The new Leaders by Daniel Coleman Sphere Books Ltd , ISBN-139780751533811
11. The 80/20 Principal by Richard Koch, Nicholas Brealey Publishings , ISBN-13 9781857883992.
12. Time management from inside out by Julie Morgenstern, Owl Books (NY), ISBN-13 9780805075908.
13. Wonderland of Indian Manageress by Sharu Ranganekar, Vikas Publishing Houses, ISBN-13 9788125942603.
14. You can win by Shiv Khera, Macmillan, ISBN-139789350591932.
15. The Ace of Soft Skills by Attitude, Communication and Etiquette for Success: Gopalaswamy Ramesh, Mahadevan Ramesh.

Guidelines for Laboratory Conduction

Teaching Methodology

Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below.

Practical Activities (Term work)

Following 10 activities are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should give students 10 assignments on the basis of the 10 activities conducted in the practical sessions. Students will submit these 10 assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed.

1. SWOT analysis: The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.

2. Personal & Career Goal setting – Short term & Long term.

3 Presentation Skills Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.

4. Letter/Application writing: Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.

5. Report writing: The teacher should teach the students how to write report .. The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal etc.

6. Listening skills The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.

7. Group discussion Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.

8. Resume writing Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.

9. Public Speaking Any one of the following activities may be conducted :

a. Prepared speech (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.

b. Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic)

c. Story telling (Each student narrates a fictional or real life story for 5 minutes each)

d. Oral review (Each student orally presents a review on a story or a book read by them)

10. Stress management: understanding the stress & its impact, techniques of handling stress.

11. Team Activity: Use of Language laboratory.

Perform any 8 exercises from serial number 1 to serial number 10 and serial number 11 is compulsory

List of Term Work/Assignments

Term work will consist the record of any 8 assignments of following exercises

1. SWOT analysis
2. Personal & Career Goal setting – Short term & Long term

3 Presentation Skill

4. Letter/Application writing
5. Report writing
6. Listening skills
7. Group discussion
8. Resume writing
9. Public Speaking
10. Stress management
11. Team Activity-- Use of Language laboratory.

Savitribai Phule Pune University, Pune
S.E. (Civil Engineering) 2015 Course

Road Safety Management
Audit Course
(Certificate to be issued by institute based on performance assessment)

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory regulation has been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the World statistics; but the comparable proportion for accidents is substantially large.

The need for stricter enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the ibid stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Objectives:

1) To provide basic overview on road safety & traffic management issues in view of the alarming increase in vehicular population of the country.
2) To explain the engineering & legislative measures for road safety.
3) To discuss measures for improving road safety education levels among the public.

Course Outcomes:

On completion of the course, learners will:

1) Show changes in awareness levels, knowledge and understanding.
2) Demonstrate a change in attitudes / behavior e.g. against drink-drive.
3) Utilize remedial education for those who make mistakes and for low level offences where this is more effective than financial penalties and penalty points.
4) Improve road safety together leading to casualty reduction

Course Contents

1. Existing Road Transport Scenario
2. Accident Causes & Remedies
3. Road Accident Investigation & Investigation Methods
4. Vehicle Technology – CMVR & Road Safety
5. Regulatory / Legislative Provisions for Improving Road Safety
6. Behavioral Training for Drivers for Improving Road Safety
7. Road Engineering Measures for Improving Road Safety

Guidelines for Conduction (Any one or more of following but not limited to)
1. Guest Lectures. 2. Visits and reports. 3. Assist authorities like RTO for audits (e.g. Particular road safety audit as critical on-site assessment of the shortcomings in the various elements of the road). 4. Mini Project
Guidelines for Assessment (Any one of following but not limited to)
1. Written Test 2. Practical Test 3. Presentation 4. Report

Faculty of Engineering

Savitribai Phule Pune University

Syllabus

of

Second Year of Computer Engineering

(Course 2015)

(with effect from June 2016)

Savitribai Phule Pune University
Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals and domain knowledge to provide effective solutions for engineering problems.

2. To prepare the graduates to work as a committed professionals with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.

3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.

4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

Program Outcomes

Students are expected to know and be able -

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis to solve complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration of public health and safety, cultural, societal, and environmental issues.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practices of lifelong learning.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
(With effect from Academic Year 2016-17)

Semester I

Course Code	Course Name	Teaching Scheme Hours / Week			Examination Scheme & Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH + TUT	PR
210241	Discrete Mathematics	04	--	--	50	50	--	--	--	100	04	--
210242	Digital Electronics and Logic Design	04	--	--	50	50	--	--	--	100	04	--
210243	Data Structures and Algorithms	04	--	--	50	50	--	--	--	100	04	--
210244	Computer Organization and Architecture	04	--	--	50	50	--	--	--	100	04	--
210245	Object Oriented Programming	04	--	--	50	50	--	--	--	100	04	--
210246	Digital Electronics Lab	--	--	02	--	--	25	50	--	75	--	01
210247	Data Structures Lab	--	--	04	--	--	25	50	--	75	--	02
210248	Object Oriented Programming Lab	--	--	02	--	--	25	50	--	75	--	01
210249	Soft Skills	--	--	02	--	--	25	--	--	25	--	01
Total											20	05
210250	Audit Course 1	--	--	--	--	--	--	--	--	--	Grade	
Total		20	--	10	250	250	100	150	--	750	25	

Abbreviations:

TW: Term Work
OR: Oral
PR: Practical
TH: Theory
TUT: Tutorial
Sem: Semester

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
(With effect from Academic Year 2016-17)

Semester II

Course Code	Course Name	Teaching Scheme Hours / Week			Examination Scheme & Marks						Credits	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH+ TUT	PR
207003	Engineering Mathematics III	04	01	--	50	50	25	--	--	125	05	--
210251	Computer Graphics	04	--	--	50	50	--	--	--	100	04	--
210252	Advanced Data Structures	04	--	--	50	50	--	--	--	100	04	--
210253	Microprocessor	04	--	--	50	50	--	--	--	100	04	--
210254	Principles of Programming Languages	03	--	--	50	50	--	--	--	100	03	--
210255	Computer Graphics Lab	--	--	02	--	--	25	50	--	75	--	01
210256	Advanced Data Structures Lab	--	--	04	--	--	25	50	--	75	--	02
210257	Microprocessor Lab	--	--	04	--	--	25	50	--	75	--	02
				Total							20	05
210258	Audit Course 2		--	--	--	--	--	--	--	--	Grade	
Total		19	01	10	250	250	100	150	--	750	25	

Abbreviations:

TW: Term Work
OR: Oral
PR: Practical
TH: Theory
TUT: Tutorial
Sem: Semester

SEMESTER I

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210241: Discrete Mathematics

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (online): 50 Marks End-Sem (paper): 50 Marks

Prerequisite:- Basic Mathematics

Course Objectives:

- To use appropriate set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context.
- Determine number of logical possibilities of events.
- Learn logic and proof techniques to expand mathematical maturity.
- Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.

Course Outcomes:

On completion of the course, student will be able to–

- Solve real world problems logically using appropriate set, function, and relation models and interpret the associated operations and terminologies in context.
- Analyze and synthesize the real world problems using discrete mathematics.

Course Contents

Unit I	Set Theory and Logic	09 Hours

Discrete Mathematics, Significance of Discrete Mathematics in Computer Engineering, **Sets–** Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Need for Sets, Representation of Sets, Set Operations, cardinality of set, principle of inclusion and exclusion, **Types of Sets** – Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets. Introduction to bounded and unbounded sets and multiset. Countability of Rational Numbers Using Cantor Diagonalization Argument, power set. **Propositional Logic-** logic**,** Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.

Unit II	Relations and Functions	09 Hours

Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations , Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Anti-Chains, Transitive Closure and Warshall‘s Algorithm, n-Ary Relations and their Applications.

Functions- Surjective, Injective and Bijective functions, Inverse Functions and Compositions of Functions, The Pigeonhole Principle.

Unit III	Counting	09 Hours
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.		
Unit IV	**Graph Theory**	**09 Hours**
Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring. Case Study- Web Graph, Google map.		
Unit V	**Trees**	**09 Hours**
Introduction, properties of trees, Binary search tree, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network). Case Study- Game Tree, Mini-Max Tree.		
Unit VI	**Algebraic Structures and Coding Theory**	**09 Hours**
The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and congruence relations, Rings, Integral Domains and Fields, coding theory, Polynomial Rings and polynomial Codes, **Case Study-** Brief introduction to Galois Theory –Field Theory and Group Theory.		

Books:

Text:

1. Kenneth H. Rosen, ―Discrete Mathematics and its Applications", Tata McGraw-Hill, ISBN 978-0-07-288008-3, 7th Edition.
2. C. L. Liu, ―Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.

References:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, ―Discrete Mathematical Structures", Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
2. N. Biggs, ―Discrete Mathematics", 3rd Edition, Oxford University Press, ISBN 0 –19 850717 – 8.
3. Narsingh Deo, ―Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
4. Dr. K. D. Joshi, ―Foundations of Discrete Mathematics", New Age International Limited, Publishers, January 1996, ISBN: 8122408265, 9788122408263
5. C.D. Cantrell, ―Modern Mathematical Methods for Engineers", Cambridge University Press, ISBN-0521670497
6. Eric Gossett, ―Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
7. Sriram P & Steven S, ―Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210242: Digital Electronics & Logic Design

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (online): 50 Marks End-Sem (paper): 50 Marks

Prerequisite: - Basic Electronics Engineering

Course Objectives:

- To understand the functionality and design of Combinational and Sequential Circuits
- To understand and compare the functionalities, properties and applicability of Logic Families.
- To understand concept of programmable logic devices and ASM chart and get acquainted with design of synchronous state machines.
- To design and implement digital circuits using VHDL.

Course Outcomes:

On completion of the course, student will be able to–

- Realize and simplify Boolean Algebraic assignments for designing digital circuits using K-Maps.
- Design and implement Sequential and Combinational digital circuits as per the specifications.
- Apply the knowledge to appropriate IC as per the design specifications.
- Design simple digital systems using VHDL.
- Develop simple embedded system for simple real world application.

Course Contents

Unit I	Combinational Logic Design	09 Hours

Logic minimization: Representation of truth-table, Sum of Product (SOP) form, Product of Sum (POS) form, Simplification of logical functions, Minimization of SOP and POS forms using K-Maps up to 4 variables and Quine-McCluskey Technique, realization of logic gates.

Design of Combinational Logic: Code converter **-** BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX): MUX (IC 74153, 74151), MUX tree, Demultiplexers (DEMUX)**-** Decoder. (IC 74138, IC 74154). DMUX Tree, Implementation of SOP and POS using MUX, DMUX, Comparators, Parity generators and Checker, Priority Encoders.

Unit II	Sequential Logic Design	09 Hours

Flip- flop: SR, JK, D, T; Preset & Clear, Master and Slave Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flip Flop. **Registers:** Buffer register, shift register, Applications of shift registers. **Counters:** Asynchronous counter. Synchronous counter, ring counters, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490).

Synchronous Sequential Circuit Design: Models – Moore and Mealy, State diagram and State Tables, Design Procedure, Sequence generator and detector. **Asynchronous Sequential Circuit Design:** Difference with synchronous circuit design, design principles and procedure, applications.

Unit III	Algorithmic State Machines	09 Hours
Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits, Sequence Generator, Types of Counters. **VHDL:** Introduction to HDL, Data Objects & Data Types, Attributes., VHDL- Library, Design Entity, Architecture, Modeling Styles, Concurrent and Sequential Statements, **Design Examples:** VHDL for Combinational Circuits-Adder, MUX, VHDL for Sequential Circuits, Synchronous and Asynchronous Counter.		
Unit IV	**Programmable Logic Devices**	**09 Hours**
ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.		
Unit V	**Logic Families**	**09 Hours**
Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Speed, power dissipation, figure of merits, fan-out, Current and voltage parameters, Noise immunity, operating temperature range, power supply requirements. **Transistor-Transistor Logic:** Operation of TTL, Current sink logic, TTL with active pull up, TTL with open collector output, Schottkey TTL, TTL characteristics, TTL 5400/7400 series, **CMOS:** CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs, **Interfacing:** TTL to CMOS and CMOS to TTL. Tristate Logic and Tristate TTL inverter.		
Unit VI	**Microcontrollers**	**09 Hours**
Comparison of typical microprocessor and microcontroller. **Microcontroller 8051:** Features, architecture, Pin description, **Programming model**– Special Function Registers, addressing modes, instruction set, Timers and Counters, serial communication, interrupts, interfacing with ADC and DAC.		

Books:

Text:

1. R.P. Jain, ―Modern Digital Electronics", TMH, 2012, ISBN–13: 978-0-07- 066911-6.
2. Stephen Brown, Zvonko Vranesic, ―Fundamentals of Digital Logic with VHDL Design", McGraw-Hill, ISBN–13:978-1-25-902597-6.
3. Muhammas Mazidi, Janice Mazidi and Rolin McKinlay, ―The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Education, ISBN-13: 9788131758991

References:

1. John Yarbrough, ―Digital Logic applications and Design", Cengage Learning, ISBN – 13: 978-81-315-0058-3
2. D. Leach, Malvino, Saha, ―Digital Principles and Applications", Tata McGraw Hill, ISBN – 13:978-0-07-014170-4.
3. Anil Maini, ―Digital Electronics: Principles and Integrated Circuits", Wiley India Ltd, ISBN:978-81-265-1466-3.
4. Norman B & Bradley, ―Digital Logic Design Principles, Wiley India Ltd, ISBN:978-81-265-1258-4.
5. Scott Mackenzie, ―The 8051 Microcontroller", Prentice Hall India, ISBN-13: 978-0130195623

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210243: Data Structures and Algorithms

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (online): 50 Marks End-Sem (paper): 50 Marks

Prerequisites: - FPL I and FPL II

Course Objectives:

- To understand the standard and abstract data representation methods.
- To acquaint with the structural constraints and advantages in usage of the data.
- To understand the memory requirement for various data structures.
- To operate on the various structured data.
- To understand various data searching and sorting methods with pros and cons.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, student will be able to–

- To discriminate the usage of various structures in approaching the problem solution.
- To design the algorithms to solve the programming problems.
- To use effective and efficient data structures in solving various Computer Engineering domain problems.
- To analyze the problems to apply suitable algorithm and data structure.
- To use appropriate algorithmic strategy for better efficiency

Course Contents

Unit I	Introduction to Algorithm and Data Structures	09 Hours

Algorithms- Problem Solving, Introduction to Algorithms, Characteristics of algorithms, Algorithm design tools: Pseudo code and flowchart, Analysis of Algorithms, Complexity of algorithms- Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, standard measures of efficiency.

Data Structures- Data structure, Abstract Data Types (ADT), Concept of linear and Non-linear, static and dynamic, persistent and ephemeral data structures, and relationship among data, data structure, and algorithm, From Problem to Program.

Algorithmic Strategies- Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

Recurrence relation - Recurrence Relation, Linear Recurrence Relations, With constant Coefficients, Homogeneous Solutions. Solving recurrence relations

Unit II	Linear Data Structures Using Sequential Organization	09 Hours

Sequential Organization, Linear Data Structure Using Sequential Organization, Array as an Abstract Data Type, Memory Representation and Address Calculation, Inserting an element into an array, Deleting an element, Multidimensional Arrays, Two-dimensional arrays, n- dimensional arrays, Concept of Ordered List, Single Variable Polynomial, Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication, Sparse Matrix, Sparse matrix representation, Sparse matrix addition, Transpose of sparse matrix, String Manipulation Using Array. **Case Study-** Use of sparse matrix in Social Networks and Maps.

Unit III	Linked Lists	09 Hours

Concept, Comparison of sequential and linked organizations, Primitive operations, Realization of Linked Lists, Realization of linked list using arrays, Dynamic Memory Management, Linked list using dynamic memory management, Linked List Abstract Data Type, Linked list operations, Head pointer and header node, **Types of linked list-** Linear and circular linked lists, Doubly Linked List and operations, Circular Linked List, Singly circular linked list, Doubly circular linked list**, Polynomial Manipulations -** Polynomial addition, Multiplication of two polynomials using linked list. **Generalized Linked List (GLL)** concept, representation of polynomial and sets using GLL. **Case Study-** Garbage Collection.

Unit IV	Stacks	09 Hours

Stacks- concept, Primitive operations, Stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations**.**
Recursion- concept, **variants of recursion-** direct, indirect, tail and tree, Backtracking algorithmic strategy, use of stack in backtracking. **Case Study-** 4 Queens problem, Android-multiple tasks/multiple activities and back stack.

Unit V	Queues	09 Hours

Concept, Queue as Abstract Data Type, Realization of Queues Using Arrays , Circular Queue, Advantages of using circular queues, Multi-queues, Deque, Priority Queue, Array implementation of priority queue, Linked Queue and operations. **Case study- P**riority queue in bandwidth management.

Unit VI	Sorting and Searching	09 Hours

Searching- Search Techniques, Sequential search, variant of sequential search- sentinel search, Binary search, Fibonacci search. **Case Study-** Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. **Sorting-** Types of sorting-Internal and external sorting, General sort concepts-sort order, stability, efficiency, number of passes, Sorting methods- Bubble sort, Insertion sort, Selection sort, Quick sort, Heap sort, Shell sort, Bucket sort, Radix sort, Comparison of All Sorting Methods. **Case Study-** Timsort as a hybrid stable sorting algorithm.

Books:

Text:

1. Brassard & Bratley, —Fundamentals of Algorithmics", Prentice Hall India/Pearson Education, ISBN 13-9788120311312**.**
2. Horowitz and Sahani, —Fundamentals of Data Structures in C++", University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
3. Goodrich, Tamassia, Goldwasser, —Data Structures and Algorithms in C++", Wiley publication, ISBN-978-81-265-1260-7

References:

1. R. Gillberg, B. Forouzn, —Data Structures: A Pseudo code approach with C", Cenage Learning, ISBN 9788131503140.
2. Horowitz, Sahani and Rajshekaran, —Fundamentals of Computer Algorithms", University Press, ISBN-13, 9788175152571.
3. Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++", Pearson Education, ISBN 81-317-0328-2.
4. A Michael Berman, —Data Structures via C++: Objects by Evolution", Oxford University Press, ISBN:0-19-510843-4.
5. M. Weiss, —Data Structures and Algorithm Analysis in C++", 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210244: Computer Organization and Architecture

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (online): 50 Marks End-Sem (paper): 50 Marks

Prerequisites: -

- Fundamentals of Programming Languages-I & II and
- Basics of Electronics Engineering

Course Objectives:

- To understand the structure, function and characteristics of computer systems.
- To understand the design of the various functional units and components of digital computers.
- To identify the elements of modern instructions sets and explain their impact on processor design.
- To explain the function of each element of a memory hierarchy, identify and compare different methods for computer I/O.
- To compare simple computer architectures and organizations based on established performance metrics.

Course Outcomes:

On completion of the course, student will be able to–

- Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os.
- Analyze the principles of computer architecture using examples drawn from commercially available computers.
- Evaluate various design alternatives in processor organization.

Course Contents

Unit I	Computer Evolution and Performance	09 Hours

Computer Organization and Architecture, Structure and Function, Evolution (a brief history) of computers, Designing for Performance, Evolution of Intel processor architecture- 4 bit to 64 bit, performance assessment. **A top level view of Computer function and interconnection-** Computer Components, Computer Function, Interconnection structure, bus interconnection, **Computer Arithmetic-** The Arithmetic and Logic Unit, addition and subtraction of signed numbers, design of adder and fast adder, carry look ahead addition, multiplication of positive numbers, signed operand multiplication, booths algorithm, fast multiplication, integer division. **Floating point representation and operations** – IEEE standard, arithmetic operations, guard bits and truncation.

Unit II	Computer Memory System	09 Hours

Characteristics of memory system, The memory hierarchy. **Cache Memory-** Cache memory principles, Elements of cache design- cache address, size, mapping functions, replacement algorithms, write policy, line size, number of cache, one level and two level cache, performance characteristics of two level cache- locality & operations. **Case Study-** PentiumIV cache organization. **Internal Memory-** semiconductor main memory, advanced DRAM organization. **External Memory-** Hard Disk organization, RAID- level 1 to level 6.

Unit III	Input and Output System	09 Hours

External devices, **I/O modules**- Module function and I/O module structure, **Programmed I/O**-overview, I/O commands, I/O instructions, Interrupt driven I/O- interrupt processing, design issues. **Case Study-** Study of Programmable Interrupt Controller Intel 82C59A in brief. **Direct Memory Access**- drawbacks of programmed and interrupt driven I/O, DMA functions, **Case Study- DMA Controller** Intel 8237A-study in brief, I/O channels and processors- evolution and characteristics, The external Interface- Thunderbolt and Infinite Band.

Unit IV	Instruction Sets	09 Hours

Characteristics and Functions- machine instruction characteristics, types of operands, **Case Study-**Intel 8086, Types **of operations-** data transfer, arithmetic, logical, conversion, input-output, system control, and transfer of control, **Case Study-**Intel 8086 operation types. **Addressing modes and Formats-** Addressing modes- immediate, direct, indirect, register, register indirect, displacement and stack, **Case Study-**8086 addressing modes, **Instruction Formats-** instruction length, allocation of bits, variable length instructions. **Case Study-** 8086 instruction formats.

Unit V	Processor Organization	09 Hours

Processor organization, Register organization- user visible registers, control and status registers, **Case Study-** register organization of microprocessor 8086. **Instruction Cycle-** The machine cycle and Data flow. **Instruction Pipelining-** Pipelining Strategy, pipeline performance, pipeline hazards, dealing with branches, **Case Study**- pipelining in Pentium.

Instruction level parallelism and superscalar processors- Super scalar verses super pipelined, constraints, **Design Issues-** instruction level and machine parallelism, Instruction issue policy, register renaming, machine parallelism, branch prediction, superscalar execution and implementation. **Case study-** Pentium IV.

Unit VI	Basic Processing Unit	09 Hours

Fundamental Concepts- register transfer, performing arithmetic or logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction- branch instructions,

Hardwired control, M**icro-programmed control-** micro instructions, micro program sequencing, wide branch addressing, microinstruction with next address field, pre-fetching microinstructions and emulation.

Books:

Text:

1. W. Stallings, –Computer Organization and Architecture: Designing for performance”, Pearson Education/ Prentice Hall of India, 2003, ISBN 978-93-325-1870-4, 7th Edition.
2. Zaky S, Hamacher, –Computer Organization”, 5th Edition, McGraw-Hill Publications, 2001, ISBN- 978-1-25-900537-5, 5th Edition.

References:

1. John P Hays, –Computer Architecture and Organization”, McGraw-Hill Publication, 1998, ISBN:978-1-25-902856-4, 3rd Edition.
2. Miles Murdocca and Vincent Heuring, –Computer Architecture and Organization- an integrated approach, Wiley India Pvt. Ltd, ISBN:978-81-265-1198-3, 2nd Edition
3. A. Tanenbaum, –Structured Computer Organization”, Prentice Hall of India, 1991 ISBN: 81 – 203 – 1553 – 7, 4th Edition
4. Patterson and Hennessy, –Computer Organization and Design”, Morgan Kaufmann Publishers In, ISBN 978-0-12-374750-1, 4th Edition.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210245: Object Oriented Programming

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem (online): 50 Marks End-Sem (paper): 50 Marks

Prerequisites: Fundamentals of Programming Languages-I and II

Course Objectives:

- To explore the principles of Object Oriented Programming (OOP).
- To understand object-oriented concepts such as data abstraction, encapsulation, inheritance, dynamic binding, and polymorphism.
- To use the object-oriented paradigm in program design.
- To lay a foundation for advanced programming.
- Provide programming insight using OOP constructs.

Course Outcomes:

On completion of the course, student will be able to–

- Analyze the strengths of object oriented programming
- Design and apply OOP principles for effective programming
- Develop programming application using object oriented programming language C++
- Percept the utility and applicability of OOP

Course Contents

Unit I	Classes and Objects	09 Hours

Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, C++ as object oriented programming language.
C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members.
Functions- Function, function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function.

Unit II	Polymorphism and Inheritance	09 Hours

Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable.
Inheritance- Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Inheritance, Public and Private Inheritance, Levels of Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Aggregation, Classes Within Classes.
Polymorphism- concept, relationship among objects in inheritance hierarchy, abstract classes, polymorphism.

Unit III	Virtual Functions	09 Hours
Virtual Functions- Pointers- indirection Operators, Memory Management: new and delete, Pointers to Objects, A Linked List Example, accessing Arrays using pointers, Function pointers, Pointers to Pointers, A Parsing Example, Debugging Pointers, Dynamic Pointers, smart pointers, shared pointers, Case Study : Design of Horse Race Simulation. **Virtual Function-** Friend Functions, Static Functions, Assignment and Copy Initialization, this Pointer, virtual function, dynamic binding, Virtual destructor.		
Unit IV	**Templates and Exception Handling**	**09 Hours**
Templates- function templates, Function overloading, overloading Function templates, class templates, class template and Nontype parameters, template and inheritance, template and friends Generic Functions, Applying Generic Function, Generic Classes, The typename and export keywords, The Power of Templates. **Exception Handling-** Fundamentals, other error handling techniques, simple exception handling-Divide by Zero, rethrowing an exception, exception specifications, processing unexpected exceptions, stack unwinding, constructor, destructor and exception handling, exception and inheritance.		
Unit V	**Files and Streams**	**09 Hours**
Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output, Early vs. Late Binding.		
Unit VI	**Standard Template Library (STL)**	**09 Hours**
Introduction to STL, Containers, algorithms and iterators, Containers- Sequence container and associative containers, container adapters, Algorithms- basic searching and sorting algorithms, min-max algorithm, set operations, heap sort, Iterators- input, output, forward, bidirectional and random access. Object Oriented Programming – a road map to future		

Books:

Text:

1. Bjarne Stroustrup, ―The C++ Programming language", Third edition, Pearson Education. ISBN 9780201889543.
2. **Deitel,** ―C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2

References:

1. Robert Lafore, ―Object-Oriented Programming in C++", fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089)
2. Herbert Schildt, ―C++ The complete reference", Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
3. Matt Weisfeld, ―The Object-Oriented Thought Process", Third Edition Pearson ISBN-13:075-2063330166
4. Cox Brad, Andrew J. Novobilski, ―Object –Oriented Programming: An Evolutionary Approach", Second Edition, Addison–Wesley, ISBN:13:978-020-1548341

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210246: Digital Electronics Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 25 Marks PR: 50 Marks

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, data sheets of various ICs, 8051 simulator and references.

Guidelines for Student's Lab Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept, circuit diagram, pin configuration, conclusion/analysis).

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab performance of student. Each lab assignment assessment should assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficiency, punctuality and neatness.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Student should perform at least 14 experiments-5 experiments from group A and 5 assignments from group B, 2 from group C and 2 from group D.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student‘s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Suggested List of Laboratory Assignments	
Sr No	**Group A**
1.	Realize Full Adder and Subtractor using a) Basic Gates and b) Universal Gates
2.	Design and implement Code converters-Binary to Gray and BCD to Excess-3
3.	Design of n-bit Carry Save Adder (CSA) and Carry Propagation Adder (CPA). Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4.	Realization of Boolean Expression for suitable combination logic using MUX 74151 / DMUX 74154
5.	Verify the truth table of one bit and two bit comparators using logic gates and comparator IC
6.	Design & Implement Parity Generator using EX-OR.
	Group B
7.	Flip Flop Conversion: Design and Realization
8.	Design and implement a system using flip-flops, to monitor number of vehicles entering and exiting from a car parking area with maximum capacity of 15 and having separate entry and exit gates.
9.	Design of Ripple Counter using suitable Flip Flops
10.	a. Realization of 3 bit Up/Down Counter using MS JK Flip Flop / D Flip Flop b. Realization of Mod -N counter using (7490 and 74193)
11.	Assume a scenario of a hall where students are entering to attend seminar. Design and implement a system which will increment count if student is entering in the hall and will decrement count if student is exiting the hall. Assume seating capacity of a hall is 63.
12.	Design and Realization of Ring Counter and Johnson Ring counter.
13.	Design and implement Sequence generator using JK flip-flop.
14.	Design and implement pseudo random sequence generator.
15.	Design and implement Sequence detector using JK flip-flop
16.	Design of ASM chart using MUX controller Method.
	Group C
17.	Design and Implementation of Combinational Logic using PLAs.
18.	Design and simulation of - Full adder , Flip flop, MUX using VHDL (Any 2) Use different modeling styles.
19.	Design & simulate asynchronous 3- bit counter using VHDL.
20.	Design and Implementation of Combinational Logic using PALs.
Group D (Study Assignments)	
21.	Study of Shift Registers (SISO,SIPO, PISO,PIPO)
22.	Study of TTL Logic Family: Feature, Characteristics and Comparison with CMOS Family
23.	Study of Microcontroller 8051 : Features, Architecture and Programming Model

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210247: Data Structures Lab		
Teaching Scheme: **PR: 04 Hours/Week**	**Credit** **02**	**Examination Scheme:** **TW: 25 Marks** **PR: 50 Marks**

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

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Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch <u>beyond the scope of syllabus.</u>

Set of suggested assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments as at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC

Suggested List of Laboratory Assignments

Group A

1. In Second year Computer Engineering class of M students, set A of students play cricket and set B of students play badminton. Write C/C++ program to find and display-
   i. Set of students who play either cricket or badminton or both
   ii. Set of students who play both cricket and badminton
   iii. Set of students who play only cricket
   iv. Set of students who play only badminton
   v. Number of students who play neither cricket nor badminton

   (Note- While realizing the set duplicate entries are to avoided)

2. Write C/C++ program to store marks scored for first test of subject 'Data Structures and Algorithms' for N students. Compute
   I. The average score of class
   ii. Highest score and lowest score of class
   iii. Marks scored by most of the students
   iv. list of students who were absent for the test

3. Department library has N books. Write C/C++ program to store the cost of books in array in ascending order. Books are to be arranged in descending order of their cost. Write function for
   a) Reverse the contents of array without using temporary array.
   b) Copy costs of books those with cost less than 500 in new array
   c) Delete the duplicate entries using temporary array
   d) Delete duplicate entries without using temporary array
   e) Count number of books with cost more than 500.

4. Set A=(1,3, a, s, t, i} represent alphanumeric characters permitted to be used to set the password of length 4. Write C/C++ program to generate all possible passwords.

5. A magazine committee is to be formed that consists of any 3 members to be selected from { Nikhita, Aboli, Megha, Sanika, Pratik, Saurabh}. Write C/C++ program to list all possible committees.

6. It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is

	to be provided to the authority. Write C++ program for array of structures to store students PRNs with date and month of birth. Let Array_A and Array_B be the two arrays for two SE Computer divisions. Arrays are sorted on date and month. Merge these two arrays into third array Array_SE_Comp_DOB resulting in sorted information about Date of Birth of SE Computer students.
7.	A magic square is an n * n matrix of the integers 1 to n^2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case n=5. In this example, the common sum is 65. Write C/C++ Program for magic square. **15 8 1 24 17** **16 14 7 5 23** **22 20 13 6 4** **3 21 19 12 10** **9 2 25 18 11**
8.	An m x n *matrix* is said to have a saddle point if some entry *a[i][j]* is the smallest value in row *i* and the largest value in *j*. Write C/ C++ function that determines the location of a saddle point if one exists.
9.	Write C/C++ program for storing matrix. Write functions for a) Check whether given matrix is upper triangular or not b) Compute summation of diagonal elements c) Compute transpose of matrix d) Add, subtract and multiply two matrices
10.	Write C++ program with class for String. Write a function • *frequency* that determines the frequency of occurrence of particular character in the string. • *delete* that accepts two integers, *start* and *length*. The function computes a new string that is equivalent to the original string, except that *length* characters being at *start* have been removed. • *chardelete* that accepts a character *c*. The function returns the string with all occurrences of *c* removed. • *replace* to make an in-place replacement of a substring *w* of a string by the string *x*. note that *w* may not be of same size of *x* • *palindrome* to check whether given string is palindrome or not
11.	Write C++ program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices
12.	Write C++ program for string operations- copy, concatenate, check substring, equal, reverse and length
13.	Write a C++ program to realize polynomial equation and perform operations. Write function a) To input and output polynomials represented as $b_m x^{e_m} + b_{m-1} x^{e_{m-1}} + \ldots + b_0 x^{e_0}$. Your functions should overload the << and >> operators. b) Evaluates a polynomial at given value of x c) Add two polynomials d) Multiplies two polynomials
	Group B
14.	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of Second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member‘s information using singly linked list. Store student PRN and Name. Write functions to

<table>
<tr><td></td><td>a) Add and delete the members as well as president or even secretary.
b) Compute total number of members of club
c) Display members
d) Display list in reverse order using recursion
e) Two linked lists exists for two divisions. Concatenate two lists.</td></tr>
<tr><td>15.</td><td>The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand
a) The list of available seats is to be displayed
b) The seats are to be booked
c) The booking can be cancelled.</td></tr>
<tr><td>16.</td><td>Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for-
a) Display free slots
b) Book appointment
c) Cancel appointment (check validity, time bounds, availability etc)
d) Sort list based on time
e) Sort list based on time using pointer manipulation</td></tr>
<tr><td>17.</td><td>Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C/C++ program to store two sets using linked list. compute and display-
i. Set of students who like either vanilla or butterscotch or both
ii. Set of students who like both vanilla and butterscotch
iii. Set of students who like only vanilla not butterscotch
iv. Set of students who like only butterscotch not vanilla
v. Number of students who like neither vanilla nor butterscotch</td></tr>
<tr><td>18.</td><td>Write C++ program to store set of negative and positive numbers using linked list. Write functions to
a) Insert numbers
b) Delete nodes with negative numbers
c) Create two more linked lists using this list, one containing all positive numbers and other containing negative numbers
d) For two lists that are sorted; Merge these two lists into third resultant list that is sorted</td></tr>
<tr><td>19.</td><td>Write C++ program for storing binary number using doubly linked lists. Write functions-
a) to compute 1's and 2's complement b) add two binary numbers</td></tr>
<tr><td>20.</td><td>Let x = (x_1,x_2, … , x_n) and y = (y_1, y_2,…. , y_m) be two doubly linked lists. Assume that in each linked list, the nodes are in non-decreasing order of their data-field values. Write C/C++ program to merge the two lists to obtain a new linked list z in which the nodes are also in this order. Following the merge, x and y should represent empty lists because each node initially in x or y is now in z. No additional nodes may be used.</td></tr>
<tr><td>21.</td><td>Design a linked allocation system to represent and manipulate univariate polynomials with integer coefficients (use circular linked lists with head nodes). Each term of the polynomial will be represented as a node Thus. a node in this system will have three data members as below:
<table><tr><td>Exponent</td><td>Link</td></tr><tr><td colspan="2">Coefficient</td></tr></table></td></tr>
</table>

	To erase polynomials efficiently, we need to use an available-space list and associated functions. The external (i.e.. for input or output) representation of a univariate polynomial will be assumed to be a sequence of integers of the form: $n, c_1, e_1 ,c_2. e_2. c_3. e_3 . . , c_n\ e_n$ where e_i represents an exponent and c_i a coefficient; n gives the number of terms in the polynomial. The exponents are in decreasing order — i.e., $e_1 > e_2 > \ldots > e_n$. Write and test the following functions: 1. istream&**operator** >>(istream& is, Polynomial& x): Read in an input polynomial and convert it to its circular list representation using a head node. 2. ostream&**operator**<< (ostream&os, Polynomial& x): Convert x from its linked list representation to its external representation and output it. 3. Polynomial:: Polynomial(**const** Polynomial& a) [Copy Constructor]: Initialize the polynomial *this to the polynomial a. 4. **const** Polynomial& Polynomial :: **operator=**(**const** Polynomial& a) [Assignment Operator]: Assign polynomial a to***this**. 5. Polynomial:: Polynomial ( ) [Destructor]: Return all nodes of the polynomial ***this** to the available-space list. 6. Polynomial **operator+** (**const** Polynomial& a, **const** Polynomial& b) [Addition]: Create and return the polynomial a + b. a and b are to be left unaltered. 7. ***Polynomial operator* (constPolynomial& a, constPolynomial& b) [Multiplication]:*** *Create and return the polynomial a * b. a and b are to be left unaltered.* 8. **float*Polynomial ::Evaluate(float x):*** Evaluate the polynomial *this at *x* and return the result.
22.	Write C++ program to realize Set using Generalized Liked List (GLL) Ex. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation.
	Group C
23.	A palindrome is a string of character that‘s the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, ”Poor Dan is in a droop” is a palindrome, as can be seen by examining the characters ―poor danisina droop” and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original-in a palindrome, the sequence will be identical. Write C++ program with functions- 1. To check whether given string is palindrome or not that uses a stack to determine whether a string is a palindrome. 2. to remove spaces and punctuation in string, convert all the Characters to lowercase, and then call above Palindrome checking function to check for a palindrome 3. to print string in reverse order using stack
24.	In any language program mostly syntax error occurs due to unbalancing delimiter such as (),{},[]. Write C++ program using stack to check whether given expression is well parenthesized or not.
25.	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions i. Operands and operator, both must be single character. ii. Input Postfix expression must be in a desired format. iii. Only '+', '-', '*' and '/ ' operators are expected.
26.	Implement C++ program for expression conversion- a) infix to prefix, b)prefix to postfix, c) prefix to infix, d) postfix to infix and e) postfix to prefix.
27.	A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an

	8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem.
Group D	
28.	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
29.	Write program to implement a priority queue in C++ using an inorder List to store the items in the queue. Create a class that includes the data items(which should be template) and the priority (which should be int)The inorder list should contain these objects ,with operator <= overloaded so that the items with highest priority appear at the beginning of the list (which will make it relatively easy to retrieve the highest item.)
30.	A double-ended queue(deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque.
31.	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.
Group E	
32.	Write C++ program to store roll numbers of student in array who attended training program in random order. Write function for- a) Searching whether particular student attended training program or not using linear search and sentinel search. b) Searching whether particular student attended training program or not using binary search and Fibonacci search.
33.	Write C++ program to store names and mobile numbers of your friends in sorted order on names. a) Search your friend from list using binary search (recursive and non recursive). Insert friend if not present in phonebook. b) Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.
34.	Write C++ program to maintain club members, sort on roll numbers in ascending order. Write function _Ternary_Search‘ to search whether particular student is member of club. Ternary search is modified binary search that divides array into 3 halves instead of two.
35.	Write C++ program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Selection Sort b) Bubble sort and display top five scores.
36.	Write C++ program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Insertion sort b) Shell Sort and display top five scores.
37.	Write C++ program to store first year percentage of students in array. Sort array of floating point numbers in ascending order using quick sort and display top five scores.
38.	Write C++ program to store XII percentage of students in array. Sort array of floating point numbers in ascending order using bucket sort and display top five scores.
39.	Write C++ program to store X percentage of students in array. Sort array of floating point numbers in ascending order using radix sort and display top five scores.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210248: Object Oriented Programming Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 25 Marks PR: 50 Marks

Guidelines for Instructor's Manual

The instructor‘s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- OOP feature/Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student‘s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. Encourage students for the use coding standards such as appropriate use of Hungarian notation, proper Indentation and comments. Use of open source software is encouraged. Instructor may also assign one real life application in the form of a mini-project. Based on the concepts learned.

Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC.

First assignment is compulsory. Set of suggested assignment list is provided in 3 groups- A, B, and C. Instructor is suggested to design assignments list by selecting/designing at least **12** suitable assignments from group A, B, and C- **compulsory assignment, 5** from group A, **4** from group B, **3** from group C.

Suggested List of Laboratory Assignments

Compulsory Assignment

1.	Install, Configure 64 bit Linux Operating Systems, study basic architecture, memory system, and learn basic administration.

Group A

2.	Implement a class Complex which represents the Complex Number data type. Implement the following operations: 1. Constructor (including a default constructor which creates the complex number 0+0i). 2. Overloaded **operator+** to add two complex numbers. 3. Overloaded **operator*** to multiply two complex numbers. 4. Overloaded << and >> to print and read Complex Numbers.
3.	Implement a class Quadratic that represents degree two polynomials i.e., polynomials of type ax^2+bx+c. The class will require three data members corresponding to a, b and c. Implement the following operations: 1. A constructor (including a default constructor which creates the 0 polynomial). 2. Overloaded **operator+** to add two polynomials of degree 2. 3. Overloaded << and >> to print and read polynomials. To do this, you will need to decide what you want your input and output format to look like. 4. A function eval that computes the value of a polynomial for a given value of x. 5. A function that computes the two solutions of the equation $ax^2+bx+c=0$.
4.	Implement a class CppArray which is identical to a one-dimensional C++ array (i.e., the index set is a set of consecutive integers starting at 0) except for the following : 1. It performs range checking. 2. It allows one to be assigned to another array through the use of the assignment operator (e.g. cp1= cp2) 3. It supports a function that returns the size of the array. 4. It allows the reading or printing of array through the use of **cout** and **cin**.
5.	Write a C++ program create a calculator for an arithmetic operator (+, -, *, /). The program should take two operands from user and performs the operation on those two operands depending upon the operator entered by user. Use a switch statement to select the operation. Finally, display the result. Some sample interaction with the program might look like this: *Enter first number, operator, second number: 10 / 3* *Answer = 3.333333* *Do another (y/n)? y* *Enter first number, operator, second number: 12 + 100* *Answer = 112* *Do another (y/n)? n*

6.	Develop an object oriented program in C++ to create a database of student information system containing the following information: Name, Roll number, Class, division, Date of Birth, Blood group, Contact address, telephone number, driving license no. etc Construct the database with suitable member functions for initializing and destroying the data viz constructor, default constructor, Copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete.
7.	Create a class template to represent a generic vector. Include following member functions: • To create the vector. • To modify the value of a given element • To multiply by a scalar value • To display the vector in the form (10,20,30,…)
8.	Create a class Rational Number (fractions) with the following capabilities: a) Create a constructor that prevents a 0 denominator in a fraction, reduces or simplifies fractions that are not in reduced form and avoids negative denominators. b) Overload the addition, subtraction, multiplication and division operators for this class. c) Overload the relational and equality operators for this class.
9.	Imagine a publishing company which does marketing for book and audiocassette versions. Create a class publication that stores the title (a string) and price (type float) of a publication. From this class derive two classes: book, which adds a page count (type int), and tape, which adds a playing time in minutes (type float). Write a program that instantiates the book and tape classes, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.
10.	Write a function in C++ to count and display the number of lines not starting with alphabet 'A' present in a text file "STORY.TXT". Example: If the file "STORY.TXT" contains the following lines, The roses are red. A girl is playing there. There is a playground. An aeroplane is in the sky. Numbers are not allowed in the password. The function should display the output as 3.
11.	Write C++ Program with base class convert declares two variables, val1 and val2, which hold the initial and converted values, respectively. It also defines the functions getinit( ) and getconv( ), which return the initial value and the converted value. These elements of convert are fixed and applicable to all derived classes that will inherit convert. However, the function that will actually perform the conversion, compute( ), is a pure virtual function that must be defined by the classes derived from convert. The specific nature of compute( ) will be determined by what type of conversion is taking place.

12.	A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the requested copies book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed; otherwise the message ―Required copies not in stock" is displayed. Design a system using a class called books with suitable member functions and Constructors. Use new operator in constructors to allocate memory space required. Implement C++ program for the system.
13.	Create employee bio-data using following classes i) Personal record ii))Professional record iii) Academic record Assume appropriate data members and member function to accept required data & print bio-data. Create bio-data using multiple inheritance using C++.
Group B	
14.	Crete User defined exception to check the following conditions and throw the exception if the criterion does not meet. a. User has age between 18 and 55 b. User stays has income between Rs. 50,000 – Rs. 1,00,000 per month c. User stays in Pune/ Mumbai/ Bangalore / Chennai d. User has 4-wheeler Accept age, Income, City, Vehicle from the user and check for the conditions mentioned above. If any of the condition not met then throw the exception.
15.	Write a menu driven program that will create a data file containing the list of telephone numbers in the following form John 23456 Ahmed 9876 ……….. ……… Use a class object to store each set of data, access the file created and implement the following tasks I. Determine the telephone number of specified person II. Determine the name if telephone number is known III. Update the telephone number, whenever there is a change.
16.	Write a C++ program that creates an output file, writes information to it, closes the file and open it again as an input file and read the information from the file.
17.	Write a C++ program using command line arguments to search for a word in a file and replace it with the specified word. The usage of the program is shown below. *$ change <old word> <new word> <file name>*
18.	Write a function template selection Sort. Write a program that inputs, sorts and outputs an integer array and a float array.

19\. You are the owner of a hardware store and need to keep an inventory that can tell you what different tools you have, how many of each you have on hand and the cost of each one. Write a program that initializes the random-access file hardware.dat to 100 empty records, lets you input the data concerning each tool, enables you to list all your tools, lets you delete a record for a tool that you no longer have and lets you update any information in the file. The tool identification number should be the record number. Use the following information to start your file:

Record #	Tool name	Quantity	Cost
3	Electric sander	7	57.98
17	Hammer	76	11.99
24	Jig saw	21	11.00
39	Lawn mower	3	79.50
56	Power saw	18	99.99

Group C

20\. Write C++ program using STL for implementation of Singly, doubly and circular linked list.

21\. Write C++ program using STL for implementation of stack & queue using SLL

22\. Write C++ program using STL to add binary numbers (assume one bit as one number); use STL stack.

23\. Write C++ program using STL for Dqueue (Double ended queue)

24\. Write C++ program using STL for Sorting and searching with user-defined records such as Person Record (Name, birth date, telephone no), item record (item code, item name, quantity and cost)

Mini-projects

25. Design and develop the Tic-Tac-Toe Game using C++

26\. Develop a Supermarket Billing System using C++. The key features of this application are listed below :

- **Bill Report**: It shows the bill report of all the items added in supermarket billing system.
- **Add, Remove or Edit items**: With this feature one can add, remove and modify item details. In add items, one can add information or details such as item no., item name, manufacturing date, price, quantity, tax percent, and many more.
- **Show item details**: This feature allows users to see the items and the corresponding details given for the item while adding the item.

  Use file to store the data.

27\. Design an E-mail Verifier which accepts the email address from the user. Depending upon the input given by user display appropriate results. Use the following concepts in the Project – Constructor, Destructor, new, delete, exceptional handling, string handling functions, etc.

28\. Design and Develop Library Management system using OOP Concepts.

29\. Write a C++ program to implement a small database mini project to understand persistent objects and operations on sequential files (ex- library information, inventory systems, automated banking system, reservation systems etc.) For example, write a program to create a database for reservation system using information such as Name, sex, age, starting place of journey and destination. Program should have following facilities a) To display entire passenger list b) To display particular record c) To update record d) To delete and sort record. Use Exception Handling for data verification

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210249: Soft Skills

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours /Week	01	TW: 25 Marks

Course Objectives:

- To encourage the all round development of students by focusing on soft skills.
- To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

On completion of the course, student will be able to–

- Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents.
- Actively participate in group discussion / meetings / interviews and prepare & deliver presentations.
- Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.

Course Contents

Unit I — Self-Development

Introduction to soft skills, Self-Management: Self-Evaluation, Self-Discipline, Self-Criticism, Self-Awareness, Self-Esteem, Positive Thinking, Perceptions and Attitudes, Values and Belief Systems, Personal success factors, Handling failure, Knowing Yourself, identifying one‘s strengths and weaknesses, SWOT analysis, Johari‘s Window, Career Planning & Goal setting, prioritization, Managing self – emotions, ego, pride, stress; Personality development.

Unit II — Communication Skills

Significance of Communication- types, barriers of communication, effective communication, Verbal and non-verbal Communication, Speaking Skills – Importance of speaking effectively, speech process, message, audience, speech. Style, feedback, conversation and oral skills, fluency and self expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques, Public Speaking, Group discussion, Listening Skills: Virtues of Listening, Barriers and filters, Fundamentals of Good Listening, Reading Skills: Comprehension, reading research papers, Communication in a Digital World.	
Unit III	**Language and Writing Skills**
Vocabulary: One - Word Substitutes, Words often Confused - Pairs of Words, Synonyms and Antonyms, Foreign Phrases, Phrasal verbs derived from the dynamic verbs, Business Writing: Note Making, Letter writing, Writing Formal Letters. Technical Report Writing, Memo, Notices/Circulars Agenda and Minutes of a Meeting, E-Mail, Essay writing. Employment Communication: Job Application, Preparation of CV and Resume writing. Presentation skills: Professional Presentation, Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation.	
Unit IV	**Leadership and Team Building**
Introduction, Leader and Leadership, Leadership Traits, Culture and Leadership: Salient Features of Corporate Culture, Leadership Styles, Leadership Trends, Team Building: Team Development Stages, Types of Teams: Cross-functional Team, Problem-solving Team, Inter- personal relations: Types of feelings, steps to deal with complex feelings. Assertiveness and Confidence building. Types of Conflict and resolutions. Emotions, emotional empathy and emotional intelligence.	
Unit V	**Stress and Time Management**
Introduction, Stress in Today‘s Time: Identify the Stress Source, Signs of Stress, Ways to Cope with Stress : Healthier Ways to Combat Stress, Steps to be Taken in the Organizations : Open communication, Time Management, Working towards Your Goals, Smart Work, Prioritize your Tasks,4 Ds of Decision Making.	
Unit VI	**Ethics, Etiquette and Mannerism**
Professional Etiquette: Etiquette at Meetings, Etiquette at Dining. Involuntary Awkward Actions, Public Relations Office(PRO)‘s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics, Problems in the Absence of Work Ethics.	
Books:	
Text: **1.** Gajendra Singh Chauhan, Sangeeta Sharma: Soft Skills – An Integrated Approach to Maximize Personality, WILEY INDIA, ISBN:13:9788126556397.	

References:

1. Indrajit Bhattacharya, ―An Approach to Communication Skills", Delhi, Dhanpat Rai, 2008.
2. Simon Sweeney, ―English for Business Communication", Cambridge University Press, ISBN 13:978-0521754507.
3. Sanjay Kumar and Pushpa Lata, ―Communication Skills", Oxford University Press, ISBN 10:9780199457069.
4. Atkinson and Hilgard's, ―Introduction to Psychology", 14th Edition, Geoffrey Loftus, ISBN-10:0155050699 © 2003
5. Kenneth G. Mcgee, ―Heads Up: How to Anticipate Business Surprises & Seize Opportunities First", Harvard Business School Press, Boston, Massachusetts, 2004, ISBN 10:1591392993.
6. Krishnaswami, N. and Sriraman, T, ―Creative English for Communication", Macmillan.

Guidelines for Instructor's Manual

The instructor‗s manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration concept objectives, outcomes, guidelines, references.

Guidelines for Student's Lab Journal and TW Assessment

The student must prepare the journal in the form of **report** elaborating the activities performed in the lab. Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOT analysis, presentations, team activity, event management, group discussion, Group exercises and interpersonal skills and similar other activities/assignments.

Guidelines for Soft skills Lab Conduction

The instructor may frame assignments to enhance skills supporting career aspects. Multiple set of activity based assignments can be prepared and distributed among batches. Every student must be given adequate opportunity to participate actively in each activity. An exercise can be designed to allow multiple skills exposure for example a group task encouraging discussions, team building, value sharing, leadership and role play all at the same time.

Suggested List of Laboratory Assignments

1.	**SWOT analysis** The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self confidence, etiquettes, non-verbal skills, achievements etc. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.
2.	**Personal & Career Goal setting – Short term & Long term** The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.

3.	**Public Speaking** Any one of the following activities may be conducted : **1. Prepared speech (**Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) **2. Extempore speech (**Students deliver speeches spontaneously for 5 minutes each on a given topic) **3. Story telling** (Each student narrates a fictional or real life story for 5 minutes each) **4. Oral review** (Each student orally presents a review on a story or a book read by them)
4.	**Reading and Listening skills** The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.
5.	**Group discussion** Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedback.
6.	**Letter/Application writing** Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
7.	**Report writing** The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal etc.
8.	**Resume writing-** Guide students and instruct them to write resume.
9.	**Presentation Skill** Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
10.	**Team games for team building -** Students should make to participate in team activity.
11.	**Situational games for role playing as leaders**
12.	**Faculty may arrange one or more sessions from following:** Yoga and meditation. Stress management, relaxation exercises, and fitness exercises. Time management and personal planning sessions.
13.	**Mock interviews-** guide students and conduct mock interviews

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement knowledge and skills. A student will be awarded the bachelor‘s degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course.

The student may opt for one of the audit courses per semester, starting from second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater details resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP (Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 1 Options

Course Code	Audit Course Title
AC1-I	Road Safety
AC1-II	Humanities and Social Sciences
AC1-III	Environmental Studies
AC1-IV	Smart Cities
AC1-V	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese (Module 1)** are provided. For other languages institute may design suitably.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-I: Road Safety

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory regulation has been responsible for increase in the number of accidents. India‘s vehicle population is negligible as compared to the World statistics; but the comparable proportion for accidents is substantially large.

The need for stricter enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the ibid stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Contents:

1. Existing Road Transport Scenario
2. Accident Causes & Remedies
3. Road Accident Investigation & Investigation Methods
4. Vehicle Technology – CMVR & Road Safety
5. Regulatory / Legislative Provisions for Improving Road Safety
6. Behavioral Training for Drivers for Improving Road Safety
7. Road Safety Education
8. Road Engineering Measures for Improving Road Safety

References:

1. ―Road Accidents in India Issues & Dimensions" , Ministry of Road Transport & Highways Government of India (www.unescap.org/sites/default/files/2.12.India_.pdf)
2. ―Road Safety in India- Insights and analysis", http://indiatransportportal.com/wp-content/uploads/2012/11/Road_safety_2012.pdf
3. Road User‘s Handbook, ROADS & MARITIME PUBLICATIONS
4. ―Improving Road Safety in Developing Countries", The national Academic Press

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-II: Humanities and Social Sciences

Objective of Humanities and Social Science (HSS) is to produce well-rounded engineers, not only having good technological skills but also with the ability to interact with different organs of an organization.

HSS is concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science". The main social sciences include economics, political science, human geography, demography and sociology. In a wider sense, social science also includes some fields in the humanities such as anthropology, archaeology, psychology, history, law and linguistics.

Course Objectives:

- Human and social development;
- Contemporary national and international affairs;
- Emergence of Indian society and Economics

Course Outcomes:

On completion of the course, student will be able to–

- Making engineering and technology students aware of the various issues concerning man and society.
- These issues will help to sensitize students to be broader towards the social, cultural, economic and human issues, involved in social changes
- Able to understand the nature of the individual and the relationship between the self and the community
- Understanding major ideas, values, beliefs, and experiences that have shaped human history and cultures

Course Contents

1. **Indian Society :** Structure of Indian Society, Indian Social Demography– Social and Cultural, Differentiations: caste, class, gender and tribe; Institutions of marriage, family and kinship- Secularization –Social Movements and Regionalism- Panchayatraj Institutions; Indian constitution; Affirmative Action Programme of the Government- various reservations and commissions.

2. **Social Development**: Scientific approach to the study of human beings. Evolution of human kind, social change and evolution. Industrial revolution. National policy on education, health and health care and human development.

3. **Sectoral Development: Agriculture:** Technology changes, Green revolutions, Employment Rural & Urban, Government Schemes. Industrial Development: Strategies, Public & Private Sectors, Categories, infrastructure, transport & communication, Consumer Awareness.

4. **Environment & Ecology:** Ecosystems: Structure, Working, components. Pollution: Water & Air Pollution, Global Warming, Control Strategies, International Treaties. Energy Sources: Renewable & Non Renewable, Hydro power, Biomass, Ocean, Geothermal & Tidal. Global Environmental Issues: Population Growth, Soil Degradation, Loss of Biodiversity.

References:

1. Krugman, ―International Economics", Pearson Education, ISBN-13:000-01334-23646
2. Prakash, ―The Indian Economy", Pearson Education, ISBN-8131758931
3. Thursen Gerald, ―Engineering Economics", Prentice Hall, ISBN-10:0138221227
4. C.S. Rao, ―Environmental Pollution Control Engineering", New Age International Pvt. Ltd, ISBN-812241835X
5. Rangarajan, ―Environmental Issues in India, Pearson Education", ISBN-10:8131708101
6. University of Delhi, ―The Individual & Society", Pearson Education. ISBN-8131704173
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, ―Social change in modern India, 1991", Orient Longman, ISBN-10:812500422X
9. David Mandelbaum, ―Society in India", 1990, Popular, ISBN-10:8171540139
10. David Newman, ―Exploring the architecture of everyday life", Pine Forge Press, 7th edition, ISBN-10:1452275947

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-III: Environmental Studies

Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
- Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

On completion of the course, student will be able to–

- Comprehend the importance of ecosystem and biodiversity
- To correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention
- Identify different types of environmental pollution and control measures
- To correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents:

1. **Natural Resources:** Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
2. **Ecosystems:** Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
3. **Biodiversity:** Genetic, Species and ecological diversity, Biogeographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
4. **Pollution:** Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution case studies, Disaster management

References:

1. Bharucha, E., ―Textbook of Environmental Studies", Universities Press (2005), ISBN-10:8173715408
2. Mahua Basu, ―Evironmental Studies", Cambridge University Press, ISBN-978-1-107-5317-3

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-IV: Smart Cities

We breathe in a world defined by urbanization and digital ubiquity, where mobile broadband connections outnumber fixed ones, machines dominate a new "internet of things," and more people live in cities than in the countryside. This course enables us to take a broad historical look at the forces that have shaped the planning and design of cities and information technologies from the rise of the great industrial cities of the nineteenth century to the present. This course considers the motivations, aspirations, and shortcomings of them all while offering a new civics to guide our efforts as we build the future together, one click at a time.

Course Objectives:

- To identify urban problems
- To study Effective and feasible ways to coordinate urban technologies.
- To study models and methods for effective implementation of Smart Cities.
- To study new technologies for Communication and Dissemination.
- To study new forms of Urban Governance and Organization.

Course Outcomes:

On completion of the course, learner will be able to–

- Better understanding of the dynamic behavior of the urban system by going beyond the physical appearance and by focusing on representations, properties and impact factors
- Exploration of the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows
- Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing
- Knowledge about the latest research results in for the development and management of future cities
- Understanding how citizens can benefit from data-informed design to develop smart and responsive cities

Course Contents:

Urbanization and Ubiquity - The slow emergence of learning cities in an urbanizing world Cities as collective learners, what do we know?- Framing a view -A gamut of learning types - Secrets of knowing and accelerating change - Why some cities learn and others do not.

References:

1. Anthony M. Townsend, W. W. Norton & Company ―Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", ISBN: 0393082873, 9780393082876.
2. Tim Campbell, Routledge ―Beyond Smart Cities: How Cities Network, Learn and Innovate", Routledge, ISBN: 9781849714266.
3. Stan Geertman, Joseph Ferreira, Jr. Robert Goodspeed, John Stillwell, ―Planning Support System ms and Smart Cities", Lecture notes in Geo information and Cartography, Springer.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-V: Foreign Language- Japanese (Module 1)

About course:

With changing times, the competitiveness has gotten into the nerves and ‗Being the Best' at all times is only the proof of it. Nonetheless, ‗being the best' differs significantly from ‗Communicating the best'. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‗resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course student

- will have ability of basic communication.
- will have the knowledge of Japanese script.
- will get introduced to reading , writing and listening skills
- will develop interest to pursue professional Japanese Language course.

Course Contents:

1 : Introduction to Japanese Language. Hiragana basic Script, colors, Days of the week

2 : Hiragana : modified Kana, double consonant, Letters combined with ya, yu, yo Long vowels, Greetings and expressions

3 : Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one's age.

References:

1. Minna No Nihongo, ―Japanese for Everyone", Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

SEMESTER II

Savitribai Phule Pune University
Second Year of Computer Engineering/IT (2015 Course)
207003: Engineering Mathematics III

Teaching Scheme:		Examination Scheme:
TH: 04 Hours/Week	Credit	In-Sem(online): 50 Marks
TUT: 01 Hour/Week	05	End-Sem(paper): 50 Marks
		TW: 25 Marks

Prerequisites:

Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of Central tendency and dispersion, Vector algebra, Algebra of complex numbers.

Course Objectives:

After completing this course, student will have adequate mathematical background, conceptual clarity, computational skills and algorithm design for problem solving related to:

- Linear differential equations of higher order applicable to Control systems, Computer vision and Robotics.
- Transform techniques such as Fourier transform, Z-transform and applications to Image processing.
- Statistical methods such as correlation, regression analysis and probability theory to analyze data and to make predictions applicable to machine intelligence.
- Vector calculus necessary to analyze and design complex electrical and electronic devices as appropriate to Computer engineering.
- Complex functions, conformal mappings and contour integration applicable to Image processing, Digital filters and Computer graphics.

Course Outcomes:

On completion of the course, student will be able to–

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Z-Transform and applications to Signal and Image processing.
- Apply statistical methods like correlation, regression analysis and probability theory for analysis and prediction of a given data as applied to machine intelligence.
- Perform vector differentiation and integration to analyze the vector fields and apply to compute line, surface and volume integrals.
- Analyze conformal mappings, transformations and perform contour integration of complex functions required in Image processing, Digital filters and Computer graphics.

Course Contents

Unit I	Linear Differential Equations (LDE) and Applications	09 Hours

LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy‘s & Legendre‘s DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II	Transforms	09 Hours

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Discrete Fourier Transform.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III	Statistics	09 Hours
Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.		
Unit IV	**Probability and Probability Distributions**	**09 Hours**
Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergometric, Test of Hypothesis: Chi-Square test, t-distribution.		
Unit V	**Vector Calculus**	**09 Hours**
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoid and Irrigational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.		
Unit VI	**Complex Variables**	**09 Hours**
Functions of Complex variables, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series, and Residue theorem.		

Books:

Text:

1. Erwin Kreyszig, ―Advanced Engineering Mathematics". 9e, Wiley India, ISBN - 10: 9780470458365, 13: 978-0470458365.
2. Peter V. O'Neil, ―Advanced Engineering Mathematics", 7e, Cengage Learning, ISBN - 10: 1111427410.

References:

1. M. D. Greenberg, ―Advanced Engineering Mathematics", 2e, Pearson Education, ISBN: 10: 0133214311, 13: 978-0133214314.
2. Wylie C.R. & Barrett L.C., ―Advanced Engineering Mathematics", McGraw-Hill, Inc., ISBN: 0-07-072188-2.
3. B. S. Grewal, ―Higher Engineering Mathematics", Khanna Publication, Delhi, ISBN : 92 803-11026
4. P. N. Wartikar & J. N. Wartikar," Applied Mathematics", Vidyarthi Griha Prakashan, Pune, ISBN: 0-7923-0594-9.
5. B.V. Ramana, ―Higher Engineering Mathematics", Tata McGraw-Hill, ISBN: 007063419X.
6. Thomas L. Harman, Dabney and Norman Richert, ―Advanced Engineering Mathematics with MATLAB", 2e, Thomson Learning, ISBN: 13: 978-0534371647

Guidelines for Tutorial and Term Work:

- Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division
- Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210251: Computer Graphics

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem(online): 50 Marks End-Sem(paper): 50 Marks

Prerequisite:

- Data Structures and algorithms
- Basic Mathematics, Geometry, linear algebra, vectors and matrices.

Course Objectives:

- To acquaint the learner with the basic concepts of Computer Graphics
- To learn the various algorithms for generating and rendering graphical figures
- To get familiar with mathematics behind the graphical transformations
- To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting

Course Outcomes:

On completion of the course, student will be able to–

- Apply mathematics and logic to develop Computer programs for elementary graphic operations
- Develop scientific and strategic approach to solve complex problems in the domain of Computer Graphics
- Develop the competency to understand the concepts related to Computer Vision and Virtual reality
- Apply the logic to develop animation and gaming programs

Course Contents

Unit I	Graphics Primitives and Scan Conversion	09 Hours

Concepts, applications of computer graphics, pixel, frame buffer, resolution, aspect ratio.

Plotting Primitives: Scan conversions, lines, line segments, vectors, pixels and frame buffers, vector generation

Scan Conversion: Line and line segments, qualities of good line drawing algorithms, line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham and parallel line algorithms, Line styles: thick, dotted and dashed. Circle drawing algorithm: DDA, Bresenham. Character generating methods: stroke and bitmap method.

Display Files: display file structure, algorithms and display file interpreter. Primitive operations on display file.

Unit II	Polygons and Clipping Algorithms	09 Hours

Introduction to polygon, types: convex, concave and complex. Representation of polygon, Inside test, polygon filling algorithms – flood fill, seed fill, scan line fill and filling with patterns.

Windowing and clipping: viewing transformations, 2-D clipping: Cohen – Sutherland algorithm, Polygon clipping: Sutherland Hodgeman algorithm, generalized clipping.

Unit III	2-D, 3-D Transformations and Projections	09 Hours

2-D transformations: introduction, matrices, Translation, scaling, rotation, homogeneous coordinates and matrix representation, translation, coordinate transformation, rotation about an arbitrary point, inverse and shear transformation.
3-D transformations: introduction, 3-D geometry, primitives, 3-D transformations and matrix representation, rotation about an arbitrary axis, 3-D viewing transformations, 3-D Clipping
Projections : Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)

Unit IV	Segment and Animation	09 Hours

Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. **Animation:** Introduction, Design of animation sequences, Animation languages, Key-frame, Morphing, Motion specification.
Colour models and applications: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY, YIQ, colour Selection and applications.

Unit V	Shading, and Hidden Surfaces	09 Hours

Illumination Models: Light Sources, Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model, **Shading Algorithms:** Halftone, Gauraud and Phong Shading. **Hidden Surfaces** Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock), BSP tree, and Scan line.

Unit VI	Curves and Fractals	09 Hours

Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, **Fractals**: Introduction, Classification, Applications, Fractal generation: snowflake, Triadic curve, Hilbert curve. **Gaming:** Introduction, Gaming platform (NVIDIA, i8060 etc.), Advances in Gaming, **Graphics Tools:** Introduction, Interactive graphics tool: OpenGL

Books:

Text:

1. S. Harrington, ―Computer Graphics”, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. D. Rogers, ―Procedural Elements for Computer Graphics”, 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.
3. Donald D. Hearn, ―Computer Graphics with Open GL”, 4th Edition, ISBN-13: 9780136053583.

References:

1. J. Foley, V. Dam, S. Feiner, J. Hughes, ―Computer Graphics Principles and Practice”, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9.
2. D. Rogers, J. Adams, ―Mathematical Elements for Computer Graphics”, 2nd Edition, Tata McGrawHill Publication, 2002, ISBN 0 – 07 – 048677 – 8.
3. Mario Zechner, Robert Green, ―Beginning Android 4 Games Development”, Apress, ISBN: 978-81- 322-0575-3.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210252: Advanced Data Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem(online): 50 Marks End-Sem(paper): 50 Marks

Prerequisite:

- Data Structures and algorithms
- Basic Mathematics, Geometry, linear algebra, vectors and matrices.

Course Objectives:

- To develop a logic for graphical modelling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, student will be able to–

- To apply appropriate advanced data structure and efficient algorithms to approach the problems of various domain.
- To design the algorithms to solve the programming problems.
- To use effective and efficient data structures in solving various Computer Engineering domain problems.
- To analyze the algorithmic solutions for resource requirements and optimization
- To use appropriate modern tools to understand and analyze the functionalities confined to the data structure usage.

Course Contents

Unit I	Trees	09 Hours

Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, **binary tree traversals-** inorder, preorder, post order, level wise -depth first and breadth first, Operations on binary tree. Binary Search Tree (BST), BST operations, Threaded binary tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary tree, in order traversal of in-order threaded binary tree. **Case Study**- Use of binary tree in expression tree-evaluation and Huffman's coding

Unit II	Graphs	09 Hours

Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Introduction to Greedy Strategy, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, Topological ordering.

Case study- Data structure used in Webgraph and Google map.

Unit III	Hashing	09 Hours
Hash Table- Concepts-hash table, hash function, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing. **Dictionary-** Dictionary as ADT, ordered dictionaries. **Skip List-** representation, searching and operations- insertion, removal.		
Unit IV	**Search Trees**	**09 Hours**
Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Introduction to Dynamic Programming, Weight balanced tree, Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree.		
Unit V	**Indexing and Multiway Trees**	**09 Hours**
Indexing and Multiway Trees- Indexing, indexing techniques, Types of search tree- Multiway search tree, B-Tree, B+Tree, Trie Tree, Splay Tree, Red-Black Tree, K-dimensional tree, AA tree. **Set-** Set ADT, realization of Set and operations. **Heap-**Basic concepts, realization of heap and operations, Heap as a priority queue, heap sort		
Unit VI	**File Organization**	**09 Hours**
Sequential file organization- concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions. **External Sort-** Consequential processing and merging two lists, multiday merging- a k way merge algorithm.		

Books:

Text:

1. Horowitz, Sahani, Dinesh Mehata, ―Fundamentals of Data Structures in C++", Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, ―File Structures", Pearson Education, ISBN:81-7758-37-5
3. Peter Brass, ―Advanced Data Structures", Cambridge University Press, ISBN: 978-1-107-43982-5

References:

1. A. Aho, J. Hopcroft, J. Ulman, ―Data Structures and Algorithms", Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, ―File Structures an Object Oriented Approach with C++", Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, ―Data Structures, Algorithms and Applications in C++", Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, ―Data Structures and Algorithms", The McGraw-Hill Companies, ISBN - 9780070667266.
5. Goodrich, Tamassia, Goldwasser, ―Data Structures and Algorithms in Java", Wiley Publication, ISBN: 9788126551903.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210253: Microprocessor

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 Hours/Week	04	In-Sem(online): 50 Marks End-Sem(paper): 50 Marks

Prerequisite: Digital Electronics and Logic Design

Course Objectives:

- To learn the architecture and programmer's model of advanced processor
- To understand the system level features and processes of advanced processor
- To acquaint the learner with application instruction set and logic to build assembly language programs.
- To understand debugging and testing techniques confined to 80386 DX

Course Outcomes:

On completion of the course, student will be able to–

- To apply the assembly language programming to develop small real life embedded application.
- To understand the architecture of the advanced processor thoroughly to use the resources for programming
- To understand the higher processor architectures descended from 80386 architecture

Course Contents

Unit I	80386DX- Basic Programming Model and Applications Instruction Set	09 Hours

Memory Organization and Segmentation- Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, Data Types, Registers, Instruction Format, Operand Selection, Interrupts and Exceptions

Applications Instruction Set- Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.

Unit II	Systems Architecture and Memory Management	09 Hours

Systems Architecture- Systems Registers, Systems Instructions.

Memory Management- Segment Translation, Page Translation, Combining Segment and Page Translation.

Unit III	Protection and Multitasking	09 Hours

Protection- Need of Protection, Overview of 80386DX Protection Mechanisms, Segment Level Protection, Page Level Protection, Combining Segment and Page Level Protection.

Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space.

Unit IV	Input-Output, Exceptions and Interrupts	09 Hours

Input-Output- I/O Addressing, I/O Instructions, Protection and I/O

Exceptions and Interrupts- Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions.

Unit V	Initialization of 80386DX, Debugging and Virtual 8086 Mode	09 Hours

Initialization- Processor State after Reset, Software Initialization for Real Address Mode, Switching to Protected Mode, Software Initialization for Protected Mode, Initialization Example, TLB Testing

Debugging- Debugging Features of the Architecture, Debug Registers, Debug Exceptions, Breakpoint Exception

Virtual 8086 Mode- Executing 8086 Code, Structure of V86 Stack, Entering and Leaving Virtual 8086 Mode.

Unit VI	80386DX Signals, Bus Cycles and 80387 Coprocessor	09 Hours

80386DX Signals- Signal Diagram, Description of Signals **80386DX Bus Cycles-** System Clock, Bus States, Pipelined and Non-pipelined Bus Cycles.

80387 NDP- Control Register bits for Coprocessor support, 80387 Register Stack, Data Types, Load and Store Instructions, Trigonometric and Transcendental Instructions, Interfacing signals of 80386DX with 80387.

Books:

Text:

1. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.
2. James Turley, ―Advanced 80386 Programming Techniques”, McGraw-Hill, ISBN: 10: 0078813425, 13: 978-0078813429.
3. Intel 387DX Math coprocessor, Order no.: 240448-005, March1992.

References:

1. Chris H. Pappas, William H. Murray, ―80386 Microprocessor Handbooks”, McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
2. Walter A. Triebel, ―The 80386Dx Microprocessor: Hardware”, Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
3. Brey, Barry B, ―8086/8088, 80286, 80386 and 80486 Assembly Language Programming”, Prentice Hall, ISBN: 13: 9780023142475.
4. Mohammad Rafiquzzaman, ―Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
5. K. Bhurchandi, A. Ray, ―Advanced Microprocessors and Peripherals”, McGraw Hill Education, Third Edition, ISBN: 978-1-25-900613-5.
6. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.
7. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210254: Principles of Programming Languages

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	TH: 03	In-Sem(online): 50 Marks End-Sem(paper): 50 Marks

Prerequisite: Data Structures & Algorithms and Object Oriented Programming

Course Objectives:
- To learn principles of programming language
- To understand structural, computational and logical implications regarding programming languages
- To explore main programming paradigms
- To understand and apply Object Oriented Programming (OOP) principles using C++ and Java

Course Outcomes:

On completion of the course, student will be able to–
- To analyze the strengths and weaknesses of programming languages for effective and efficient program development.
- To inculcate the principles underlying the programming languages enabling to learn new programming languages.
- To grasp different programming paradigms
- To use the programming paradigms effectively in application development.

Course Contents

Unit I	Programming Language Syntax and semantics	07 Hours

Software development process, language and software development environments, language and software design methods, languages and computer architecture, programming language qualities, languages and reliability, languages and maintainability, languages and efficiency, a brief historical perspective and early high level languages, a bird's eye view of programming language concepts.

Syntax and semantics-language definition, syntax, abstract syntax, concrete syntax, and pragmatics, semantics, an introduction to formal semantics, languages, language processing, interpretation, translation, the concept of binding, variables, name and scope, Type, l-value, r-value, reference and unnamed variables, routines, generic routines, aliasing and overloading, an abstract semantic processor, run time structure. Case study- run time structure of C.

Unit II	Structuring the Data, Computations and Program	07 Hours

Structuring of Data- Built in and primitive types, Data aggregates and type constructors, Cartesian product, Finite mapping User-defined types and abstract data types, Type systems, Static versus dynamic program checking, Strong typing and type checking, Type compatibility, Type conversions, Types and subtypes, Generic types, monomorphic versus polymorphic type systems, Case Study- The type structure of C++, Java. **Structuring of Computations-** Structuring the computation, Expressions and statements, Conditional execution and iteration, Routines, Style issues: side effects and aliasing, Exceptions, Case Study-Exception handling in C++.

Unit III	Structuring of Program	07 Hours

Structuring of Program-
Software design method, Concepts in support of modularity, Encapsulation, Interface and implementation, Separate and independent compilation, Libraries of modules, Language features for programming in the large, Program organization, Grouping of units, Encapsulation, Interface and implementation, Abstract data types, classes, and modules, Generic units, Generic data structures, Generic algorithms, Generic modules, Higher levels of genericity.
Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based.
Study of Java as Object oriented programming language.

Unit IV	Java as Object Oriented Programming Language-Overview	07 Hours

Java History, Java Features, Java and Internet, Java and Word Wide Web, Web Browsers, Java Virtual Machine, **Data Types and Size** (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type) **Arrays:** one dimensional array, multi-dimensional array, alternative array declaration statements. **Control Statements** Revision of identical selection Statements in brief (if, else if, Nested if, Switch, Nested Switch), Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop, Using comma in for loop), Jump Statements (Labeled Break and Labeled Continue), **String Handling:** String class methods.

Unit V	Inheritance, Polymorphism, Encapsulation using Java	07 Hours

Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length arguments. **Inheritances**: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.

Unit VI	Exception Handling in Java	07 Hours

fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class, **Applet**: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Difference between Applet and Application Program.

Books:

Text:

1. Carlo Ghezzi, Mehdi Jazayeri, ―Programming Language Concepts",3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.
2. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9.

References:

1. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
2. Deugo, ―Java Gems", Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
3. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation", 4th Ed, PHI, ISBN 81-203-2035-2.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210255: Computer Graphics Lab

Lab Scheme:	Credit	Examination Scheme:
PR: 02 Hours/Week	01	TW: 25 Marks PR: 50 Marks

Guidelines for Instructor's Manual

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Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student‘s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. Encourage students for the use of industry coding standards such as appropriate use of Hungarian notation, Indentation and comments. Use Display file where ever suitable.

Use of open source software is encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project. Based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

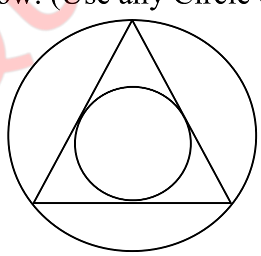
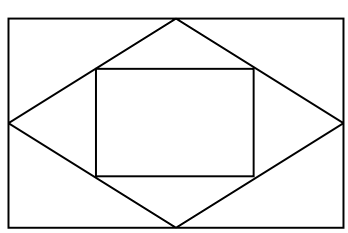
Operating System recommended :- 64-bit Open source Linux or its derivative

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC.

Set of suggested assignment list is provided in groups- A, B, and C. Instructor is suggested to design lab assignments list by selecting/designing **12** suitable assignments- any 5 of group A, 5 from group B, **2** from group C (assignment number 26 is mandatory).

Suggested List of Laboratory Assignments

Group A

1.	Write C++/Java program to draw line using DDA and Bresenham's algorithm. Inherit pixel class and Use function overloading.
2.	Write C++/Java program to draw circle using Bresenham's algorithm. Inherit pixel class.
3.	Write C++/Java program to draw 2-D object and perform following basic transformations, a) Scaling b) Translation c) Rotation Use operator overloading.
4.	Write C++/Java program to fill polygon using scan line algorithm. Use mouse interfacing to draw polygon.
5.	A Mandelbrot Set is a set of complex number z that does not diverge under the transformation $x_{n+1} = x_n^2 + z$ with $x_0 = 0$. Where, both x and z represent the complex numbers. Write C++/Java program to a). Plot the Mandelbrot set for the threshold |x|= 2. b) Plot Julia set choosing z ≠ 0. Use 254 colors for plotting in both cases.
6.	Write C++/Java program to draw the polygons by using the mouse. Choose colors by clicking on the designed color pane. Use window port to draw. Use DDA algorithm for line drawing.
7.	Write C++/Java program to draw inscribed and Circumscribed circles in the triangle as shown as an example below. (Use any Circle drawing and Line drawing algorithms) 
8.	Write C++/Java program to draw the following pattern using any Line drawing algorithms. 

9.	Write C++/Java program to draw a 4X4 chessboard rotated 45˚ with the horizontal axis. Use Bresenham algorithm to draw all the lines. Use seed fill algorithm to fill black squares of the rotated chessboard.
Group B	
10.	Write C++/Java program for line drawing using DDA or Bresenhams algorithm with patterns such as solid, dotted, dashed, dash dot and thick.
11.	Write C++/Java program to draw a convex polygon and fill it with desired color using Seed fill algorithm. Use mouse interfacing to draw polygon.
12.	Write C++/Java program to draw a concave polygon and fill it with desired pattern using scan line algorithm. Use mouse interfacing to draw polygon.
13.	Write C++/Java program to implement Cohen-Sutherland line clipping algorithm for given window. Draw line using mouse interfacing to draw polygon
14.	Write C++/Java program to draw any object such as flower, waves using any curve generation techniques
15.	Write C++/Java program to implement Painter‘s algorithm for hidden surface removal
16.	Write C++/Java program to implement reflection of2-D object about X axis, Y axis and about X=Y axis. Also rotate object about arbitrary point given by user.
17.	Write C++/Java program to generate Hilbert curve using concept of fractals.
18.	Write C++/Java program to generate snowflake using concept of fractals.
19.	Write C++/Java program to generate Bouncing ball animation using Direct3D/Maya/Blender
20.	Write program to implement Cohen Sutherland Hodgman algorithm to clip any polygon. Provide the vertices of the polygon to be clipped and pattern of clipping interactively.
21.	Write C++/Java program to implement translation, sheer, rotation and scaling transformations on equilateral triangle and rhombus.
Group C	
22.	Write C++/Java program to draw 3-D cube and perform following transformations on it using OpenGL. a) Scaling b) Translation c) Rotation about one axis
23.	Design and simulate any data structure like stack, queue, and trees using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL.
24.	Write C++/Java program to draw implement Cube rotation about vertical axis passing through its centroid.
25.	Write C++/Java program to generate fractal patterns by using Koch curves.
26.	Write C++/Java program to simulate any one of or similar scene- • Clock with pendulum • National Flag hoisting • Vehicle/boat locomotion • Water drop falling into the water and generated waves after impact • Kaleidoscope views generation (at least 3 colorful patterns)
Mini Project (Optional)- Design and implement game / animation clip / Graphics Editor using open source graphics library.	

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210256: Advanced Data Structures Lab		
Lab Scheme: **PR: 04 Hours/Week**	**Credit** **02**	**Examination Scheme:** **TW: 50 Marks** **PR: 50 Marks**

Guidelines for Instructor's Manual

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Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Practical Examination

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student‘s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

Guidelines for Laboratory Conduction

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, Indentation and comments. Use of open source software is encouraged.

In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Set of suggested assignment list is provided in six groups. Each student must perform at least 13 assignments as at least 02 from group A, 02 from group B, 2 from group C, 2 from group D, 01 from group E, 01 from group F and 3 from group G.

Operating System recommended : 64-bit Open source Linux or its derivative
Programming tools recommended: Open Source C++ Programming tool like G++/GCC

Suggested List of Laboratory Assignments

Write C++/Java program for following-

Group A

1.	A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method.
2	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - i. Insert new node ii. Find number of nodes in longest path iii. Minimum data value found in the tree iv. Change a tree so that the roles of the left and right pointers are swapped at every node v. Search a value
3	For given expression eg. a-b*c-d/e+f construct inorder sequence and traverse it using postorder traversal(non recursive).
4	Read for the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function?
5	Given binary tree with n nodes, assign this tree to another [operator=] and then erase all nodes in a binary tree.
6	Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm.
7	Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity.
8	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation.

Group B

9	Write a function to get the number of vertices in an undirected graph and its edges. You may assume that no edge is input twice. i. Use adjacency list representation of the graph and find runtime of the function ii. Use adjacency matrix representation of the graph and find runtime of the function
10	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight takes to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Justify the storage representation used.
11	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.
12	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
13	Consider the scheduling problem. n tasks to be scheduled on single processor. Let t1, ..., tn be durations required to execute on single processor is known. The tasks can be executed in any order but one task at a time. Design a greedy algorithm for this problem and find a schedule that minimizes the total time spent by all the tasks in the system. (The time spent by one is the sum of the waiting time of task and the time spent on its execution.)
	Group C
14	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client‘s telephone number.
15	Implement all the functions of a dictionary (ADT) using hashing. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique Standard Operations: Insert(key, value), Find(key), Delete(key)
16	For given set of elements create skip list. Find the element in the set that is closest to some given value.
17	The symbol table is generated by compiler. From this perspective, the symbol table is a set of name-attribute pairs. In a symbol table for a compiler, the name is an identifier, and the attributes might include an initial value and a list of lines that use the identifier. Perform the following operations on symbol table: (1) Determine if a particular name is in the table (2) Retrieve the attributes of that name (3) Modify the attributes of that name (4) Insert a new name and its attributes (5) Delete a name and its attributes
	Group D

18	Given sequence k = k1 <k2 < … < kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key.
19	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
Group E	
20	To create ADT that implements the SET concept. a. Add (newElement) -Place a value into the set b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection e. Intersection of two sets, f. Union of two sets, g. Difference between two sets, h. Subset
21	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyze the algorithm.
Group F	
22	Assume we have two input and two output tapes to perform the sorting. The internal memory can hold and sort m records at a time. Write a program in java for external sorting. Find out time complexity.
23	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to main the data.
24	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.
Group G	
25	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language.
26	Any application defining scope of Formal parameter, Global parameter, Local parameter accessing mechanism and also relevance to private, public and protected access. Write a Java program which demonstrates the scope rules of the programming mechanism.
27	Write a Java program which will demonstrate a concept of Interfaces and packages: In this assignment design and use of customized interfaces and packages for a specific application are expected.
28	Write a Java program which will demonstrate a concept of cohesion and coupling of the various modules in the program.
29	Write a program on template and exception handling in Java: in this assignment multiple templates are to be designed as a pattern and these patterns to be used to take decisions.
30	Write a Java program for the implementation of different data structures using JAVA collection libraries (Standard toolkit library): at least 5 data structures are used to design a suitable application.
31	Design a mini project using JAVA which will use the different data structure with or without Java collection library and show the use of specific data structure on the efficiency (performance) of the code.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210257: Microprocessor Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 04 Hours/Week	02	TW: 25 Marks PR: 50 Marks

Guidelines for Instructor's Manual

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Guidelines for Student's Lab Journal

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Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Lab /TW Assessment

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Guidelines for Practical Examination

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In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

Operating System: Latest 64-bit Version and update of Microsoft Windows 7/ Windows 8 Operating System onwards or 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM 64x or equivalent, Microsoft Visual Studio x64 Intrinsic.

Suggested List of Laboratory Assignments (Any 12)

1.	Write X86/64 ALP to count number of positive and negative numbers from the array
2.	Write X86/64 ALP to perform non-overlapped and overlapped block transfer (with and without string specific instructions). Block containing data can be defined in the data segment.
3.	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for: (a) HEX to BCD b) BCD to HEX (c) EXIT. Display proper strings to prompt the user while accepting the input and displaying the result. (wherever necessary, use 64-bit registers)
4.	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition and add and shift method. (use of 64-bit registers is expected)
5.	Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file. The text file has to be accessed during Program_1 execution and write FAR PROCEDURES in Program_2 for the rest of the processing. Use of PUBLIC and EXTERN directives is mandatory.
6.	Write X86/64 ALP to switch from real mode to protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers.
7.	Write X86 program to sort the list of integers in ascending/descending order. Read the input from the text file and write the sorted data back to the same text file using bubble sort
8.	Write X86 menu driven Assembly Language Program (ALP) to implement OS (DOS) commands TYPE, COPY and DELETE using file operations. User is supposed to provide command line arguments in all cases.
9.	Write x86 ALP to find the factorial of a given integer number on a command line by using recursion. Explicit stack manipulation is expected in the code.
10.	Write 80387 ALP to find the roots of the quadratic equation. All the possible cases must be considered in calculating the roots.
11.	Write 80387 ALP to plot Sine Wave, Cosine Wave and Sinc function. Access video memory directly for plotting.
12.	Write 80387 ALP to obtain: i) Mean ii) Variance iii) Standard Deviation Also plot the histogram for the data set. The data elements are available in a text file.
13.	Write a Terminate but Stay Resident (TSR) program for a key-logger. The key-presses during the stipulated time need to be displayed at the center of the screen. **OR** Write a TSR to generate the pattern of the frequency tones by reading the Real Time Clock (RTC). The duration of the each tone is solely decided by the programmer.
14.	Write 80386 ALP to implement multitasking. Where each task is supposed to change the color of the text displayed at the center of the screen

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course.
The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

Criteria:

The student registered for audit course shall be awarded the grade AP(Audit Course Pass) and shall be included such AP grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 2 Options

Audit Course Code	Audit Course Title
AC2-I	Water Management
AC2-II	Intellectual Property Rights and Patents
AC2-III	The Science of Happiness
AC2-IV	Stress Relief: Yoga and Meditation
AC2-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-I: Water Management

Water is a vital resource for all life on the planet. Only three percent of the water resources on Earth are fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. One fifth of the remaining one percent is in remote, inaccessible areas. As time advances, water is becoming scarcer and having access to clean, safe, drinking water is limited among countries. Pure water supply and disinfected water treatment are prerequisites for the well-being of communities all over the world. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. This course will provide students a unique opportunity to study water management activities like planning, developing, distributing and optimum use of water resources. This course covers the topics that management of water treatment of drinking water, industrial water, sewage or wastewater, management of water resources, management of flood protection.

Course Objectives:

- To develop understanding of water recourses.
- To study global water cycle and factors that affect this cycle.
- To analyze the process for water resources and management.
- To study the research and development areas necessary for efficient utilization and management of water recourses.

Course Outcomes:

On completion of the course, learner will be able to–

- Understanding of the global water cycle and its various processes
- Understanding of climate change and their effects on water systems
- Understanding of Drinking treatment and quality of groundwater and surface water
- Understanding of the Physical, chemical, and biological processes involved in water treatment and distribution.

Course Contents:

1. Understanding ‗water‘-Climate change and the global water cycle, Understanding global hydrology
2. Water resources planning and management-Water law and the search for sustainability: a comparative analysis, Risk and uncertainty in water resources planning and management
3. Agricultural water use -The role of research and development for agriculture water use
4. Urban water supply and management - The urban water challenge, Water sensitive urban design

References:

1. R. Quentin Graft, Karen Hussey, Quentin Graft, Karen Hussey, Publisher, "Water Resources Planning and Management", Cambridge University Press, ISBN: 9780511974304, 9780521762588.
2. P. C. Basil, "Water Management in India", ISBN: 8180690970, 2004.
3. C.A. Brebbia, "Water Resources Management", ISBN: 978-1-84564-960-9

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-II: Intellectual Property Rights and Patents

Intellectual property is the area of law that deals with protecting the rights of those who create original works. It covers everything from original plays and novels to inventions and company identification marks. The purpose of intellectual property laws is to encourage new technologies, artistic expressions and inventions while promoting economic growth.

Innovation and originality have great potential value. Whatever line of activity you are engaged in, future success depends on them. The last few years have seen intellectual property rights become an issue of general interest: the smart phone ―patent wars", the introduction of Digital Rights management (DRM) and the rise of generic pharmaceuticals and open-source software are just some examples that have been in the public eye. Protecting your intellectual rights appropriately should be a top priority. Yet too many people embark on their chosen professions without even a basic awareness of intellectual property.

Course Objectives:

- To encourage research, scholarship, and a spirit of inquiry
- To encourage students at all levels to develop patentable technologies.
- To provide environment to the students of the Institute for creation, protection, and commercialization of intellectual property and to stimulate innovation.

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition
- Identify, apply and assess principles of law relating to each of these areas of intellectual property
- Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents:

- **Introduction to Intellectual Property Law** – The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law
- **Introduction to Trade mark** – Trade mark Registration Process – Post registration Procedures – Trade mark maintenance - Transfer of Rights – Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark
- **Introduction to Copyrights** – – Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works
- **Introduction to Trade Secret** – Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement

References:

1. Debirag E. Bouchoux: ―Intellectual Property". Cengage learning ISBN-10:1111648573
2. Ferrera, Bird, Darrow, ―Cyber Law. Texts & Cases", South- ISBN:0-324-39972-3
3. Prabhuddha Ganguli: ―Intellectual Property Rights" TMH, ISBN-10:0070077177

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-III : The Science of Happiness

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That‘s where this course comes in. The —The subject —Science of Happiness” aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives:

- To understand the feeling of happiness
- To study the sources of positive feelings
- To analyze the anatomy of the happiness system
- To study the effect of thoughts and emotions on the happiness system

Course Outcomes:

On completion of the course, learner will be able to–

- Ability to understand what happiness is and why it matters to you
- Ability to learn how to increase your own happiness
- Understanding of the power of social connections and the science of empathy
- Ability to understand what is mindfulness and its real world applications

Course Contents:

1. Happiness: what is it?
2. The secret of smiling
3. The autonomy of positive feelings
4. Positive feelings as a compass
5. The happiness system
6. Foundations: Emotions, Motivation and nature of Well being
7. Subjective well being
8. Love and well being
9. Optimal well being
10. Religion, Spirituality and well being

References:

1. Happier, Stefan Klein , "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get”, Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing”, William, Cengage Learning, 2012, ISBN10: 1111834121.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-IV: Stress Relief: Yoga and Meditation

The concepts and practices of Yoga originated in India about several thousand years ago. Its founders were great Saints and Sages. The great Yogis presented rational interpretation of their experiences of Yoga and brought about a practical and scientifically sound method within every one‘s reach. Yoga today, is no longer restricted to hermits, saints, and sages; it has entered into our everyday lives and has aroused a worldwide awakening and acceptance in the last few decades. The science of Yoga and its techniques have now been reoriented to suit modern sociological needs and lifestyles.

Yoga is one of the six systems of Vedic philosophy. The Yoga advocates certain restraints and observances, physical discipline, breathe regulations, restraining the sense organs, contemplation, meditation and Samadhi. The practice of Yoga prevents psychosomatic disorders and improves an individual‘s resistance and ability to endure stressful situations.

Course Objectives:

- To impart knowledge about the basic technique and practice of yoga, including instruction in breath control, meditation, and physical postures
- To gain an intellectual and theoretical understanding of the principles embodied in the Yoga Sutras, the Bhagavad-Gita, and other important texts and doctrines
- Relaxation and stress reduction ,Personal insight and self understanding, Personal empowerment, Gaining wisdom and spiritual discernment
- Awakening the abilities or powers of the Super conscious mind

Course Outcomes:

On completion of the course, learner will be able to–

- Students understanding of philosophy and religion as well as daily life issues will be challenged and enhanced.
- Enhances the immune system.
- Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.
- Powers of concentration, focus, and awareness will be heightened.

Course Contents:

1. Meaning and definition of yoga – Scope of Yoga - Aims and Objectives of Yoga – Misconception about yoga.
2. Ayurveda: an introduction to this system of health care derived from the Vedic tradition Anatomy and Physiology as they relate to Yoga
3. Yoga Philosophy and Psychology

References:

1. B.K.S. Iyengar, ―BKS Iyengar Yoga The Path to Holistic Health", DK publisher, ISBN-13: 978-1409343479
2. Osho, ―The Essence of Yoga", Osho International Foundation, ISBN: 9780918963093

Savitribai Phule Pune University, Pune
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-V: Foreign Language (Japanese) Module 2

With changing times, the competitiveness has gotten into the nerves and ‗Being the Best' at all times is only the proof of it. Nonetheless, ‗being the best' differs significantly from ‗Communicating the best'. The best can merely be communicated whilst using the best suited Language!!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course student-

- will have ability of basic communication.
- will have the knowledge of Japanese script.
- will get introduced to reading, writing and listening skills for language Japanese.
- will develop interest to pursue professional Japanese Language course.

Course Contents:

- Katakana basic Script, Denoting things (nominal & prenominal demonstratives), Purchasing at the Market / in a shop / mall (asking & stating price)
- Katakana : Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting & finishing time (kara ~ made), Point in time (denoting the time when any action or the movement occurs)
- Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle

References:

1. Minna No Nihongo, ―Japanese for Everyone", (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. http://www.tcs.com (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

SAVITRIBAI PHULE PUNE UNIVERSITY

FACULTY OF ENGINEERING

SYLLABUS FOR S. E. (ELECTRICAL ENGINEERING)

(2015 course)

WITH EFFECT FROM YEAR 2016-2017

SavitribaiPhule Pune University
S.E. Electrical Engineering 2015 – Course
(w. e. f. 2016-2017)

Semester I													
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Semester Examination Scheme of Marks**						**Credit**	
			Th.	**Tut.**	**Pr.**	**Paper In Sem(Online)**	**Paper End Sem**	**TW**	**PR**	**OR**	**Total**	**TH/ TUT**	**PR+OR**
1.	203141	Power Generation Technologies	04	--	--	50	50	--	--	--	100	**04**	**---**
2.	207006	Engineering Mathematics-III	04	01	--	50	50	25	--	--	125	**05**	**---**
3.	203142	Material Science	04	--	02	50	50	--	--	50	150	**04**	**01**
4.	203143	Analog and Digital Electronics	04	--	02	50	50	25	50	--	175	**04**	**01**
5.	203144	Electrical Measurements and Instrumentation	04	--	02	50	50	25	50	--	175	**04**	**01**
6.	203151	Soft Skills	--	--	02	--	--	25	--	--	25	**--**	**01**
	Total											**21**	**04**
7.	203154	Audit Course I	--	--	--	--	--	--	--	--	--	Grade: PP/NP	
	Total		**20**	**01**	**08**	**250**	**250**	**100**	**100**	**50**	**750**	**25**	

Semester II													
Sr. No.	**Subject Code**	**Subject Title**	**Teaching Scheme**			**Semester Examination Scheme of Marks**						**Credit**	
			Th.	**Tut.**	**Pr.**	**Paper In Sem (Online)**	**Paper End Sem**	**TW**	**PR**	**OR**	**Total**	**TH/ TUT**	**PR+OR**
1.	203145	Power System I	04	--	--	50	50	--	--	--	100	**04**	**--**
2.	203146	Electrical Machines I	04	--	02	50	50	25	50	--	175	**04**	**01**
3.	203147	Network Analysis	04	--	02	50	50	50	--	--	150	**04**	**01**
4.	203148	Numerical Methods and Computer Programming	04	01	02	50	50	25	50	--	175	**05**	**01**
5.	203149	Fundamentals of Microcontroller and Applications	04	--	02	50	50	--	--	50	150	**04**	**01**
	Total											**21**	**04**
6.	203155	**Audit Course II**										Grade: PP/NP	
	Total		**20**	**01**	**08**	**250**	**250**	**100**	**100**	**50**	**750**	**25**	

TW: Term Work **OR:Oral** **PR:** Practical
PP: Passed (Only for non-credit courses) **NP:** Not Passed (Only for non-credit courses)

Audit Course

- Audit Course: Optional for 1st and 2nd term of SE Electrical Engineering
- 'Audit Courses' means a Course in which the student shall be awarded Pass or Fail only. It is left to the discretion of the respective affiliated institute to offer such courses to the students. Evaluation of audit course will be done at institute level itself.
- Teaching-learning process for these subjects is decided by concern faculty/industry experts appointed by the affiliated Engineering College.
- Marks obtained by student for audit course will not be taken into consideration of SGPA or CGPA.

203154:Audit Course I	**Solar Thermal Systems.**
203155:Audit Course II	**(A) Solar PV Systems.** **(B)Installation & Maintenance of Electrical appliances.**

203141: Power Generation Technologies

Teaching Scheme	Credits	Examination Scheme [Marks]
Th:04 Hrs/ Week	Th/Tut:04	In Sem (Online):50 Marks
		End Sem:50 Marks

Prerequisite:
- Fuel calorific value.
- Semiconductor materials for PV cells.
- Work, power and energy calculation.

Course Objective:
- To introduce conventional energy conversion system with steam, hydro based and nuclear based power plant.
- To initiate non-conventional energy conversion system with solar, wind, fuel cell, tidal ocean, geothermal, biomass etc.
- To commence interconnection of energy source to gird, stand alone and hybrid system.

Course Outcome: Upon successful completion of this course, the students will be able to :-
- Identify operations of thermal power plant with all accessories and cycles.
- Be aware of the principle of operation, components, layout, location, environmental and social issues of nuclear, diesel and gas power plant.
- Identify and demonstrate the components of hydro power plant and calculation of turbine required based on catchment area.
- Find the importance of wind based energy generation along with its design, analysis and comparison.
- Apply solar energy in thermal and electrical power generation considering energy crisis, environmental and social benefits.
- Understand the operation of electrical energy generation using biomass, tidal, geothermal, hydel plants, fuel cell and interconnection with grid.

Unit 01 : Thermal Power Plant (9 Hrs)

Basic thermodynamic cycles: Thermodynamic cycle of steam flow; Rankine cycle; Actual Rankine cycle; Reheat cycle; Carnot cycle, heat rate.
Thermal Power Plants: Site selection, Main parts and its working. Types of boilers, Feed water and its treatment, Various boiler controls, assessment of heat recovery systems Steam turbines types, selection and control of turbines.
Fuel Handling: delivery of load, unloading, preparation, transfer, outdoor (dead) storage, indoor (live) storage, In-plant Handling, Coal weighing.
Ash disposal and dust collection: Draught systems, electrostatic precipitator. Recent Development in thermal power plants.

Unit 02 : (9 Hrs)

A. **Nuclear Power Plant:** Introduction, atomic physics, nuclear reaction, materials, site selection, nuclear reactors and working of each part, classification of nuclear reactor, nuclear waste disposal, plant layout. Recent Development in nuclear power plants.
B. **Diesel Power Plants:** Main components and its working, Diesel plant efficiency and heat balance, choice and characteristic of diesel power plant. Selection of components and sizing.
C. **Gas Power Plant:** Introduction to gas cycles. Simple gas turbine power plant, methods to improve thermal efficiency, open loop and closed loop cycle power plants, gas fuels, gas turbine materials, plant layout. Combined cycle power plants and concept of heat to power ratio. Recent Development in Gas power plants.

Unit 03 : Hydro Power Plant (8 Hrs)

Site selection, Hydrology, storage and pondage, general arrangements and operation of hydro power plant, Hydraulic turbines, turbine size, pelton wheel turbine, Francis and Kaplan turbines, selection of turbines, Dams, Spillways, gates, intake and out take works, canals and layout of penstocks, water hammer and surge tank, simple numerical on hydrographs and number of turbine required. Control of hydro turbines. Small, mini and micro hydro power plant, Recent Development in hydro power plants.

Unit 04 : Wind Energy Systems (8 Hrs)

Historical Development of Wind Power, Types of wind turbine electrical generators, Power in the Wind, Impact of Tower Height, Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind, Wind turbine power converters (block diagrams), Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Environmental Impacts of Wind Turbines. Change in wind pattern and its effect on power generation. Control of wind turbine generator.

Unit 05 : Solar Energy (8 Hrs)

Principles of solar radiations, solar constant, cloudy index and concentration ratio, measurement of solar radiation. Solar energy collectors (solar thermal applications), principle of energy conversion, collection systems and their features, types of collectors with comparison. Solar thermal power plants. Over view of recent development of PV technologies. A Generic Photovoltaic Cell, The Simplest Equivalent Circuit for a Photovoltaic Cell From Cells to Modules to Arrays, The PV I–V Curve under Standard Test Conditions (STC), Impacts of Temperature and Insolation on I–V Curves, Shading Impacts on I–V curves, System: Introduction to the Major Photovoltaic System Types.

Unit 06 : Other Sources and Grid Connection (6 Hrs)

Biomass energy, conversion to electricity, municipal solid waste to energy conversion, geothermal energy and ocean energy and Fuel cell Energy storage requirements and selection criteria, stand alone, hybrid stand alone and grid connected renewable systems and their requirements.

Industrial Visit: One industrial visit to conventional /non-conventional power plant is necessary. A separate report file should be maintained in the department.

Text Books:

[T1] P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill Publications.
[T2] Dr. P. C. Sharma, “Power Plant Engineering”, S.K. Kataria Publications.
[T3] R. K. Rajput, “A text book on Power System Engineering”, Laxmi Publications (P) Ltd.
[T4] Chakrabarti, Soni, Gupta, Bhatnagar, “A text book on Power System Engineering”, DhanpatRai publication.
[T5] R.K. Rajput, “Non-Conventional Energy Sources and Utilization”, S. Chand Publications.
[T6] M.M. Wakil, “Power Plant Engineering”, McGraw Hill, Indian Edition.
[T7] G. D. Rai, “Renewable Energy Sources”, Khanna Publications.

Reference Books:

[R1] Arora and Domkundwar, "A Course in Power Plant Engineering", DhapatRai Publication.
[R2] Dr. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publication.
[R3] Mukund Patel, "Wind and Solar Power Plants", CRC Press.
[R4] Gilbert Masters John, "Renewable Energy", Wiley and sons' publications.

Unit	Text Books	Reference Books
1	T1,T2,T3	R1
2	T1,T2,T3	R1
3	T1,T2,T3	R1
4	T6,T7	R3,R4
5	T5,T6	R2,R3,R4
6	T5,T7	R4

SE(Electrical/Instrumentation and Control)
207006: Engineering Mathematics-III

Teaching Scheme	Credits	Examination Scheme [Marks]
Th:04 Hrs/ Week	Th/Tut: 05	In Sem (Online):50 Marks
Tut:01 Hr/Week		End Sem:50 Marks
		Term Work:25 Marks

Prerequisite:

- Differential and Integral Calculus
- Taylor series and Infinite series
- Differential equations of first order and first degree
- Fourier series, Vector algebra
- Algebra of complex numbers.

Course Objective: After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:-

- Linear differential equations of higher order applicable to Control systems.
- Transforms such as Laplace transform, Fourier transform, Z-Transform and applications to Control systems and Signal processing.
- Vector differentiation and integration required in Electro- Magnetics and Wave theory.
- Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image Processing.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Laplace transform, Fourier transform, Z-Transform and applications to Signal processing and Control systems.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electro-Magnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 01 : Linear Differential Equations (LDE) and Applications (9 Hrs)

LDE of nth order with constant coefficients,Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit 02 : Laplace Transform(LT) (9 Hrs)

Definition of LT, Inverse LT, Properties & theorems, LT of standard functions, LT of some special functions viz. Periodic, Unit Step, Unit Impulse. Applications of LT for solving Linear differential equations.

Unit 03 : Fourier and Z - transforms (9 Hrs)

Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses.

Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit 04 : Vector Differential Calculus (9Hrs)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit 05 : Vector Integral Calculus and Applications (9Hrs)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.

Unit 06 : Complex Variables (9Hrs)

Functions of Complex variables, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series and Residue theorem.

Text Books:

[T1] Erwin Kreyszig, "Advanced Engineering Mathematics", 9e,(Wiley India).
[T2] Peter V. O'Neil, "2. Advanced Engineering Mathematics", 7e,(Cengage Learning).

Reference Books:

[R1] M. D. Greenberg, "Advanced Engineering Mathematics", 2e, Pearson Education.
[R2] Wylie C.R. & Barrett L.C. "Advanced Engineering Mathematics", McGraw-Hill, Inc.
[R3] B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.
[R4] P. N. Wartikar& J. N. Wartikar, "Applied Mathematics (Volumes I and II)", Pune VidyarthiGrihaPrakashan, Pune.
[R5] B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
[R6] Thomas L. Harman, JamesDabney and Norman Richert, "Advanced Engineering Mathematics with MATLAB", 2e, Brooks/Cole, Thomson Learning.

Guidelines for Tutorial and Term Work:

1. Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
2. Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

203142: Material Science

Teaching Scheme	Credits	Examination Scheme [Marks]
Th:04 Hrs/ Week	Th/Tut: 04	In Sem (Online):50 Marks
PR:02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Oral :50 Marks

Prerequisite:

- Students should have knowledge of various classes of materials like solid, liquid, gaseous, conducting, insulating and resistive along with their basic characteristics.

Course Objective:

- To classify different materials from Electrical Engineering application point of view.
- To understand various properties and characteristics of different classes of materials.
- To select materials for applications in various electrical equipment.
- Toimpart knowledge of Nano-technology, battery and solar cell materials.
- Todevelop ability to test different classes of materials as per IS.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Categorize and classify different materials from Electrical Engineering applications point of view.
- Explain and summarize various properties and characteristics of different classes of materials.
- Choose materials for application in various electrical equipment.
- Explain and describe knowledge of nanotechnology, batteries and solar cell materials.
- Test different classes of materials as per IS.

Unit 01 A] : Dielectric Properties of Insulating Materials: (6Hrs)

Static Field, Parameters of Dielectric material [Dielectric constant, Dipole moment, Polarization, Polarizability], Introduction to Polar and Non- Polar dielectric materials. Mechanisms of Polarizations-Electronic, Ionic and Orientation Polarization (descriptive treatment only), ClausiusMossotti Equation, Piezo-Electric, Pyro-Electric & Ferro-Electric Materials, Dielectric loss and loss tangent, Concept of negative tan delta (δ).

Unit 01 B] : Optical Properties of Materials: (2 Hrs)

Comparison between materials used for Photo-Conductive, Photo-Electric Emissive and Photo-Voltaic cell. Different materials used for plastic, organic and thin-film solar cells (Mono-Crystalline, Poly-Crystalline). Introduction to fiber optics, materials used and its applications.

Unit 02 A] : Insulating Materials, Properties & Applications: (6Hrs)

Introduction, Characteristics of Good Insulating Material, Classification, Solid Insulating Materials-Paper, Press Board, Fibrous Materials, Ceramics, Mica, Asbestos, Resins, Amorphous materials Polymers, Ceramics, Enamels. Liquid Insulating Materials such as Transformer Oil, Varnish, Askarel. Insulating Gases like Air, SF_6. Insulating Materials for Power & Distribution Transformers, Rotating Machines, Capacitors, Cables, Line Insulators and Switchgears.

Unit 02 B] : Dielectric Breakdown: (2 Hrs)

Introduction, Concept of Primary and Secondary Ionization of Gases (descriptive treatment only), Breakdown Voltage, Breakdown Strength, Factors affecting Breakdown Strengths of Solid, Liquid and Gaseous dielectric materials.

Unit 03 : Magnetic Materials: (8Hrs)

Introduction, Parameters of Magnetic material [Permeability, Magnetic Susceptibility, Magnetization], Classification of Magnetic Materials, Diamagnetism, Paramagnetism, Ferromagnetism, Ferri-magnetism, Ferro-magnetic behavior below Critical Temperature, Spontaneous Magnetization, Curie-Weiss law, Anti-ferromagnetism, Ferrites, Applications of Ferro-magnetic Materials, Magnetic materials for Electric Devices such as Transformer Core , Core of Rotating Machines, Soft Magnetic Materials, Hard Magnetic Materials, Magnetic Recording Materials, Compact Discs. Introduction to laser and magnetic strip technology.

Unit 04 : Conducting Materials: (8Hrs)

General Properties of Conductor, Electrical Conducting Materials - Copper, Aluminum and its applications, Materials of High & Low Resistivity-Constantan, Nickel-Chromium Alloy, Tungsten, Canthal, Silver & Silver alloys, Characteristics of Copper Alloys (Brass & Bronze), Materials used for Lamp Filaments, Transmission Lines, Electrical Carbon Materials, Materials for Super-capacitors. Material used for Solders, Metals & Alloys for different types of Fuses, Thermal Bimetal & Thermocouple. Introduction to Superconductivity and Super Conductors.

Unit 05 A] : Nanotechnology: (6Hrs)

Introduction, Concepts of Energy bands & various Conducting Mechanism in Nano-structures, Carbon Nano-structures, Carbon Molecules, Carbon Clusters, Carbon Nano-tubes and applications. Special Topics in Nano Technology such as Single Electron Transistor, Molecular Machines, BN Nanotubes, Nano wires.

Unit 05 B] : Batteries: (2 Hrs)

Materials used for Batteries: Lead Acid, Lithium-ion, Sodium-Sulphur, Nickel-Cadmium, Zero Emission Battery Research Activity (ZEBRA) Batteries. Batteries used in Electric Vehicle (EV) and Electric Hybrid Vehicle (EHV).

Unit 06 : Testing of Materials: (8Hrs)

Explanation of following with objectives, equipment required, circuit diagrams and observations to be taken.

1. Measurement of Dielectric Loss Tangent (tan δ) by Schering Bridge-IS 13585-1994.
2. Measurement of Dielectric Strength of Solid Insulating Material-IS 2584.
3. Measurement of Dielectric Strength of Liquid Insulating Material – IS 6798.
4. Measurement of Dielectric Strength of Gaseous Insulating Material as per IS.
5. Measurement of Flux Density by Gauss-meter.

Guidelines for Instructor's Manual

Practical Sessions:-

Instructor's Manual should contain following things related to every experiment-

1. The circuit diagram of the experiment should be drawn at the start.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Five - six questions based on that experiment should be written at the end.

Guidelines for Student's Lab Journal

Student's Lab Journalshould be **Hand Written/ Drawn** containing, following things related to every experiment-

1. The circuit diagram of the experiment should be drawn on the graph paper at the start of the experiment.
2. Aim, apparatus, theory related to that experiment should be written.
3. One sample calculation should be shown, result table should be made and graph should be plotted if required.
4. Conclusion based on calculations, result and graph (if any) should be written.
5. Students should write answers to five - six questions based on that experiment at the end.

Guidelines for Lab /TW Assessment

There is **no Term Work** for the subject. But continuous assessment should be carried out such as checking of previous experiment along with its mock oral session (minimum 4-5 questions to each student), while conducting new experiment.

Guidelines for Laboratory Conduction

1. The circuit diagram should be explained to students in such a way that they should be able to develop it at their own.
2. Detail explanation of the experiment along with its circuit diagram, observation table, calculations, result table and plotting of graphs (if any).
3. While conducting new experiment, assessment of previous experiment should be carried out by its checking along with its mock oral session (minimum 4 -5 questions to each student).

List of Experiments: (Any **eight experiments** from the list below).

1. To measure dielectric strength of solid insulating materials.
2. To measure dielectric strength of liquid insulating materials.
3. To measure dielectric strength of gaseous insulating materials using Sphere Gap-Unit.
4. To obtain Hysteresis Loop of the Ferro-Magnetic Material.
5. To understand the principle of thermocouple & to obtain characteristics of different thermocouples.
6. To measure Insulation Resistance &kVAr capacity of power capacitor.
7. To measure Resistivity of High Resistive Alloys.
8. To observe development of tracks due to ageing on different insulating materials e.g. Bakelite, Perspex, polyesters, Mica, Fiberglass etc.
9. Testing of resins and polymers.
10. Measurement of Tangent of Dielectric Loss Angle (tan δ) of solid/liquid dielectric materials.
11. Measurement of Flux Density by Gauss-meter.

Industrial Visit: Minimum one visit should be arranged to an industry related to manufacturing of batteries, capacitors, cables, transformers (Any one industry). A hand written report should be submitted by every student as a part of term work.

Text Books:

[T1] S. P. Seth, "A Course in Electrical Engineering Materials", DhanpatRai and Sons publication.
[T2] "Electrical Engineering Materials", T.T.T.I, Madras.
[T3] K. B. Raina& S. K. Bhattacharya, "Electrical Engineering Materials", S. K. Kataria& Sons.
[T4] P.K. Palanisamy, "Material Science for Electrical Engineering", SciTech Pub. (India) Pvt. Ltd., Chennai.
[T5] Charles P. Poole, Jr. Frank & J. Ownes, "Introduction to Nanotechnology", Wiley Student Edition.
[T6] Ronald M. Dell and David A.J. Rand, "Understanding Batteries", Royal Society of Chemistry, 2001 Publication.

Reference Books:

[R1] D. M. Tagare, "Electrical Power Capacitors-Design & Manufacture", Tata McGraw Hill Publication.
[R2] S. P. Chalotra& B. K. Bhatt, "Electrical Engineering Materials", Khanna Publishers, Nath Market.
[R3] C. S. Indulkar& S. Thiruvengadam, "Electrical Engineering Materials", S. Chand & Com. Ltd.
[R4] Kamraju& Naidu, "High Voltage Engineering", Tata McGraw Hill Publication.
[R5] James F. Shackelford & M. K. Muralidhara, "Introduction to Material Science for Engineering", Sixth Edition by Pearson Education.
[R6] "Insulation Technology Course Material of IEEMA Ratner", Pearson Education.
[R7] Traugott Fischer, "Materials Science for Engineering Students", Elsevier publications.
[R8] Rakosh Das Begamudre, "Energy Conversion Systems", New Age International Publishers.
[R9] David Linden, "Handbook of Battery and Fuel Cells", McGraw Hill, 1984, Publication.
[R10] Chetan Singh Solanki, "Solar Photovoltaic: Fundamentals, Technologies and Applications", Prentice Hall of India Publication.
[R11] R. P. Deshpande, "Ultra capacitors – future of energy storage", McGraw Hill, Publication.
[R12] Linden and Reddy, "Handbook of Batteries", New York McGraw Hill, 2002, Publication.
[R13] R. P. Khare, "Fiber optics and Optoelectronics", Oxford University publication.

Unit	Text Books	Reference Books
1	T1, T3	R1, R3, R8, R10, R13
2	T1, T4	R1, R3
3	T1, T2	R2, R3, R5
4	T1, T2	R1, R3, R6
5	T5, T6	R7, R9, R11, R12
6	T1	R4

203143: Analog And Digital Electronics

Teaching Scheme	Credits	Examination Scheme [Marks]
Lecture : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
Practical : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Practical : 50 Marks
		Term Work : 25 Marks

Prerequisite:

- Basics of numbering system.
- Basics of diodes and BJT.

Course Objective:

- To demonstrate the concept of numbering system & Boolean's algebra reduction using K map.
- To design and analyze sequential and combinational circuits.
- To develop the concept of basics of operational Amplifier and its applications.
- To introduction to BJT and diode rectifier.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Understand conversion of number system, perform binary arithmetic and reduce Boolean expressions by K- Map.
- Demonstrate basics of various types of Flip flops, design registers and counter.
- Analyze parameter of Op-amp and its applications.
- Apply the knowledge of Op-amp as wave form generators & filters.
- Use BJT as amplifier with various configurations.
- Analysis of uncontrolled rectifier.

Unit 01 : Number system & Boolean's Algebra: (8 Hrs)

Numbering systems-binary, octal, decimal and hexadecimal and their conversion, codes-BCD, Grey and excess3, Binary arithmetic: - addition and subtraction by 1's and 2's compliment. Booleans algebra, De-Morgan's theory etc. K-map: - structure for two, three and four Variables, SOP and POS form reduction of Boolean expressions by K-map.

Unit 02 : Combinational & Sequential circuits: (9 Hrs)

Concept of Combinational & Sequential circuits, Flip flops – R-S, Clocked S-R, D latches, Edge Triggered D flip-flops, Edge triggered JK flip flops, JK Master - slave flip flop, Register- Buffer registers, shift registers, controlled shift registers, ring counter, Counters – asynchronous Counters, synchronous counter, up - down counter , twisted ring counters, N –moduleCounters.

Unit 03 : Operational Amplifier & Applications: (8 Hrs)

Op-Amp: Block diagrams of 741, ideal and practical parameters, open loop and close loop configuration of Op-Amp. Applications of Op- Amp- Comparator, Schmitt trigger, zero crossing detectors, V-I and I-V converters, Instrumentation amplifier, peak detector.

Unit 04 : Waveform generators, Filters & Regulators: (8 Hrs)

Waveform generation using Op-amp - sine, square, saw tooth and triangular generator, Active filters-Its configuration with frequency response, Analysis of first order low pass and high pass filters, IC 555 –construction, working and modes of operation- astable and monostable multi vibrators, Sequence generator, voltage regulators using ICs 78xx, 79xx, LM 317

Unit 05 : BJT & Applications: (8 Hrs)

BJT amplifier: Introduction, Class A amplifier, AC-DC load line analysis, Single stage and Multistage BJT amplifier, direct coupled, RC coupled and transformer coupled, Darlington pair, Push-Pull amplifier and differential amplifier FET-construction, Parameters, Characteristics.

Unit 06 : Diode & Precision Rectifiers: (7 Hrs)

Diode rectifier: Introduction, Single phase half wave rectifier with R, RL loads. Single phase full wave rectifier-Center tap and bridge rectifier supplying R and RL load and performance parameters. Three phase full wave bridge rectifier with R load. Comparison of single phase half wave and full wave rectifiers,
Precision rectifiers: Half wave and Full wave. Comparison of diode and precision rectifier.

Guidelines for Instructor's Manual

Practical Sessions -

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used.
- Few questions related to the experiment (3 to 5)
- List of components required with their specifications , data sheets of ICs used

Guidelines for Student's Lab Journal

TheStudent's Lab Journal should contain following related to every experiment –

- Theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used.
- List of components required with their specifications, data sheets of ICs used.

Guidelines for Lab /TW Assessment

- There should be continuous assessment of the TW.
- Assessment must be based on understanding of theory, attentiveness during practical session, how efficiently the student is able to do connections on bread board and get the results.
- Timely submission of journal.

Guidelines for Laboratory Conduction

- First half an hour should be utilized for explaining the circuit diagram and theory related to the experiment.
- Next one hour for connection and conduction of the experiment.
- Remaining half an hour for continuous assessment and timely checking of the experiment (This time slot can be adjusted as per convenience)
- Separate breadboard should be provided for every student for those experiments which are compulsory to be performed on breadboard.

List of Experiments:

Total **ten** experiments are to be conducted out of following experiments:

First seven experiments are compulsory.

1. Study of ring counter and twisted ring counter.
2. Study of up - down counters (IC 74192/74193) and N- modulo counter. (IC 7490/7493).

3*. Study of Op-amp as Schmitt trigger.

4. Study of Instrumentation amplifier using three Op-amp, CMR measurement

5*. Study of Op-amp as sine, and triangular wave generator.

6*. Study of IC-555 applications- astable, monostablemultivibrator.

7*. Study of Single Phase Full-wave bridge rectifier with RL load.

Any three experiments are to be conducted of following experiments:

1. Study of Three Phase Full-wave Rectifier with R load.

2*. Study of active filters- Low pass and high pass filters.

3. Transistor amplifiers: frequency response of BJT, multistage BJT amplifier.

4*. Study of Single Phase Half-Wave Rectifier.

5. Study of op-amp as a ZCD & Comparator
6. Study of various flip-flops and verification of truth table.
7. Study and verify shift register operation (IC 7495).

**** These experiments should be performed on general purpose PCB/ Breadboard.***

Text Books:

[T1] Floyd and Jain, "Digital Fundamentals", Pearson Education.

[T2] R. P. Jain, "Digital Electronics", Tata McGraw Hill, New Delhi.

[T3] Malvino, "Digital Computer Electronics- An Introduction to Microcomputers," Tata McGraw Hill.

[T4] Gaikwad R., "Operational Amplifier", PHI New Delhi.

[T5] Floyd, "Electronics Devices", Pearson Education.

[T6] Mottershed, "Electronics Devices & Circuits", PHI New Delhi

[T7] Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd edition, Pearsons Education.

Reference Books:

[R1] Tokheim, "Digital Electronics-Principles and Application", 6th edition, Tata McGraw Hill, New Delhi.
[R2] A Jaico and Charles H. Roth, "Fundamentals of Logic Design" Jr. Forth Edition.
[R3] K. R. Botkar, "Integrated Circuits", Khanna Publication, New Delhi.
[R4] James, "Operational Amplifier and Linear Integrated Circuits Theory and Application."
[R5] P John Paul, "Electronics Devices and circuits", New Age international Publications.
[R6] P. S. Bimbhra, "Power Electronics", Khanna Publications.

Unit	Text Books	Reference Books
1	T1, T2	R1
2	T1, T2, T3	R2
3	T4, T5	R3, R4
4	T4, T5	R3, R4
5	T5, T6	R5
6	T7	R6

203144: Electrical Measurements and Instrumentation

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	**Th/Tut: 04**	**In Sem (Online) : 50 Marks**
PR : 02 Hrs/ Week	**PR:01**	**End Sem : 50 Marks**
		Practical : 50 Marks
		Term Work : 25 Marks

Course Objective:

- To provide the knowledge of system of units, classification and essentials of measuring instruments.
- To get the knowledge about the construction & operation of various electrical & non electrical measuring instruments.
- To apply the knowledge to identify the measuring instruments & make use of it for quantifying measurements of electrical parameters.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Understand various characteristics of measuring instruments, their classification and range extension technique.
- Classify resistance, apply measurement techniques for measurement of resistance, inductance.
- Explain construction, working principle and use of dynamometer type wattmeter for measurement of power under balance and unbalance condition.
- Explain Construction, working principle of 1-phase and 3-phase induction, static energy meter and calibration procedures.
- Use of CRO for measurement of various electrical parameters, importance of transducers, their classification, selection criterion and various applications.
- Measurement of various physical parameters using transducers.

Unit 01 : (9 Hrs)

A. **Classification of Measuring Instruments -** Characteristics of measuring instruments: static and dynamic, accuracy, linearity, speed of response, dead zone, repeatability, resolution, span, reproducibility, drifts. Necessity of calibration, standards and their classification, absolute and secondary instruments, types of secondary instruments: indicating, integrating, and recording, analog / digital.
   Ammeter and Voltmeter Theory: Essentials of indicating instruments deflecting, controlling and damping systems. Construction, working principle, torque equation, advantages and disadvantages of Moving Iron (MI) (attraction and repulsion), and Permanent Magnet Moving Coil (PMMC), block diagram and operation of digital ammeter & voltmeter.
B. **Range Extension:** PMMC ammeters and voltmeters using shunts, multipliers. Universal shunt, universal multiplier. Instrument Transformers : Construction, connection of CT & PT in the circuit, advantages of CT / PT over shunt and multipliers for range extension of MI Instruments, transformation ratio, turns ratio, nominal ratio, burden, ratio and phase angle error.(descriptive treatment only)

Unit 02 : (8 Hrs)

A. **Measurement of Resistance:** Measurement of low, medium and high resistance. Wheatstone bridge, Kelvin's double bridge, ammeter-voltmeter method, megger, loss of charge method. Earth tester for earth resistance measurement.
B. **Measurement of Inductance**: Introduction, sources and detectors for A.C. bridge, general equation for bridge at balance. Measurement of inductance: Maxwell's inductance & Maxwell's inductance – Capacitance Bridge, Anderson's bridge.

Unit 03 : (8 Hrs)

Measurement of Power: Construction, working principle, torque equation, errors and their compensation, advantages and disadvantages of dynamometer type wattmeter, low power factor wattmeter, poly-phase wattmeter. Active & reactive power measurement in three phase system for balanced and unbalanced load using three wattmeter method, two wattmeter method & one wattmeter method. Power analyzer, Multi meter.

Unit 04 : (7 Hrs)

Measurement of Energy: Construction, working principle, torque equation, errors and adjustments of single phase conventional (induction type) energy meter. Calibration of energy meter. Block diagram and operation of electronic energy meter. Three phase energy meter, TOD meter.

Unit 05 : (8 Hrs)

A. **Oscilloscope:** Introduction, various parts, front panel controls, use of CRO for measurement of voltage, current, period, frequency. Phase angle & frequency by lissajous pattern & numerical. Introduction to DSO.
B. **Transducers:** Introduction, classification, types: resistive, inductive, capacitive, basic requirements for transducers.
C. **Pressure Measurement:** Introduction, classification of pressure as low, medium & high, absolute, gauge, vacuum, static, dynamic & head pressure. High pressure measurement using electric methods, low pressure measurement by McLeod gauge and pirani gauge, capacitive pressure transducer.

Unit 06 : (8 Hrs)

A. **Level Measurement:** Introduction and importance of level measurement, level measurement methods: mechanical, hydraulic, pneumatic, electrical, nucleonic and ultrasonic.
B. **Displacement Measurement:** LVDT & RVDT – construction, working, application, null voltage, specifications, advantages & disadvantages, effect of frequency on performance.
C. **Strain Gauge**: Introduction, definition of strain, types of strain gauge: Wire strain gauge, foil strain gauge, semiconductor strain gauge etc.; their construction, working, advantages and disadvantages.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- The instructor's manual need to include prologue (about University / program / institute / department / foreword / preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration- concept, objectives, outcomes, list of experiments, references etc.
- The feedback seeking sheet for enhancement of instructor's manual may be added as annexure.

Guidelines for Student's Lab Journal

- The laboratory experiments are to be submitted by student in the form of journal.
- Journal consists of prologue, Certificate, table of contents, and write-up of each experiment (Title, Objectives, Outcomes, List of apparatus, Circuit diagram, Theory, Observation Table, Sample Calculation, Result Table, Conclusion / Analysis, exercises - MCQs, assignments, Date of Completion, Assessment grade and assessor's sign with date).

Guidelines for Lab /TW Assessment

- Each experiment will be assigned grade based on parameters with appropriate weightage.
- Suggested parameters include- timely completion, performance, innovation, punctuality and neatness.

Guidelines for Laboratory Conduction

- The instructor is expected to shortlist necessary experiments from the suggested list of experiments. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
- Proper safety instructions and demonstration of the experiment is to be given before asking the students to perform the experiment. The experiment is carried out by the students under the supervision of the instructor.
- The instructor should take utmost care towards safety of the students, self and other hazards that may be caused by improper operation of the equipment.
- The instructor may also design an experiment which is relevant to the subject and beyond the scope of syllabus.

List of Experiments:

Compulsory Experiments: (06) Six.

1. Demonstration of working parts of various types of meter by opening the instrument & explanation of symbols & notations used on instruments.
2. Extension of instrument range: ammeter, voltmeter, watt meter using CT & PT.
3. Measurement of active & reactive power in three phase circuit using two wattmeter methods (balanced & unbalanced loads).
4. Measurement of active & reactive power in three phase balanced circuit using one wattmeter method with two way switch.
5. Calibration of single phase static energy meter at different power factors.
6. Measurement of voltage, current, time period, frequency & phase angle using CRO.

Any four experiments are to be conducted of following experiments:

1. Measurement of reactive power by one wattmeter with all possible connections of current coil and pressure coil.
2. Measurement of power in three phase, four wire system using three CTs & two wattmeter.
3. Calibration of single phase wattmeter at different power factors.
4. i) Measurement of resistance by ammeter voltmeter method.
   ii) Measurement of low resistance using Kelvin's double bridge.
5. Measurement of inductance using Anderson's bridge/ Maxwell's bridge.

6. Displacement measurement by LVDT.
7. Electrical methods for measurement of liquid level.

Industrial Visit (If Any): Minimum one visit should be arranged to electrical instrument manufacturing company or where electrical instruments are calibrated or where various measuring instruments (Electrical/Mechanical) can be seen or observed.

Text Books:

[T1] A. K. Sawhney, "A Course in Electrical and Electronic Measurements & Instrumentation" DhanpatRai& Co.

[T2] J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation" S. K. Kataria& Sons,

[T3] R. K. Jain, "Mechanical and Industrial Measurements" Khanna Publishers.

[T4] B. C. Nakra& K. K. Chaudhari, "Instrumentation Measurement and Analysis", Tata McGraw Hill.

Reference Books:

[R1] E. W. Golding & F. C. Widdies, "Electrical Measurements & Measuring Instruments" Reem Publications.

[R2] Dr. Rajendra Prasad, Electronic Measurements & Instrumentation, Khanna Publishers

[R3] Arun K. Ghosh, "Introduction to Measurements and Instrumentation, PHI Publication

[R4] M. M. S. Anand "Electronics Instruments and Instrumentation Technology" by, PHI Publication.

Unit	Text Books	Reference Books
1	T1,T2,T3,T4	R1,R2,R3,R4
2	T1,T2	R1,R4
3	T1,T2	R1,R2
4	T1,T2	R1,R2
5	T1,T2,T3,T4	R2,R3,R4
6	T1,T2,T3	R2,R3

203151: Soft Skills

Teaching Scheme	Credits	Examination Scheme [Marks]
PR : 02 Hrs/ Week	PR: 01	Term Work : 25 Marks

Course Objective: The course aims to:-

- To possess knowledge ofthe concept of Self-awareness and Self Development.
- To Understand the importance of Speaking Skills, listening skills, Presentation Skills and leadership skills.
- To gain the knowledge of corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting.
- To get conversant with Team work, Team effectiveness, Group discussion, Decision making.
- To recognize the importance of time management and stress management.

Course Outcome: Students will be able to :-

- DoSWOT analysis.
- Develop presentation and take part in group discussion.
- Understand andImplement etiquettes in workplace and in society at large.
- Work in team with team spirit.
- Utilize the techniques for time management and stress management.

Unit 01 : Self-Awareness & self-Development: (4Hrs)

A) **Self-Assessment , Self-Appraisal, SWOT, Goal setting - Personal & career** - Self-Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self-appraisal, Personal Goal setting,

B) Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting and prioritization.

Unit 02 : Communication Skill: (6 Hrs)

A) Importance of communication, types, barriers of communication, effective communication.

B) **Speaking Skills:** Public Speaking, Presentation skills, Group discussion- Importance of speaking effectively, speech process, message, audience, speech style, feedback, conversation and oral skills, fluency and self-expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques.

C) **Listening Skills:**Law of nature- you have 2 ears and 1 tongue so listen twice and speak once isthe best policy, Empathic listening, Avoid selective listening-

D) **Group Discussion:**Characteristics, subject knowledge, oral and leadership skills, team management, strategies and individual contribution and consistency.

E) **Presentation skills:**Planning, preparation, organization, delivery.

F) **Written Skills:** Formal & Informal letter writing, Report writing, Resume writing - Sentence structure, sentence coherence, emphasis. Paragraph writing. Letter writing skills – form and structure, style and tone. Inquiry letters, Instruction letters, complaint letters,

Routine business letters, Sales Letters etc.

Unit 03 : Corporate / Business Etiquettes: (2 Hrs)

Corporate grooming & dressing, Email & telephone etiquettes, etiquettes in social & office setting: Understand the importance of professional behavior at the work place, Understand andImplement etiquettes in workplace, presenting oneself with finesse and making otherscomfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Bodylanguage, Meeting etiquettes (targeted at young professionals who are just entering businessenvironment), Introduction to Ethics in engineering and ethical reasoning, rights andresponsibilities.

Unit 04 : Interpersonal relationship: (4 Hrs)

A) **Team work, Team effectiveness, Group discussion, Decision making** – Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity.

B) **Group Discussion**- Preparation for a GD, Introduction and definitions of a GD, Purpose of a GD, Types of GD, Strategies in a GD, Conflict management, Do's and Don'ts in GD

Unit 05 : Leadership skills: (2 Hrs)

Leaders' role, responsibilities and skill required - Understanding good Leadership behaviors, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example,effective feedback.

Unit 06 : Other skills: (2 Hrs)

A) **Time management**- The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to priorities using decision matrices, to beat the most common time wasters, how to plan ahead, how to handle interruptions , to maximize your personal effectiveness, how to say "no" to time wasters, develop your own individualized plan of action.

B) **Stress management**- understanding the stress & its impact, techniques of handling stress.

C) Problem solving skill, Confidence building Problem solving skill, Confidence building

Term Work/Assignments:

Term work will consist the record of any 8 assignments of following exercises

1. SWOT analysis
2. Personal & Career Goal setting – Short term & Long term
3. Presentation Skill
4. Letter/Application writing
5. Report writing
6. Listening skills
7. Group discussion
8. Resume writing
9. Public Speaking
10. Stress management
11. Team Activity-- Use of Language laboratory

**** Perform any 8 exercises out of above 11 with exercise no. 11 as compulsory.***

Teaching Methodology:

Each class should be divided into three batches of 20-25 students each. The sessions should be activity based and should give students adequate opportunity to participate actively in each activity. Teachers and students must communicate only in English during the session. Specific details about the teaching methodology have been explained in every activity given below.

Practical Assignments (Term work)

Minimum 8 assignments are compulsory and teachers must complete them during the practical sessions within the semester. The teacher should explain the topics mentioned in the syllabus during the practical sessions followed by the actual demonstration of the exercises. Students will submit report of their exercise (minimum 8) assignments as their term work at the end of the semester but it should be noted that the teacher should assess their assignment as soon as an activity is conducted. The continual assessment process should be followed.

1. **SWOT analysis:**

   The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements etc. through this activity. The teacher should explain to them on how to set goals, SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self-esteem. The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.

2. **Personal & Career Goal setting – Short term & Long term**

3. **Presentation Skills:**

   Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.

4. **Letter/Application writing:**

   Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.

5. **Report writing:**

   The teacher should teach the students how to write report. The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal etc.

6. **Listening skills:**

   The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.

7. Group discussion:

Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback.

8. Resume writing:

Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.

9. Public Speaking:

Any one of the following activities may be conducted :

A) **Prepared speech**(topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.
B) **Extempore speech** (students deliver speeches spontaneously for 5 minutes each on a given topic)
C) **Story telling** (Each student narrates a fictional or real life story for 5 minutesearch)
D) **Oral review**(Each student orally presents a review on a story or a book read by them)

10. Team Activity-- Use of Language laboratory

Text Books:

[T1] Sanjay Kumar and PushpaLata, "Communication Skills", Oxford University Press.
[T2] Krishna Mohan, MeeraBanerji, "Developing Communication Skill", McMillan India Ltd.
[T3] Simon Sweeney, "English for Business Communication", Cambridge University Press

Reference Books:

[R1] Accenture, Convergys, Dell et.al, "NASSCOM-Global Business Foundation Skills, Foundation Books, Cambridge University Press.
[R2] E. H. McGrath, "Basic Managerial Skills for all", Eastern Economy Edition, Prentice hall India.
[R3] Barun K. Mitra, "Personality Development and Group Discussions", Oxford University Press.
[R4] PriyadarshiPatnaik, "Group Discussions and Interview Skills: Foundation Books", Cambridge University Press.
[R5] Napoleon Hill, "Thinks and Grow Rich", Ebury Publishing, ISBN 9781407029252.
[R6] Tony Robbins, "Awaken the Giant Within", Harper Collins Publishers, ISBN-139780743409384.

[R7] Wayne Dyer, “Change Your Thoughts, Change Your Life”, Hay House India, ISBN-139788189988050.
[R8] Stephen Covey, “Habits of Highly Effective People”, Pocket Books, ISBN-139781416502494.
[R9] Dr. Joseph Murphy, “The Power of Your Subconscious Mind”, MaanuGraphics, ISBN-13 9789381529560.
[R10] Daniel Coleman, “The new Leaders”, Sphere Books Ltd, ISBN-139780751533811.
[R11] Richard Koch, “The 80/20 Principal”, Nicholas Brealey Publishing , ISBN-13 9781857883992.
[R12] Julie Morgenstern, “Time management from inside out”, Owl Books (NY),ISBN-13 9780805075908.
[R13] SharuRanganekar, “Wonderland of Indian Manageress”, Vikas Publishing Houses, ISBN-13 9788125942603.
[R14] Shiv Khera, “You can win”, Macmillan, ISBN-139789350591932.
[R15] Gopalaswamy Ramesh, Mahadevan Ramesh, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”.

203154:Audit Course I

Solar Thermal Systems

Course Name: Solar Thermal Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:
Lectures: 2 h per week
Field Visit: 4 h

Examination Schemes: Audit (P/F)
Written and MCQ
Term paper

Description:

The course will introduce the basics of: solar energy, availability, applications, heat transfer as applied to solar thermal systems, various types of solar thermal systems, introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The field visits will be designed for firsthand experience and basic understanding of the system elements.

Course Objective:

- To understand basics and types of solar thermal systems.
- To get knowledge of various types of concentrators.
- To make students aware of different Standards and certification for Concentrator Solar Power.

Course Outcome: Student Will be able to

- Differentiate between types of solar Concentrators
- Apply software tool for solar concentrators
- Design different types of Solar collectors and balance of plant

Course Contents:

- Sun, Earth and seasons
- Solar Radiation
- Basics of heat transfer
- Absorption, reflection and transmission of radiation
- Types of Solar thermal systems
- Basic design of different types of systems
- Applications of solar thermal systems and their economics
- Need for solar concentration
- Various types of solar concentrators
- Movement of Sun and tracking
- Control systems for solar tracking
- Concentrating solar thermal (CSP)
- Concentrating solar PV (CPV)
- Balance of plant for CSP
- Critical points in concentrating solar system installation
- Operation and maintenance of CSP

- Typical financial analysis of CSP
- Software tools for concentrating solar power
- Environmental impact assessment
- Standards and certification for CSP
- Basics of solar thermal (STH) systems
- Elements of various STH systems
- Design, materials and manufacturing of
    - Flat plate solar collector
    - Evacuated tube solar collector
    - Parabolic trough collector
    - Dish type solar concentrators
    - Concentrating PV systems
    - Balance of plant
- Manufacturing standards
- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

References:

- Trainers Textbook Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India
- Students Workbook for Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India

203145: Power System I

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
		End Sem : 50 Marks

Prerequisite:

- Power Generation.
- Various insulating materials and properties.
- Knowledge of fundamental of electrical circuit components.

Course Objective:

- To learn basic structure of electrical power systems, various electrical terms related with power system and understand various types of tariffs.
- To understand specifications and applications of major electrical equipment present in power plant.
- To get knowledge of mechanical & electrical design of overhead and underground transmission system.
- To learn representation of transmission lines for performance evaluation.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Recognize different patterns of load curve, calculate different factors associated with it and tariff structure for LT and HT consumers.
- Aware of features, ratings, application of different electrical equipment in power station and selection of overhead line insulators.
- Analyze and apply the knowledge of electrical and mechanical design of transmission lines.
- Identify and analyze the performance of transmission lines.

Unit 01 : Structure of Electrical Power Systems and tariff: (8 Hrs)

A) Structure of Electrical Power Systems: Structure of Electrical Power System**,** Different factors associated with generating stations such as Connected load, Maximum Demand, Demand Factor, average load, load factor, diversity factor, plant capacity factor, reserve capacity, plant use factor, Load curve, load duration curve, concept of base load and peak load stations, Interconnected grid system. Fitting of available generating stations into the area load duration curve.

B) Tariff : Introduction of Tariff, Tariff setting principles, desirable characteristics of Tariff, various consumer categories and implemented tariffsuch as two part, three part, Time of Day tariff for H.T. & L.T. industrial and commercialconsumers along with current electricity charges, Introduction to Availability Based Tariff (ABT), Interruptible tariff, Incentives and penalties applied to various consumers.

Unit 02 : Major Electrical Equipment's in Power Stations and Overhead line insulators : (8 Hrs)

A) Major Electrical Equipment's in Power Stations : Descriptive treatment of ratings of various equipment used in power station, Special features, field of use of equipment like alternators, necessity of exciters, various excitation systems such as dc excitation, ac excitation and static excitation systems, transformers, voltage regulators, bus-bars, current limiting reactors, circuit breakers, protective relays, current transformers, Potential transformers, Lightning arresters, Earthingswitches, isolators, carrier current equipment (P.L.C.C.), Control panels, battery rooms, metering and other control room equipment in generating stations.

B) Overhead Line Insulators: Types of insulators & their applications such as pin type, suspension type, strain type, Silicon Rubber insulators, post insulators, Shackle insulators, bushings, voltage distribution along string of suspension insulators, string efficiency, equalization of potential across each unit, method of improving string efficiency, insulator failure.

Unit 03 : Mechanical Design of Overhead Lines and Underground Cables: (8 Hrs)

A) Mechanical Design of Overhead Lines: Main components of overhead lines, Line supports, conductor spacing, length of span, calculation of sag for equal and unequal supports and effect of ice and wind loadings.

B) Underground Cables: Classification, Construction of cable, XLPE cables, insulation resistance, dielectric stress in single core cable, capacitance of single core and three core cable, cables used for HVDC transmission. Grading of cables, inter sheath grading, capacitance grading.

Unit 04 : Resistance and Inductance of Transmission Line: (9 Hrs)

Resistance of transmission line, skin effect and its effects, proximity effect, internal & external flux linkages of single conductor, inductance of single phase two wire line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of G.M.R. and G.M.D, necessity of transposition,inductance of three phase double circuit line with symmetrical and unsymmetrical spacing, inductance of bundled conductors.

Unit 05 : Capacitance of Transmission Line: (7 Hrs)

Electric potential at single charged conductor, potential at conductor in a group of charged conductors, capacitance of single phase line, Capacitance of single phase line with effect of earth's surface on electric field, Concept of G.M.R. and G.M.D for capacitance calculations, capacitance of three phase line with symmetrical and unsymmetrical spacing, capacitance of double circuit three phase line with symmetrical and unsymmetrical spacing.

Unit 06 : Performance of Transmission Lines: (8 Hrs)

Classification of lines based on length and voltage levels such as short, medium and long lines. Performance of short transmission line with voltage current relationship and phasor diagram, Representation of medium lines as 'Nominal Pi' and 'Nominal Tee' circuits using R, L and C parameters. Ferranti effect, Representation of 'Tee' and 'Pi' models of lines as two port networks, evaluation and estimation of generalized circuit constants (ABCD) for short and medium lines, Estimation of Efficiency & regulation of short & medium lines.

Industrial visit: Minimum one visit to HV substations is recommended.

Text Books:

[T1] J. B. Gupta, "Transmission and Distribution", S. K. Kataria& Sons, New Delhi.
[T2] V. K. Mehta, Rohit Mehta, "Principles of Power System", S. Chand Publication
[T3] J. B. Gupta, "Generation and Economic Considerations", S. K. Kataria& Sons, New Delhi.
[T4] Dr. B. R. Gupta, "Generation of Electrical Energy",S. Chand Publication
[T5] A Chakraborty, M. L. Soni, P. V. Gupta, U.S. Bhatnagar, "A text book on Power System Engineering", Dhanpatrai& Co., Delhi.
[T6] S. N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India.

Reference Books:

[R1] Nagrath& Kothari, "Power System Engineering", Tata McGraw Hill Publications.
[R2] D. Das, "Electrical Power System", New Age Publication.
[R3] W.D. Stevenson, "Power System Analysis", Tata McGraw Hill Publications.
[R4] "Know your Power – citizen's primer" – Prayas energy group

References:

www.mahadiscom.in
www.mercindia.org.in

203146: Electrical Machines I

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Practical : 50 Marks
		Term Work : 25 Marks

Prerequisite:

- Magnetic circuit, mutual induced EMF, Dynamically induced EMF, Direction of magnetic field in current carrying conductor, Flemings LHR & RHR, Electromechanical energy conversion.

Course Objective:

- To understand energy conversion process.
- To understand selection of machines for specific applications.
- To test & analyze the performance of machine.
- To understand the construction, principle of operation of transformers, DC Machine & Induction Machine.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Apply energy conversion principles to different machines.
- Select machine for specific applications.
- Test the various machine for performance calculation.

Unit 01 : Transformers: (8 Hrs)

Single phase Transformer: Concept of ideal transformer. Corrugated core transformer. Toroidal core Transformer Useful and leakage flux, its effects. Resistance, leakage reactance and leakage impedance of transformer windings & their effects on voltage regulation and efficiency. Exact and approximate equivalent circuits referred to L.V. and H. V. side of the transformer. Phasor diagrams for no-load and on load conditions. Transformer ratings. Losses in a transformer, their variation with load, voltage & Frequency on no load losses Efficiency and condition for maximum efficiency. All day Efficiency. Open circuit and short circuit tests, determination of equivalent circuit parameters from the test data and determination of voltage regulation and efficiency. Autotransformers, their ratings and applications. Comparison with two winding transformer with respect to saving of copper and size.

Unit 02 : Transformers: (8 Hrs)

Polarity test. Parallel operation of single phase transformers, conditions to be satisfied, load sharing under various conditions. & Welding Transformer

Three Phase Transformers: Standard connections of three phase transformers and their suitability for various applications, voltage Phasor diagrams and vector groups. Descriptive treatment of Parallel operation of three phase transformers Scott connection and V connections. Three winding (tertiary windings) transformers

Unit 03 : D.C. Machines: (8 Hrs)

Construction, main parts, magnetic circuits, poles, yoke, field winding, armature core, Armature windings: Simple lap and wave winding, commutator and brush assembly. Generating action, E.M.F equation, magnetization curve, Flashing of Generator. Motoring action. Types of DC motors, significance of back E.M.F torque equation, working at no-load and on-load. Losses, power flow diagram and efficiency. Descriptive treatment of armature reaction.

Unit 04 : D.C. Machines: (8 Hrs)

Characteristics and applications of D.C. Shunt and Series Motors, Starting of DC motors, study of starters for series and shunt motor, solid state starters, speed control of various types of DC motors.

Commutation: Process of commutation, time of commutation, reactance voltage, straight line commutation, commutation with variable current density, under and over commutation, causes of bad commutation and remedies, inter poles, compensating windings. (Descriptive treatment only)

Unit 05 : Three Phase Induction Motor: (8 Hrs)

Production of rotating mmf by 3-phase balanced voltage fed to a symmetrical 3-phase winding. Construction: Stator, Squirrel cage & wound rotors. Principle of working, simplified theory with constant air gap flux; slip, frequency of rotor emf and rotor currents, mmf produced by rotor currents, its speed w.r.t. rotor and stator mmf. Production of torque, torque-slip relation, condition for maximum torque, torque-slip Characteristics, effect of rotor resistance on torque-slip characteristics. Relation between starting torque, full load torque and maximum torque. Losses in three phase induction motor, power-flow diagram. Relation between rotor input power, rotor copper loss & gross mechanical power developed, efficiency.

Unit 06 : Three Phase Induction Motor: (8 Hrs)

Induction motor as a generalized transformer; phasor diagram. Exact & approximate equivalent circuit. No load and blocked rotor tests to determine the equivalent circuit parameters and plotting the circle diagram. Computation of performance characteristics from the equivalent circuit and circle diagram. Performance curves. Necessity of starter for 3-phase induction motors. Starters for slip-ring and cage rotor induction motors; stator resistance starter, auto transformer starter, star delta starter and rotor resistance starter. D.O.L. starter and soft starting, with their relevant torque and current relations. Comparison of various starters. , testing of three phase induction motor as per IS 325 & IS 4029.

Guidelines for Instructor's Manual

- Prepare 4/5 sets of standard experiments. It must contain title of the experiment. Also, Aim, Apparatus including name of machines with their specifications, rheostats, ammeter, voltmeter, wattmeter if used along with their ratings / ranges and whether moving coil or moving iron etc.
  - **Theory:** Brief theory explaining the experiment
  - **Circuit / connection diagram** or construction diagram must be drawn either manually using geometrical instruments or using software on A-4 size quality graph paper / plain white paper.
  - **Procedure:** Write down step by step procedure to perform the experiment.
  - **Observation table:**
  - **Sample calculation:** For obs. number ---
  - **Result table:**
  - **Nature of graph:**
  - **Conclusion:**
  - **Comments if any:**
  - **Questions / Answers**: Write minimum 5/ 6 questions / answers based on each experiment.

Theory part must be typed on A-4 good quality paper on single side. Put these pages of experiments / circuit diagram in plastic folder and provide it to a group of 4/5 students.

Guidelines for Student's Lab Journal

1. Students should write the journal in his own hand writing.
2. Circuit / Connection diagram or construction diagram must be drawn either manually using or using software. [Do not use Xerox copy of standard journal]
3. Hand writing must be neat and clean.
4. Journal must contain certificate indicating name of the institute, student, department, subject, class/ year, number of experiments completed, signature of staff, Head of the department and the Principal.
5. Index must contain sr. number, title of the experiment, page number, and the signature of staff along with date.
6. Put one blank page in between two experiments. Prepare the parallelogram at the center of page and write experiment number, date and title of the experiment in separate line.
7. Use black or blue ink pen for writing.

Guidelines for Laboratory Conduction

1. Check whether the MCB / ELCB / main switch is off.
2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, use thick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.
3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.
5. After completion of experiment, switch off the MCB / ELCB / main switch.
6. Write the experiment in the journal and get it checked within week.

Guidelines for Lab /TW Assessment

1. Do the continuous assessment. The experiment performed in a particular week, should be checked within same week or at the most in next week.
2. While assessment, teacher should put the remark by writing word “Complete” and not simply “C”. Put the signature along with date at the end of experiment and in the index.
3. Assign 10 marks for each experiment as per following format
   Timely completion = 03 marks
   Neat and clean writing = 02 marks
   Depth of understanding = 03 marks
   Regular attendance = 02 marks
4. Maintain continuous assessment sheet. At the end of semester, convert these marks out of as prescribed in syllabus structure and display on the notice board.

List of Experiments:
Compulsory Experiments:

1. O.C. and S.C. test on single phase Transformer.
2. Polarity test on single phase and three phase transformer
3. Parallel operation of two single phase transformers and study of their load sharing under various conditions of voltage ratios and leakage impedances.

Any five experiments are to be conducted of following experiments:

1. Speed control of D.C. Shunt motor and study of starters.
2. Brake test on D.C. Shunt motor
3. Load characteristics of D.C. series motor.
4. Hopkinson's test on D.C. shunts machines.
5. Load test on 3-phase induction motor.
6. No load & blocked-rotor test on 3-phase induction motor :
   a) Determination of parameters of equivalent circuit.
   b) Plotting of circle diagram.
7. Calculation of motor performance from (a) & (b) above.
8. Determination of sequence impedance of the transformer
9. To study Sumpner's test.
10. Measurements of non-sinusoidal current waveform of transformer at no load Swinburne Test on DC shunt Motor.

Industrial Visit:

- Minimum One visit to above machines manufacturing industry (mentioned in syllabus) is recommended.
- Assignment based on IS 2026.

Text Books:

[T1] Edward Hughes "Electrical Technology", ELBS, Pearson Education.
[T2] Ashfaq Husain, "Electrical Machines", DhanpatRai& Sons.
[T3] S. K. Bhattacharya, "Electrical Machine", Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
[T4] Nagrath& Kothari, "Electrical Machines", Tata McGraw Hill.
[T5] Bhag S Guru, Husein R. Hiziroglu, "Electrical Machines", Oxford University Press.
[T6] K Krishna Reddy, "Electrical Machines- I and II", SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

[R1] A.E. Clayton and N. N. Hancock, "Performance and Design of Direct Current Machines", CBS Publishers, Third Edition.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd., Fifth Edition.
[R3] A.S. Langsdorf, "Theory and performance of DC machines", Tata McGraw Hill.
[R4] M.G. Say, "Performance and Design of AC. Machines", CBS Publishers and Distributors.
[R5] SmarajitGhosh, "Electrical Machines", Pearson Education, New Delhi.
[R6] Charles I Hubert, "Electrical Machines Theory, Application, & Control", Pearson Education, New Delhi, Second Edition.

203147: Network Analysis

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Term Work : 50 Marks

Prerequisite:

- Terminology of electrical networks, Laplace transforms linear differential equations.

Course Objective:

- To develop the strong foundation for Electrical Networks.
- To develop analytical qualities in Electrical circuits by application of various theorems.
- To understand the behavior of circuits by analyzing the transient response using classical methods and Laplace Transform approach.
- To apply knowledge of Network theory for analysis of 2-port networks and design of other circuits like filters.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Developing strong basics for network theory.
- Develop the problem solving technique for networks by application of theorems.
- Understand the behavior of the network by analyzing its transient response.
- Apply their knowledge of network theory for designing special circuits like filters.

Unit 01 : Basics of Network: (8 Hrs)

Source transformation: voltage and current sources, mesh analysis, nodal analysis, Concept of super node and super mesh, coupled circuits and dot conventions. Concept of network graphs (incidence, tie set and cut set matrix), Concept of duality and dual networks.

Unit 02 : Network Theorems: (8 Hrs)

Superposition, Thevenin, Norton, Maximum Power Transfer Theorem, Reciprocity theorem, Millman theorems applied to both ac/dc circuits.

Unit 03 : Analysis of Transient Response in Circuits-Classical Method: (8 Hrs)

Initial and Final Condition of network, General and Particular Solution, time constant. Transient response of R-L, R-C and R-L-C network in time domain.

Unit 04 : Analysis of Transient Response in Circuits: Laplace Transform Approach: (8 Hrs)

Standard test inputs: Step, Ramp, Impulse, Their Laplace transform, Representation of R,L,C in S domain, transformed network, Application of Laplace transform to solve series and parallel R-L, R-C and R-L-C circuits (Source free, Source driven).

Unit 05 : Two Port Network and Network Functions: (8 Hrs)

Two port parameters: Z, Y, H and Transmission parameters Network Functions for 1 and 2 port, calculation of network functions, Poles and zeros of network functions, Restrictions on poles and zeros, Time–domain behavior from the pole and zero location, Necessary conditions for stable driving point function and Transfer function.

Unit 06 : Filters: (8 Hrs)
Classification of filters: Low pass, High Pass, Band pass, Band stop, Symmetrical networks : characteristic impedance , propagation constant, Design of constant K- low pass and constant K- high pass filters using symmetrical networks.

Guidelines for Instructor's Manual

- Specify objective(s) of the experiment.
- List out equipment required to perform the experiment with their ratings.
- Include circuit diagram with specifications.
- Related theory of the experiment must be included.
- Include step by step procedure to perform the experiment.
- Tabular representation of results taken from the experiment/observation table must be included wherever applicable.
- It should include the formulae required to calculate desired results.
- Instructions for plotting the graphs must be included wherever required.
- Provide space to write conclusion on their own.
- For simulation experiments using MATLAB, the Simulink diagram with proper details must be included.

Guidelines for Student's Lab Journal

- Students are expected to write the journal in the following sequence:
  - Aim –
  - Equipment –
  - Circuit diagram –
  - Theory –
  - Procedure –
  - Observation table –
  - Calculations –
  - Graphs –
  - Conclusion.
- Students are expected to draw the circuit diagrams on 1mm graph paper.
- For plotting the characteristics they must use 1mm graph papers.
- Students should write conclusion on their own.
- Students should get the assignment and lab write up checked within 1 week after performing the experiment.

Guidelines for Lab /TW Assessment

Assessment should be on the basis of:

- Neatness of circuit diagram.
- Completed write up including theory, procedure.
- The detail calculations to obtain results.
- Graph with title, scale, labeling of axes etc.
- Conclusion.
- Punctuality, discipline, attendance, understanding and neatness of the journal.
- Few questions on the basis of the experiment can be asked to verify the understanding of the students about that experiment.

Guidelines for Laboratory Conduction

- Give the safety instructions to students.
- Allow 4-5 students per group for performing the experiment.
- Explain theory related to the experiment to be conducted.
- Introduce the equipment required to students.
- Explain students the calibration process of equipment.
- Explain the circuit diagram of the experiment.
- Connections should be completed by the students according to circuit diagram.
- Perform the experiment in the presence of instructor.
- Verify the results obtained.

List of Experiments:

Any **four** experiments from the first five of the following and any **four** experiments from rest of the list. (Minimum four experiments should be based on simulation software PSPICE/MATLAB along with hardware verification)

1. Verification of Superposition theorem in A.C. circuits.
2. Verification of Thevenin's theorem in A.C. circuits.
3. Verification of Reciprocity theorem in A.C. circuits.
4. Verification of Millmans' theorem.
5. Verification of Maximum Power Transfer theorem in A.C. circuits.
6. Determination of time response of R-C circuit to a step D.C. voltage input. (Charging and discharging of a capacitor through a resistor)
7. Determination of time response of R-L circuit to a step D.C. voltage input. (Rise and decay of current in an inductive circuit)
8. Determination of time response of R-L-C series circuit to a step D.C. voltage input.
9. Determination of parameter of Two Port Network.
10. Frequency response of constant K- low pass filters
11. Frequency response of constant K- high pass filters.

Text Books:

[T1] M. E. Van Valkenburg, "Network Analysis", Prentice Hall of India Private Limited, Third Edition,

[T2] D Roy Choudhary, "Network and Systems", New age international publishers.

[T3] AbhijitChakroborty, "Circuit Theory", DhanpatRai and Company, 7th edition.

[T4] Ravish R Singh, "Network Analysis and synthesis", McGraw Hill education (India) Pvt. Ltd, 3rd edition 2015.

Reference Books:

[R1] William H. Hayt, Jr. Jack E. Kemmerly, "Engineering Circuit Analysis" McGraw Hill Publication.

[R2] N.C. Jagan, "Network Analysis", BS Publication, Hyderabad, Second Edition.

[R3] G. K. Mittal, "Network Analysis and Synthesis", Khanna Publication.

Unit	Text Books	Reference Books
1	T1,T2,T3,T4	R1,R3
2	T2,T3,T4	R1,R3
3	T1,T3	R2,R3
4	T2,T3	R1,R2
5	T2,T3,T4	R3
6	T2,T3,T4	R1

203148: Numerical Methods and Computer Programming

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 05	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
Tutorial : 01 Hr/ Week		Practical : 50 Marks
		Term Work : 25 Marks

Prerequisite:

- Differentiation and integration of a single real variable, ordinary differential equations.
- Fundamentals of Programming languages.
- Linear Algebra.

Course Objective:

- To emphasize the need of computational techniques and analyze errors involved in the computation.
- To provide sound knowledge of various numerical methods.
- To apply various numerical methods to obtain solution of different types of equations such as transcendental, simultaneous, ODE etc. and also for interpolation, integration and differentiation.
- To impart skills to develop programs using C language.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Develop algorithms and implement programs using C language for various numerical methods.
- Demonstrate types of errors in computation and their causes of occurrence.
- Identify various types of equations and apply appropriate numerical method to solve different equations.
- Apply different numerical methods for interpolation, differentiation and numerical integration.
- Apply and compare various numerical methods to solve first and second order ODE.
- Apply and compare various numerical methods to solve linear simultaneous equations.

Unit 01 : Basics of C Language: (8 Hrs)

Revision: Basics of ‘C’ language - Data types, Operators and its precedence. Control statements: ‘if-else’ and nested ‘if-else’, ‘for, while and do-while’.
Arrays: Introduction, one and two dimensional arrays.
Functions: Types of functions User Defined Functions - declaration and prototypes, Local and Global variables.
Pointers: Introduction, declaring and initializing pointers.

Unit 02 : Numerical Methods , Errors and Concept of root of equation: (8 Hrs)

A) Basic principle of numerical methods. Floating point algebra with normalized floating point technique, Significant digits.
Errors: Different types of errors, causes of occurrence and remedies to minimize them. Generalized error formula.

B) **Concept of roots** of an equation. Descartes’ rule of signs, Sturm’s theorem, Intermediate value theorem. Synthetic division, Roots of Polynomial Equations using Birge-Vieta method.

Unit 03 : Solution of Transcendental and polynomial equation and Curve Fitting: (8 Hrs)

A) **Solution of Transcendental and polynomial equation:** Bisection, Secant, Regula-Falsi, Chebyeshev and Newton-Raphson methods, Newton-Raphson method for two variables.

B) **Curve Fitting** using least square approximation – First order and second order.

Unit 04 : Interpolation and Numerical Differentiation: (8 Hrs)

A) **Interpolation:** Difference operators, Introduction to interpolation - Newton's forward, backward interpolation formulae, Stirling's and Bessel's central difference formulae, Newton's divided difference formula, Lagrange's interpolation.

B) **Numerical Differentiation** using Newton's forward and backward interpolation formulae.

Unit 05 : Solution of Ordinary Differential Equation(ODE) and Numerical Integration: (8 Hrs)

A) **Solution of First order Ordinary Differential Equation (ODE)** using Taylor's series method, Euler's, Modified Euler's methods. Runge-Kutta second and fourth order methods. **Solution of Second order ODE** using 4th order Runge-Kutta method.

B) **Numerical Integration:** Trapezoidal and Simpson's rules as special cases of Newton-Cote's quadrature technique for single and double integrals.

Unit 06 : Solution of linear simultaneous equation: (8 Hrs)

A) **Solution of simultaneous equation:** Direct methods - Gauss and Gauss-Jordan elimination methods, concept of pivoting – partial and complete. Iterative methods – Jacobi and Gauss Seidel methods.

B) **Matrix Inversion** using Jordon method and Eigen values using Power method.

Guidelines for Instructor's Manual

Practical Sessions -

The Instructor's Manual should contain following related to every program –

- Theory related to the method.
- Algorithm and Flowchart of the method.
- One or two solved numerical.
- Brief description of the few C commands used in the program.
- Seven - eight questions based on method and related C commands.
- Printout of C program and output.

Tutorial Sessions -

The Instructor's Manual should contain following related to every Tutorial –

- Algorithm, flowchart and program related to the tutorial C assignments.
- One – two solved numerical related to every method in the tutorial.

Guidelines for Student's Lab Journal

Practical Sessions -

The Student's Lab Journal should be a hand written containing following related to every experiment –

- Theory related to the method.
- Algorithm and Flowchart of the method.
- One solved numerical.
- Brief description of the few C commands used in the program.
- Questions & Answers based on method and related C commands.
- Printout of C program and output.

Tutorial Sessions –

The Student's Tutorial Notebook should contain following related to every Tutorial –

- Algorithm, flowchart and program related to the tutorial C assignments.
- At least one solved numerical related to every method in the tutorial.

Guidelines for Lab /TW Assessment

- There should be continuous assessment of the TW.
- TW assessment should be based on – understanding of the method, proficiency in C programming, involvement during lab sessions, neatness in journals and timely submission.
- Students performance in tutorial sessions should also be evaluated and considered for final TW assessment with due weightage.

Guidelines for Laboratory Conduction

- Detail theory and numerical related to the method should be taken in the lecture prior to the lab session.
- Algorithm should be discussed in detail in the lab session.
- Students are expected to do the program based on the discussed algorithm individually.
- Printout of the program and output should be taken on the day when the program is performed.

List of Experiments:

Term work shall consist of minimum **EIGHT** computer programs in C language with flowcharts and results.

1. Solution of a polynomial equation using Birge-Vieta method.
2. Solution of a transcendental equation using Bisection or Regula-Falsi method.
3. Solution of two variable non-linear equation using N-R method.
4. Program for interpolation using Newton's forward or backward interpolation.
5. Program for interpolation using Lagrange's or Newton's Divided difference interpolation.
6. First order curve fitting using Least square approximation.
7. Solution of simultaneous equation using Gauss Seidel or Jacobi method.
8. Solution of simultaneous equation using Gauss elimination or Jordon method.
9. To find largest Eigen value using Power method.

10. Solution of Numerical Integration using Simpson's (1/3) rd or (3/8) thrule.
11. Solution of first order ODE using 4th order RK method or Modified Euler method.

List of Tutorials:

***** Tutorials should be based on following methods.**

1. Minimum 6 'C' programs based on decision making, for, while, and do-while loops, one and two dimensional arrays and user defined functions.
2. Sturm's Theorem and BirgeVieta method.
3. RegulaFalsi method, Newton Raphson method and Second order Least Square Approximation method.
4. Any two methods of interpolation with equal interval and all methods for unequal interval.
5. One direct and one iterative method for solution of linear simultaneous equations.
6. 4th order R-K method for first order ODE and 2nd order ODE and Simpson's rule for single and double integrals.

****** A Tutorial can be extended for more than one week to include all the mentioned methods.***

Text Books:

[T1] M. K. Jain, S.R.K. Iyangar, R. K. Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Publications.
[T2] T. Veerarajan and T. Ramchandran, "Numerical Methods with Programs in C and C++", Tata McGraw Hill Publication.
[T3] P.P. Gupta & G.S Malik, "Calculus of Finite Difference and Numerical Analysis", Krishna Prakashan Media Ltd, Meerut.
[T4] Dr. B. S. Grewal, "Numerical Methods in Engineering & Sciences", Khanna Publishers.
[T5] E. Balagurusamy, "Programming in ANSI C", Tata McGraw Hill Publication.
[T6] E. Balagurusamy, "Numerical Methods", Tata McGraw Hill Publication.

Reference Books:

[R1] J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH, New Delhi.
[R2] Steven Chapra, Raymond P. Canale, "Numerical Methods for Engineers", Tata McGraw Hill Publication.
[R3] YashwantKanetkar, "Let us C", BPB Publications.
[R4] S.S. Sastry, "Introductory methods of Numerical Analysis", PHI Learning Private Ltd.
[R5] P. Thangaraj, "Computer oriented Numerical Methods", PHI Learning Private Ltd.

Unit	Text Books	Reference Books
1	T5	R3
2	T6,T1,T3	R4,R2 ,R5
3	T2,T3,T4	R2 ,R1,R5
4	T2,T3,T4	R2,R1,R5
5	T2,T3,T4	R2,R1,R5
6	T2,T3,T4	R2,R1,R5

203149: Fundamentals of Microcontroller and Applications

Teaching Scheme	Credits	Examination Scheme [Marks]
Th : 04 Hrs/ Week	Th/Tut: 04	In Sem (Online) : 50 Marks
PR : 02 Hrs/ Week	PR:01	End Sem : 50 Marks
		Oral : 50 Marks

Prerequisite:

- Knowledge of numbering systems and Boolean algebra.
- Knowledge of combinational and sequential logic circuits.

Course Objective:

- To understand the differences between microcontrollers and microprocessors learn microcontroller architecture & describe the features of a typical microcontroller.
- To use the 8051 addressing modes and instruction set and apply this knowledge to perform programs - arithmetic & logic operations, data & control transfer operations, input & output operations.
- To define the protocol for serial communication and understand the microcontroller development systems.
- To build and test a microcontroller based system; interface the system to switches, keypads, displays, A/D and D/A converters.
- To provide students with the concepts and techniques required in designing computer hardware interfaces embedded software for microcontrollers and measurement of various analog parameters.

Course Outcome: Upon successful completion of this course, the students will be able to :-

- Differentiate between microprocessor and microcontroller.
- Describe the architecture and features of various types of microcontroller.
- Demonstrate programming proficiency using the various addressing modes and all types of instructions of the target microcontroller.
- Program using the capabilities of the stack, the program counter the internal and external memory, timer and interrupts and show how these are used to execute a programme.
- Write assemble assembly language programs on PC and download and run their program on the training boards.
- Design electrical circuitry to the Microcontroller I/O ports in order to interface with external devices.
- Write assembly language programs and download the machine code that will provide solutions real-world control problems such as fluid level control, temperature control, and batch processes.

Unit 01 : (8 Hrs)

Introduction to concept of microcontroller, comparison of Microprocessor and microcontroller, Comparison of all 8 bit microcontrollers, Intel 8051 microcontroller architecture, Pin diagram, Memory organization of 8051, special function registers, Internal structure of I/O ports, operation of I/O ports. Interfacing of 8051 with externalmemory.

Unit 02 : (8 Hrs)

Addressing modes of 8051, Instruction set of 8051, Stack and Stack Related instruction, Data exchange, byte level logical operations, bit level logical operations, rotate and swap operations, instruction affecting flags, incrementing, decrementing, arithmetic operations, jump and recall instruction, Call and return subroutines.

Unit 03 : (8 Hrs)

Assembly language programming of 8051. Counters and timers in 8051, timer modes and its programming.

Unit 04 : (8 Hrs)

Interrupts- timer flag interrupt, serial port interrupt, external interrupts, software generated, interrupt control and interrupt programming. Serial communication and its programming. Serial data input, output, Serial data modes, interfacing of 8051 with PC through RS232.

Unit 05 : (8 Hrs)

Microcontroller development tools- study of simulator, emulator, assemblers, programmers, cross assembler for microcontrollers. Study, interfacing and programming of PPI 8255 - mode 0, 1, BSR mode. Interfacing of 8051 with 8255 for expanding of I/O. Programming and Interfacing of 8051 with 8 bit ADC (0809) and DAC (0808).

Unit 06 : (8 Hrs)

Part A: (Theoretical Treatment only)

Measurement of parameters such as matrix (4 x 4) Keyboard pressure, temperature, flow, level, voltage, current, power (KW), power factor and frequency using 8051.

Part B: Interfacing and Programming

Interfacing of 8051 with single key, LED, Relay, voltage, current, speed control of dc motors, Stepper motor control (speed /position).

Guidelines for Instructor's Manual

1. Commands to be followed in order to operate the 8051 micro controller kit.
2. Architecture of 8051 micro controller kit-Functional block diagram & its explanation.
3. Pin Diagram of 8051 micro controller with description of all the 40 pins.
4. Addressing modes-Explanation with an example.
5. Instruction set for Data transfer, Arithmetic, Logical, Branching& Bit manipulation along with explanation.
6. User manuals of all the interfacing kits such as stepper motor, DC motor,DAC, ADC &LED.

Guidelines for Student's Lab Journal

1. Title of the program.
2. The program has to be written in the following format.Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on separate page.

Guidelines for Laboratory Conduction

1. Each group in the lab should have not more than three students.
2. Each student within the group has to enter and execute the program turn wise.
3. Staff member has to check the result of all the groups after the execution of the program.

List of Experiments:

Compulsory Experiments:

1. Study and use of 8051 Microcontroller trainer kit.
2. Assembly Language Program for arithmetic operation of 8 bit numbers.
3. Assembly Language Program for finding largest number and smallest number from a given array of 8 bit numbers.
4. Assembly Language program to arrange 8 bit numbers stored in array in ascending order and descending order.
5. Assembly Language Program for data conversion.
6. Assembly Language Program for use of Timer/Counter for various applications.

Any six experiments are to be conducted of following experiments:

1. Implementation of Serial Communication by using 8051 serial ports.
2. Programming using cross assembler.
3. Blinking display of LED's interfaced with 8051 through 8255.
4. Interfacing of 8 bit DAC 0808 with 8051 to generate various waveforms.
5. Interfacing of 8 bit ADC 0809 with 8051 Microcontroller.
6. Interfacing of relay with 8051.
7. Stepper motor control by 8051 Microcontroller.
8. Interfacing of matrix keyboard/ 7 segment display with 8051

Text Books:

[T1] V Udayashankara and M S MallikarjunaSwamy, "8051 Microcontroller, Hardware, software and applications", TATA McGraw Hill.
[T2] Muhammad Ali Mazidi, J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearsons Publishers.
[T3] Ajay Deshmukh, "Microcontroller 8051" –TATA McGraw Hill.
[T4] Theagrajan," Microprocessor and Microcontroller", BS Publication.
[T5] K. J. Ayala, "The 8051 Microcontrollers- Architecture, Programming and Applications", Peram International Publications.
[T6] SubrataGhoshal, "8051 microcontroller", Pearsons Publishers.

Reference Books:

[R1] Scott Mackenzie, "8051 Microcontroller", Pearson Education.
[R2] Intel Microcontroller data book.
[R3] Intel Corporation 1990- 8 bit embedded controller handbook.

NOTE: - Text books given covers total syllabus.

203155: Audit Course II

(A) Solar Photovoltaic Systems

Course Name: Solar Photovoltaic Systems

Prerequisite: Completion of FE or equivalent

Teaching Scheme:
Theory: 02Hrs/ Week
Practical: 2 h x 3

Examination Schemes: Audit (P/F)
Written and MCQ

Description:
The course will introduce the basics of: solar energy, availability, semiconductors as photovoltaic convertors and solar cells, applications of photovoltaic, various types of solar photovoltaic systems, and introduction to manufacturing of the systems, characterization, quality assurance, standards, certification and economics. The following topics may be broadly covered in the classroom. The practical will be designed for basic understanding of the system elements.

Course Objective:
- To learn Solar PV system and its appliances
- To get knowledge of balance of PV system, batteries, inverters etc.
- To understand grid tied SPV solar plants

Course Outcome: Students
- Will be able to do design of Solar PV system for small and large installations
- Will be able to handle software tools for Solar PV systems

Course Contents:
- Physics of photovoltaic (PV) electricity
- Photodiode and solar cell
- Solar radiation spectrum for PV
- Types of solar cell and comparison
- Introduction to various types of solar module manufacturing
- Basic system design and economics
- Types of systems
- Common applications of solar PV
- Introduction to solar PV (SPV) systems
- SPV appliances
- Small capacity SPV power plants
- Grid tied SPV power plants
- Large scale SPV power plants
- Balance of system
- Solar inverters
- Batteries
- Financial modeling of SPV
- Operation and maintenance of SPV
- Software tools for SPV
- Environmental impact assessment
- Standards and certification for SPV
- Basics of SPV systems
- Elements of SPV appliances and power plants

- Procurement versus production
- Bought-outs, assemblies, sub-assemblies
- Manufacturing and assembly
- Manufacturing standards
- Quality assurance and standards
- Certification
- Special purpose machines and Automation in manufacturing
- Site assembly and fabrication
- Typical shop layouts
- Inventory management
- Economics of manufacturing

Practical:

- PV characterization
- Batteries and energy storage
- PV system design

References:

[1] A.S.Kapur -A Practical Guide for Total Engineering of MW capacity Solar PV Power Project

[2] Solanki C.S- Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers- PHI

[3] Solanki C.S- SolarPhotovoltaics - Fundamentals, Technologies and Applications- PHI

[4] S. Sukhatme -Solar Energy : Principles of Thermal Collection and Storage- McGraw Hill

203155: Audit Course II

(B) Course Name: Installation & Maintenance of Electrical appliances

Prerequisite: Completion of FE/DEE or equivalent

Teaching Scheme:
Theory / Practical: 02Hrs/ Week

Examination Schemes: Audit (P/F)
Written and MCQ
Term paper

Field Visit: 4 h

Course Objective:
This course has been designed to provide the knowledge of Repairing and Maintenance of home appliances. Students will be familiar with maintenance of everyday household necessities.

Course Outcome: At the end of the course the students will be having knowledge of: -

- Observing the safety precautions while working,
- Test line cord for continuity with test lamp/ multimeter
- Dismantle and reassemble an electric iron
- Heater, kettle, room heater, toaster, hair dryer, mixer grinder etc.
- Install a ceiling fan and the regulator
- Check a fluorescent lamp chock, starter and install it
- Domestic installation testing before energizing a domestic installation

Course Contents:

- **General safety & electrical safety –**
  - What is safety, Why safety is needed,
  - Tools for electrical safety,
  - Safety rules
  - Precaution during electrical maintenance
- **Crimping & crimping tool, soldering**
  - What is crimping, crimping tool, How to use RJ-11 connector, telephone wire, UTP Cable
  - crimping technique, precaution during crimping
  - Soldering Iron, Soldering wire, Soldering Flux,
  - Soldering method, Zero defect soldering
- **Earthing& types of Earthing**
  - Introduction of Earthing ,
  - Need of Earthing, Hazard,
  - Types of Earthing
  - Advantage of Earthing, working of Earthing
- **Simple house wiring circuit**
  - Introduction of Wiring ,types of wiring,
  - need of wiring, advantage of wiring,
  - wiring methods
  - electrical panel, cable type
- **Install, service and repair of automatic electric iron, mixer grinder, ceiling and table fan, heater, iron, kettle, washing machine etc**
  - Installation procedure of electric iron,
  - Installation procedure mixer grinder
  - Installation procedure of ceiling and table fan,

- Installation procedure heater, iron, kettle
- Installation procedure washing machine
- fault finding & removal of faulty component in electric iron, mixer grinder, ceiling and table fan
- fault finding & removal of faulty component in heater, iron, kettle, washing machine

- **Assemble and install of a fluorescent lamp**
  - Parts of fluorescent lamp,
  - Working principle of fluorescent lamp,
  - assembling procedure of lamp
- **Thermostat heat controls of Automatic electric iron, steam iron, spray irons.**
  - Thermostat, Bimetal, Wax Pallet , Gas Expansion, Pneumatic,
  - Bimetallic Switching thermostat, Simple two wire thermostats
  - Combination heating/Cooling regulation, Heat Control of Steam Iron, Electric Iron
- **Maintenance of decorative serial lamp for a required supply voltage**
  - What is decorative lamp, Working of decorative lamp
  - Description of decorative serial lamp,
  - Maintenance of decorative serial lamp
- **Introduction to re- winding Insulating material used**
  - Material, Types of Material
  - Insulating Material, Types of Insulating Material
  - Need of insulating material, winding, re-winding

References:

[1] S. K. Shastri – Preventive Maintenance of Electrical Apparatus – Katson Publication House

[2] B.K.N.Rao -Hand book of condition monitoring- Elsevier Advance Tech., Oxford(UK).

[3] Eric Kleinert-Troubleshooting and Repairing Major Appliances / Edition 3- McGraw Hill

[4] Service Manual of Electrical Home Appliances

Savitribai Phule Pune University

Syllabus

FOR

S.E. Mechanical and Automobile Engineering

2015 Course

UNDER FACULTY OF ENGINEERING

EFFECTIVE FROM June 2016

Structure of S.E. (Mechanical Engineering/ Automobile Engineering)
2015 Course

Semester-I

Subject Code	Subject	Teaching Scheme Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	PR	In-Sem (online)	End-Sem	TW	PR.	Oral		Lect/Tut	PR/OR
207002	Engineering Mathematics – III	04	01	-	50	50	25	-	-	125	05	-
202041	Manufacturing Process-I	03	-	**02**	50	50	50	-	-	150	03	01
202042	Computer Aided Machine Drawing	01	-	02	--	--		50	-	50	01	01
202043	Thermodynamics	04	-	**02**	50	50	-	-	50	150	04	01
202044	Material Science	03	01	-	50	50	25	-	-	125	03	01
202051	Strength of Materials	04	-	**02**	50	50	-	-	50	150	04	01
202055	Audit course											
					--	--						
	Total	**19**	**02**	**08**	**250**	**250**	100	50	100	**750**	**20**	**05**
	Total of Part-I	**29 Hrs**				**750**					**25**	

Note: Material Science and Engineering Mathematics-III practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

Semester-II

Subject Code	Subject	Teaching Scheme Hours/Week			Examination Scheme					Total Marks	Credits	
		L	Tut.	PR	In-Sem (online)	End-Sem	TW	PR.	Oral		Lect/Tut	PR/OR
202045	Fluid Mechanics	04	-	02	50	50	-	50	-	150	04	01
202047	Soft Skills	-	-	02	--	--	25	-	-	25	-	01
202048	Theory of Machines – I	04	01	-	50	50	25	-	25	150	04	01
202049	Engineering Metallurgy	03	01	-	50	50	-	-	25	125	03	01
202050	Applied Thermodynamics	04	-	02	50	50	-	50	-	150	04	01
203152	Electrical and Electronics Engineering	03	-	02	50	50	25	-	-	125	03	01
202053	Machine Shop – I	-	-	02	--	--	25	-	-	25	-	01
	Total	**18**	**02**	**10**	**250**	**250**	**100**	**100**	**50**	**750**	**18**	**07**
	Total of Part-II	**30 Hrs**				**750**					**25**	

Note: Theory of Machine-I and Engineering Metallurgy practical may be carried out fortnightly for two hours, so that the tutorial hours may be used as practical.

Audit Course1

In addition to credits courses, it is recommended that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for one of the audit courses, starting in second year first semester. Though not mandatory, such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose one audit course from the list. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.
(Ref-http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

Guidelines for Conduction and Assessment (Any one or more of following but not limited to)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations
- Surveys
- Mini Project
- Hands on experience on specific focused topic

Guidelines for Assessment (Any one or more of following but not limited to)

- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

List of courses under Audit Course1

Course Code	**Audit Course Title**
202054 A	Road Safety
202054 B	Innovations in engineering field / Agriculture
202054 C	Value Education

The detail course contents of above mentioned audit courses are available in Mechanical Engineering 2015 course syllabus. Moreover students can opt for any other audit course from the list of Audit Course1 of any branch of engineering.

SEMESTER-I

207002: Engineering Mathematics III (Mechanical + SW / Production + SW / Industrial /Automobile Engineering)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Lectures: 4 Hrs./Week	**Theory:** 04	**Ins-Sem:** 50 Marks
Tutorials: 1 Hr./Week	**Tutorial:** 01	**End-Sem:** 50 Marks
		Term work: 25 Marks

Prerequisites: - Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of central tendency and dispersion, Vector algebra

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Ordinary and partial differential equations applied to Mechanical engineering problems such as mechanical vibrations and heat transfer.
2. Integral Transform techniques such as Laplace transform, Fourier transform and applications to ordinary and partial differential equations in Vibration theory, Fluid dynamics, Heat transfer and Thermodynamics.
3. Statistical methods such as correlation, regression analysis and probability theory in analyzing and interpreting experimental data applicable to Reliability engineering
4. Vector differentiation and integration applied to problems in Fluid Mechanics.

Course Outcomes:

At the end of this course, students will be able to:

1) Solve higher order linear differential equations and apply to modeling and analyzing mass spring systems.

2) Apply Laplace transform and Fourier transform techniques to solve differential equations involved in Vibration theory, Heat transfer and related engineering applications.

3) Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data and probability theory in testing and quality control.

4) Perform vector differentiation and integration, analyze the vector fields and apply to fluid flow problems.
5) Solve various partial differential equations such as wave equation, one and two dimensional heat flow equations.

Unit I: Linear Differential Equations (LDE) and Applications (09 Hours)

LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of mass-spring systems, free and forced damped and undamped systems.

Unit II: Transforms (09 Hours)

Laplace Transform **(LT):** LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Fourier Transform **(FT):** Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.

Unit III: Statistics and Probability (09 Hours)

Measure of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Probability, Probability distributions: Binomial, Poisson and Normal distributions, Population and sample, Sampling distributions, t-distribution, Chi-square distribution.

Unit IV: Vector Differential Calculus (09 Hours)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (09 Hours)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) (09 Hours)

Basic concepts, modeling of Vibrating String, Wave equation, one and two dimensional Heat flow equations, method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier Transforms, Two-dimensional wave equation.

Text Books:

1. Advanced Engineering Mathematics, 9e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).

Reference Books:

1. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
2. Advanced Engineering Mathematics, Wylie C.R. & Barrett L.C. (McGraw-Hill, Inc.)
3. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar & J. N. Wartikar (Pune Vidyarthi Griha Prakashan, Pune).
5. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
6. Advanced Engineering Mathematics with MATLAB, 2e, by Thomas L. Harman, James Dabney and Norman Richert (Brooks/Cole, Thomson Learning).

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

202041: Manufacturing Process- I

Teaching Scheme:		**Credits**	**Examination Scheme:**	
TH:	**03 Hrs/week**	**Th: 03**	**In-Sem:**	**50**
		Tut:--	**End-Sem:**	**50**
PR:	**02 Hrs/week**	**PR/OR/TW: 01**	**PR:**	**--**
			OR:	**--**
			TW:	**50**

Course Objectives:

- To make acquaintance of foundry processes pattern making and casting
- To study metal forming processes such forging, rolling, extrusion and wire drawing.
- To make study of different plastic molding processes
- To study metal joining processes
- To design and development of product with Sheet metal working process
- Introduction to center lathe

Course Outcomes:

On completion of the course, learner will be able to–

- Understand and analyze foundry practices like pattern making, mold making, Core making and Inspection of defects.
- Understand and analyze Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
- Understand different plastic molding processes, Extrusion of Plastic and Thermoforming
- Understand different Welding and joining processes and its defects
- Understand, Design and Analyze different sheet metal working processes
- Understand the constructional details and Working of Centre Lathe

Course Contents

Unit I Casting Processes: (9 Hrs)

SAND CASTING – Pattern- types, material and allowances, Molding sand- types, properties and testing, Molding – types, equipment's, tools and machines, Core – types and manufacturing, Gating system and Riser – types and design (Numerical), Heating and pouring, cooling and solidification- process and time estimation (Numerical), Cleaning and Finishing, Defects and remedies, Inspection techniques. Die casting, Investment casting, Centrifugal Casting, Continuous Casting- Types, equipment, process parameters, material to cast**.**

Unit II Metal Forming Processes: (8 Hrs)

Hot and Cold Working – Concepts and comparative study, Material behavior in metal forming, strain rate sensitivity, friction and lubrication in metal forming Rolling – Types of rolling mills, flat rolling analysis, power required per roll for simple single pass two rollers. (Simple Numerical) Forging – Types, process parameter, Analysis of open die forging (Numerical) Extrusion – Types, process parameter, Extrusion dies, Shape factor (Numerical), Drawing – Wire drawing and its analysis (Numerical), tube drawing

Unit III Plastic Processing: (6Hrs)

Molding – Compression molding, Transfer molding, Blow molding, Injection molding – Process and equipment. Extrusion of Plastic – Type of extruder, extrusion of film, pipe, cable and sheet Thermoforming – Principle, pressure forming and vacuum forming

Unit IV Joining Processes: (6Hrs)

Surface preparation and types of joints. Welding Classification Arc welding – Theory, SMAW, GTAW, FCAW, Submerged arc welding, Stud welding. Resistance welding – Theory, Spot, seam and projection weld process. Gas welding. Soldering, brazing and braze welding. Joint through Adhesive – classification of adhesive, types of adhesive, applications. Weld inspection, Defects in various joints and their remedies.

Unit V Sheet Metal Working: (7Hrs)

Types of sheet metal operations, Types of dies and punches, material for dies and punches, Die design for Progressive and Drawing Die, clearance analysis, center of pressure, blank size determination (Numerical), strip layout, sheet utilization ratio (Numerical), method of reducing forces

Unit VI Centre lathe: (7Hrs)

Introduction to centre lathe, types of lathe, construction and working of lathe, attachments and accessories, various operations on lathe, taper turning and thread cutting methods (numerical), machining time calculation (numerical)

Books:

Text

1. Hajara Choudhari, Bose S.K. – Elements of workshop Technology Vol. I &II , Asian Publishing House
2. D. K. Singh – Fundamentals of Manufacturing Engineering – Ane's Books. Pvt. Ltd.

Reference:

1. B. Ravi – Metal Casting – Computer Aided design and analysis- Prentice Hall of India
2. Reikher – Casting: An analytical approach – Springer
3. Wang – Rapid tooling guidelines for sand casting – Springer
2. J. T. Black – Degormos Materials and process in manufacturing – John Willey and sons
3. M.P Grover – Fundamentals of modern manufacturing: Materials and systems
4. A.S Athalye – Processing of plastic – Colour Publication (Pvt.)Ltd. U.K
5. Cryil Donaldson and George H LeCain – Tool Design – Tata McGraw Hill Education Pvt. Ltd.
6. Dr. R. S. Parmar, Welding Processes And Technology, Khanna Publishers, New Delhi.

Lab Assignments

1. Manufacturing of any one assembly consisting of minimum two components and involving all the lathe operations
2. Demonstration of Sand Moulding Processes
3. Job on TIG/ MIG/ Resistance welding

Guidelines for Term Work assessment

Each student must complete and submit following Term Work

i) Assgmenyt-1 and assignment-3 w.r.t. above mentioned laboratory assignments

ii) Journal consisting of following write-ups:

a) Study of casting processes

b) Study of plasting moulding processes

c) Study of welding processes

d) Study of centre lathe and single point cutting tool geometry

202042: Computer Aided Machine Drawing

Teaching Scheme:	Credits	Examination Scheme:
TH: 01 hr/week	Th:01	TH In-Sem: 50
		End-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	PR: 50
		OR: --
		TW: --

Prerequisites: -

1. Fundamentals Engineering Drawing
2. Projection of Solids
3. Basic knowledge of 2-D drafting using graphics software

Course Objectives:

- To understand Parametric Modeling Fundamentals, Procedure, and "Shape before Size" Approach.
- To develop an ability to Create Parametric 2-D Sketches, and Create and Edit Parametric Dimensions.
- To develop an ability to Create Solid Models of machine components. The student should be able to apply these skills to the solution of a variety of practical problems and be able to employ their knowledge to solve more complicated problems.
- To develop an ability to Create assembly models of simple machine (minimum 5 components). The student should be prepared to continue the study of computer aided machine drawing through further subjects/projects in further years of engineering.
- To develop the ability to apply Limits, Fits, and Dimensional Tolerances, as well as Geometric Tolerances to components and assemblies on Engineering Drawings.
- To develop an ability to create 2D drawings from 3D models

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD, PLM.
- Understand the significance of parametric technology and its application in 2D sketching.
- Understand the significance of parametric feature-based modeling and its application in 3D machine components modeling.
- Ability to create 3D assemblies that represent static or dynamic Mechanical Systems.
- Ability to ensure manufacturability and proper assembly of components and assemblies.
- Ability to communicate between Design and Manufacturing using 2D drawings.

Course Contents

Unit I Introduction (2 Hrs)
Introduction – evolution of CAD, importance of CAD in the light of allied technologies, solid modeling, introduction to Graphical User Interface (GUI) of any commercially used solid modeling software

Unit II Parametric Sketching (2 Hrs)
Parametric sketching - draw and modify 2D entities, apply/modify constraints and dimensions

Unit III Parametric Solid Modelling (2 Hrs)
Parametric solid modeling - fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, Free form feature modeling, design by features, feature recognition.

Unit IV Assembly Modelling (2 Hrs)
Assembly modeling - defining relationship between various parts of machine, creation of constraints, generation of exploded view

Unit V Geometric Dimensioning and Tolerancing (2 Hrs)
Geometric dimensioning and tolerancing - Limits, Fits, Dimensional Tolerances, Geometric Tolerances, Introduction to ASME Y14.5 – 2009

Unit VI Production Drawing (2 Hrs)
Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning and tolerancing

Books:

Text Books:

1. Bhat N. D., "Machine Drawing", Charotar Publications, New Delhi 2014
2. Ajeet Siingh, " Machine Drawing", Mc Graw Hill Publications, New Delhi 2012
3. ASME Y14.5 -2009, ASME, 2009

Lab Work:

1. Assignment on 2-D sketching with geometrical and dimensional constraints (2 hrs.)
2. Assignment on parametric solid modeling of a machine component (4 hrs.)
3. Assignment on solid modeling of the parts of a machine (min. 5 components) (10 hrs.)
4. Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions and generation of exploded view. (4 hrs.)
5. Generation of production drawings of the parts and assembly with appropriate tolerancing. (4 hrs.)

2043: Thermodynamics

Teaching Scheme:	Credits	Examination Scheme:
TH: 04 Hr/week	Th:04	TH In-Sem: 50
		End-Sem: 50
PR: 02 Hrs/week	PR/OR/TW:01	PR: --
		OR: 50
		TW: --

Prerequisites: -

1. Engg. Mathematics
2. Engg. Physics/Chemistry
3. Fundamental Concepts and laws of Thermodynamics.

Course Objectives:

- Identify and use units and notations in Thermodynamics.
- State and illustrate first and second laws of Thermodynamics.
- Explain the concepts of entropy, enthalpy, reversibility and irreversibility.
- Apply the first and second laws of Thermodynamics to various gas processes and cycles.
- To get conversant with properties of steam, dryness fraction measurement, vapor processes and Thermodynamic vapor cycles, performance estimation.
- To get conversant with Psychrometric Charts, Psychrometric processes, human comfort conditions.

Course Outcomes:

- On completion of the course, learner will be able to–
- Apply various laws of thermodynamics to various processes and real systems.
- Apply the concept of Entropy, Calculate heat, work and other important thermodynamic properties for various ideal gas processes.
- Estimate performance of various Thermodynamic gas power cycles and gas refrigeration cycle and availability in each case.
- Estimate the condition of steam and performance of vapour power cycle and vapour compression cycle.
- Estimate Stoichiometric air required for combustion, performance of steam generators and natural draught requirements in boiler plants.
- Use Psychromertic charts and estimate various essential properties related to Psychrometry and processes

Course Contents

Unit I Laws of thermodynamics (6 Hrs) Introduction of thermodynamics, Review of basic definitions, Zeroth law of thermodynamics, Macro and Microscopic Approach, State Postulate, State, Process and Thermodynamic Cycles, First law of thermodynamics, Joules experiment, Applications of first law to flow and non flow processes and cycles. Steady flow energy equation and its application to different devices. Equivalence of Clausius and Kelvin Planck Statement, PMM I and II, Concept of Reversibility and Irreversibility.
Unit II Entropy (4 Hrs) Entropy as a property, Clausius inequality, Principle of increase of Entropy, Change of entropy for an ideal gas and pure substance. **Ideal Gas (6 Hrs)** **Ideal Gas definition Gas Laws**: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas processes- on P-V and T-S diagrams Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes, Calculations of heat transfer, work done, internal energy. Change in entropy, enthalpy.
Unit III Thermodynamic cycles (6 Hrs) **Gas Power Cycles:** Air Standard Cycle, Efficiency and Mean Effective Pressure, Carnot Cycle, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles, Brayton cycle, **Gas Refrigeration Cycle:** Reversed Carnot, Bell Coleman Cycle. **Availability (4 Hrs)** Available and unavailable energy, concept of availability, availability of heat source at constant temperature and variable temperature, Availability of non flow and steady flow systems, Helmholtz and Gibbs function, irreversibility and second law efficiency.
Unit IV Properties of Pure substances (5 Hrs) Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer. **Thermodynamic Vapour Cycle (5 Hrs)** **Vapour Power Cycles:** Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle, **Vapour Refrigeration Cycles:** Reversed Carnot Vapor Cycle, Vapor Compression Cycle and representation of cycle on P-h and T-s diagram, Refrigerating effect, Compressor power and COP estimation **(Numerical treatment using R134a only and enthalpy Cp, Cv data should be provided in tabulated form).**

Unit V Steam Generators **(6 Hrs)**
Introduction to fuels, Theoretical amount of Oxygen / Air required for combustion. Stoichiometric Air: Fuel ratio, Excess air, lean and rich mixtures, Stoichiometric A: F ratio for petrol **(No Numerical Treatment on fuels and combustion, only basic definitions and terminologies to be covered)**.
Classification, Constructional details of low pressure boilers, Features of high pressure (power) boilers, Introduction to IBR, Boiler performance calculations-Equivalent evaporation, Boiler efficiency Energy balance, Boiler draught (natural draught numerical only).

Unit VI Psychrometry **(6 Hrs)**
Psychrometry and Psychrometric Properties, Basic Terminologies, Psychrometric Relations, Psychrometric Chart, Psychrometric Processes, Thermodynamics of Human Body, Comfort Conditions **(Numerical treatment using Psychrometric chart only).**

Books:

Text:

1. R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications
2. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications
3.

Reference:

1. Y. Cengel & Boles: Thermodynamics – An Engineering Approach,
2. P. L Ballany: Thermal Engineering, Khanna Publishers
3. C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill.
4. S. Domkundwar, C. P. Kothandaraman, Anand Domkundwar, Thermal Engineering, Dhanpat Rai Publishers.

List of Practical's:

1. Joule's experiment to validate first law of thermodynamics.
2. Determination of Cp and Cv for Ideal gas.
3. Performance estimation of Air standard cycle using standard simulation software's (MATLAB, VC++ etc.).
4. Determination of dryness fraction of steam (At least two Calorimeters).
5. Experiment to Calculate COP of Simple Vapor Compression Cycle (VCC).
6. Performance estimation of VCC using any professional software (CoolPack etc.)
7. Study of Boiler Mountings.
8. Study of Boiler Accessories.
9. Trial on boiler to determine boiler efficiency, equivalent evaporation and Energy Balance.
10. Industrial visit to any process industry which uses boiler and submission of detailed report.
11. Demonstration of Psychrometric processes (At least four).

Notes:

1. Minimum 8 experiments should be performed.
2. Experiment No. 9 and 10 are compulsory.

202044: Material Science

Teaching Scheme:	Credits	Examination Scheme:	
TH: 03 Hrs/week	**Theory: 03**	**TH**	**In-Sem: 50**
			End-Sem: 50
TUT: 01 Hr/week	**Tutorial: 01**		**PR: 50**
			OR: --
			TW: 25

Course Objectives:

- To acquaint students with the basic concepts and properties of Material Science
- To impart a fundamental knowledge of Materials Processing
- Selection and application of different Metals & Alloys
- To understand the structure of Engineering Materials
- To develop futuristic insight into Materials

Course Outcomes:

On completion of the course, learner will be able to–

- Understand the basic concepts and properties of Material.
- Understand about material fundamental and processing.
- Select proper metal, alloys, nonmetal and powder metallurgical component for specific requirement
- Detect the defects in crystal and its effect on crystal properties.
- Evaluate the different properties of material by studying different test
- Recognize how metals can be strengthened by cold-working and hot working

Course Contents

Unit I Structure of Metals & Materials. (6 Hrs)

Basic concepts of Crystal structures, Types of crystal systems , Crystal structure of metals(BCC, FCC and HCP systems), ceramics & molecular arrangement of polymers , Miller indices , indexing of lattice planes & directions, Lattice parameters (coordination number, no. of atoms per unit cell, atomic packing factor, density)

Unit II Mechanical Behaviors of Metal & Materials (6 Hrs) Introduction to Crystal imperfections & Classification , Crystal imperfections : point defects, line defects- edge and screw dislocations, surface defects, volume defects, Mechanism of Elastic & plastic deformation (slip and twinning) ,Theory of dislocation , deformation of single crystal by slip, plastic deformation of polycrystalline materials, work hardening theory, Changes in properties due to cold working & hot working.
Unit III Destructive & Non-destructive Testing (8 Hrs) Study of destructive testing, Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, Numerical based on Evolution of properties, compression test, different hardness tests-Vickers, Rockwell, Brinnel, Poldi, Micro Hardness Test, Durometers, Impact test, fatigue test, creep test, Erichsen Cupping Test. Non Destructive testing: Principals & procedure, advantages, disadvantages and Industrial applications of NDT, such as Visual Inspection ,Liquid /dye penetrate test, Magnaflux test, Eddy current test, Sonic & Ultrasonic testing and Radiography testing.
Unit IV Metals Corrosion & Its Prevention (4 Hrs) Classification of corrosion : Dry corrosion & wet corrosion, Mechanism of corrosion ,Types of corrosion : Pitting corrosion, stress corrosion , season cracking, cavitation corrosion, caustic embrittlement , intergranular corrosion , crevice corrosion , erosion corrosion, uniform corrosion, galvanic corrosion, Corrosion prevention methods : classification of different methods, e,g, inhibitors, cathodic & anodic protection, internal & external coatings, Low & High temperature corrosion. Design against corrosion.
Unit V Surface Modification Methods. (6 Hrs) Importance of surface modification, classification of different methods & factors affecting : electroplating , PVD , CVD ,IVD, powder coating, shot blasting, ion implantation, plasma nitriding , anodizing, Surface preparation before coating & coating defects.

Unit VI Powder Metallurgical Technology (6 Hrs)

Basic steps of powder metallurgy process, classification & methods of powder manufacturing, characteristics of metal powders, Conditioning of metal powders (Screening, Blending & mixing, annealing), Compaction techniques (cold compaction, hot compaction, Isostatic compaction & powder rolling) , mechanism & importance of sintering , Pre-sintering & sintering secondary operations

Advantages, limitations and applications of powder metallurgy. Production of typical P/M components (with flow charts), self lubricated bearing, cemented carbides, cermets, refractory metals, electrical contact materials, friction materials, and diamond impregnated tools, friction plate, clutch plate, commutator brushes.

Books:

Text:

1. Kodgire V. D. "Material Science and Metallurgy"
2. "Material Science & Engg." Raghvan V., Prentice Hall of India , New Delhi. 2003

Reference:

1. Science of Engineering Materials, Smith, Prentice-Hall
2. Materials Science and Engineering, Callister W. D., John Wiley
3. "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004.
4. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.
5. Mechanical Metallurgy, Dieter, G.E., McGraw-Hill, 1988.

List of Tutorials

1. Numerical based on Indexing, Atomic packing factor, Density.
2. Study and Trial of Tensile Test & numerical based on Tensile test.
3. Study of Compression Test
4. Study and Trial of Rockwell Hardness Test & Hardness conversion number.
5. Study of Ultra Sonic Test.
6. Vickers Hardness Test.
7. Brinell Hardness Test
8. Poldi Hardness Test
9. Magnetic Particle Test.
10. Dye Penetrant Test.
11. Impact Test.
12. Study of Self lubricated Bearings / Cemented carbide tips ,in Powder Metallurgy

Note : Out of above Twelve Tutorials , any Eight Tutorials should be conducted .

202051: Strength of Materials

Teaching Scheme:		Credits	Examination Scheme:		
TH:	04 hr/week	Th:04	TH	In-Sem:	50
				End-Sem:	50
PR:	02 hrs/week	PR/OR/TW:01		PR:	--
				OR:	50
				TW:	--

Prerequisites: -

1. Fundamentals of engineering mechanics
2. Analysis of forces and moments
3. Laws of motion, kinetics, kinematics
4. Algebra and trigonometry

Course Objectives:

To understand

- Mechanical behavior of the body by determining the stresses, strains and deflections produced by the loads up to the elastic limit.
- Fundamental concepts related to deformation, strain energy, moment of inertia, load carrying capacity, slope an deflection of beams, shear forces, bending moments, torsional moments, column and struts, principal stresses and strains and theories of failure

Course Outcomes:

Student should be able to

- Apply knowledge of mathematics, science for engineering applications
- Design and conduct experiments, as well as to analyze and interpret data
- Design a component to meet desired needs within realistic constraints of health and safety
- Identify, formulate, and solve engineering problems
- Practice professional and ethical responsibility
- Use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Contents

Unit I Simple stresses and strains **(8 Hrs)**
Stress, strain, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants,
Stress-strain diagram for ductile and brittle materials, factor of safety.
Stresses and strains in determinate and indeterminate, homogeneous and composite bars under concentrated loads and self weight.
Temperature stresses in simple members.

Unit II Shear Force and Bending Moment Diagrams **(8 Hrs)**
Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading, shear force and bending moment.
Maximum bending moment and position of points of contra flexure.

Unit III Stresses in Machine Elements **(8 Hrs)**
Bending stresses : Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.
Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web.

Unit IV **(8 Hrs)**
Slope and deflection of beams: Relation between bending moment and slope, slope and deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope and deflection for standard cases.
Strain energy: Strain energy due to axial load (gradual, sudden and impact), strain energy due to bending and torsion.

Unit V **(8 Hrs)**
Torsion: Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, derivation of torsion equation, stresses due to combined torsion, bending and axial force on shafts.
Buckling of columns: Concept of buckling of columns, derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, limitations of Euler's formula, Rankine's formula, safe load on columns

Unit VI **(8 Hrs)**

Principal stresses and strains: Normal and shear stresses on any oblique plane. Concept of principal planes, derivation of expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear.

Graphical solution using Mohr's circle of stresses. Principal stresses in shaft subjected to torsion, bending moment and axial thrust (solid as well as hollow),

Concept of equivalent torsional and bending moments.

Theories of elastic failure: Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory – their applications and limitations.

Books:

Text:

1. G. H. Ryder- Strength of Materials- 3rd Edition, Macmillan Pub, India
2. S.S. Rattan - Strength of Material – Tata McGraw Hill Publication Co. Ltd. S.
3. Ramamurtham - Strength of material - Dhanpat Rai Publication.
4. Timoshenko and Young - Strength of Materials - CBS Publication

Reference:

1. Beer and Johnston - Strength of materials - CBS Publication.
2. E.P. Popov - Introduction to Mechanics of Solids - Prentice Hall Publication.
3. Singer and Pytel - Strength of materials - Harper and row Publication.
4. B.K. Sarkar - Strength of Material - Tata McGraw Hill New Delhi.

List of Practicals:
(Any 6 out of 1 to 8 and any 2 out of 9 to 11)

1. Tension test for aluminum alloy and mild steel using extensometer.
2. Tension test for brass using extensometer
3. Shear test of ductile material on Universal Testing Machine.
4. Experimental verification of flexural formula in bending for cantilever beam.
5. Experimental verification of flexural formula in bending for simply supported beam.
6. Measurement of stresses and strains in beams for different end conditions using strain gauges.
7. Experimental verification of torsion formula for circular bar.
8. Experimental verification of von Mises theory of failure.
   Graphical simulation of - (using suitable software like MD-Solids, Matlab, MS-Excel etc.)
9. Shear force and bending moment diagrams with different end conditions.
10. Slope and deflection.
11. Principal stresses through graphical and analytical method.

202054: Value Education

Teaching Scheme:		Credits	Examination Scheme:		
TH: --		Tut:01	TH	In-Sem:	--
				End-Sem:	--
Tutorial:	01 hr/ week	TW:--		PR:	--
				OR:	--
				TW:	25

Course Objectives:

- To enable the students to understand meaning of values and select their goals by self-investigation based on personal values.
- To enable the students to understand value of truth, commitments, honesty, sacrifice, care, unity, team work and relationship.
- To educate and make the young generation students aware of their social responsibilities.
- To increase awareness among students about environment and create attitude towards sustainable lifestyle.

Course Outcomes:

On completion of the course, learner will be able to–

- Understood human values, their significance and role in life.
- Promote self-reflection and critical inquiry that foster critical thinking of one's value and the values of others.
- Practice respect for human rights and democratic principles.
- Familiarized with various living and non-living organisms and their interaction with environment.
- Understood the basics regarding the leadership and to become a conscious professional.

Course Contents

UNIT 1: Introduction of Value Education (2 Hrs)

Value Education: Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

UNIT 2: Salient values for life (2 Hrs)

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

UNIT 3: Human Rights **(2 Hrs)**

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

UNIT 4: Environment and Ecology **(2 Hrs)**

Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...

UNIT 5: Social values & Ethical values **(2 Hrs)**

Social values - Social consciousness and responsibility, Consumer rights and responsibilities.

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Books:

Text:

1. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007
2. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics & Human Values", PHI Learning Press, 2013.

References:

1. Chakravarthy S. K., "Values and ethics for Organizations: Theory and Practice", Oxford University Press, New Delhi, 1999.
2. Man Singh Das, Vijay Kumar Gupta, "Social values among young adults: A changing scenario", MD Publications Pvt. Ltd, 1995.
3. Ram Ahuja, "Social Problems in India", Rawat Publications, 2012.
4. Leah Levin, "HUMAN RIGHTS Questions and Answers", UNESCO Publishing, 2012.
5. P D Sharma, Ecology and Environment, Rastogi publications, 2005.
6. Kalam A P J, Arun Tiwari, "Wings of Fire", University Press Publications, 2003.
7. http://www.ncert.nic.in/recent/env_edu.html
8. http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf
9. https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf

Term Work shall consist of following assignments:

1. Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? What have been your achievements and shortcomings in your life? (Observe and analyze by student themselves and write outcome.)
2. Visit to Non Governmental Organizations (NGO), charitable trusts working for welfare of people in society and submit visit report.
3. (a) Presentation given by Teacher in the class on the Dr. A P J Kalam's ten points for enlightened Citizenship.

   (b) Conduct Guest Lecturer on: The role of media in value building and Right to Information Act - 2005 - a Tool for Good Governance. (Make report on seminars outcome)
4. Arrange a **Group Discussion** on topics:
   Energy and natural resource depletion, Environmental pollution, Global warming, Ozone depletion, Deforestation, Soil degradation, Drought, Water harvesting etc. Make a report on outcomes.
   (Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback. Write outcomes.)
5. Make Report on Code of ethics for engineers, Consumer rights and responsibilities and report conclude with role of Value, value Education and its relevance in present days.

202054 A: Innovations in Engineering Field/ Agriculture

Prerequisites:

1. Knowledge of Mathematics, Physics, and Chemistry is necessary.
2. Out of box/ unconventional thinking for solving typical problems.
3. Adapting analytical tools traditionally.
4. Application oriented thinking of learnt topics

Course Objectives:

- To develop holistically built thinking habit needed for innovative ideas.
- To make students aware about key field of agriculture contributing to sustenance and development of a mankind.
- To expose students to their roles and responsibilities of building a nation through engineering insights in agriculture
- To be updated with innovations and technological advancements in respective fields of engineering.

Course Outcomes:

On completion of the course, learner will be able to -

- Understand what is thinking, its tools and process and its application to innovation
- Practice application of innovation in engineering
- Understand important terms like national productivity, sustainable development and inclusive growth
- Throw a light on developing technologies in agriculture
- Learn Interdisciplinary Engineering applications in Agriculture

Course Contents

Unit I: Thinking and thinking process **(2 Hrs)**

Thinking and thinking tools: Thinking, Types of thinking, Top-Down (Analysis) & Bottom-Up (Synthesis) thinking and combination of both, Judgement and Creativity, Concept Maps-Connecting the ideas, Generating ideas. Communicating ideas. Systems thinking and beyond. Critical thinking. Definition of innovation. Example of application of thinking process to any one practical innovation.

Unit II: Engineering Innovation and its scope **(2 Hrs)**

Incremental, radical and disruptive Innovation. Scope of innovation: Product innovation, Process innovation, Position innovation, Paradigm innovation. Innovation within the engineering profession. Awareness about latest technological advancements.

Unit III: Agriculture and innovation **(2 Hrs)**

Definition of agriculture? Role of Agriculture in our life and in national productivity. Concept of sustainable development and inclusive growth. India's urban awakening. Innovation in agriculture and its types. Importance of agriculture innovation.

Unit IV: Developing technologies in agriculture **(2 Hrs)**

Favorable conditions for Agriculture innovation. Dynamics of Innovation System. Role and responsibility of Engineers in agricultural innovations and making India the net exporter of major agricultural produces. FINOvation Awards. Ideas on developing technologies in agriculture viz. Vehicle automation, Engine emissions technology, Fire suppression technology etc. The future of robotics on farms.

Unit V: Interdisciplinary Engineering in Agriculture **(2 Hrs)**

Technological innovations that are revolutionizing Indian agriculture. Case study presenting Interdisciplinary Engineering application in Agriculture.

Books:

Text:

1. Kasser, J., E., 2015. Holistic Thinking: Creating Innovative Solutions to Complex Problems: Volume 1 (Solution Engineering). Create Space Independent Publishing Platform; 2 edition.
2. Wenwu Zhang, 2011. Intelligent Energy Field Manufacturing: Interdisciplinary Process Innovations. CRC Press, Taylor & Francis Group.
3. Educating engineers to drive the innovation economy, 2012. Publisher: The Royal Academy of Engineering, London.

Reference:

1. Crowder, J., A., Carbone, J., N., Demijohn, R., 2016. Multidisciplinary Systems Engineering: Architecting the Design Process. Springer Publishing.
2. India's urban awakening: Building inclusive cities, sustaining economic growth, 2010. Mckinsey Global Institute report.

List of Tutorials/Assignments:

1. What is 'thinking?' What are different tools of thinking? Write a note on Analysis and Synthesis and combination of both. Give any one example of application of thinking process to a practical innovation.
2. What are the types of innovations? What is its scope? Write a note on Innovation within engineering. State and explain 10 engineering innovations took place in last year.
3. What is agriculture? Explain its role in our life and in national productivity. What is sustainable development? What is inclusive growth? What is innovation in agriculture? What is importance of agriculture innovation?
4. What is favorable condition for agriculture innovation? Write a note on dynamics of innovation system. Discuss the ideas of developing technologies in agriculture. Write a note on future of robotics in agriculture.
5. State and explain minimum 10 Technological innovations that are revolutionizing Indian agriculture. Discuss any one case study encompassing Interdisciplinary Engineering application in Agriculture

Notes: All above 5 tutorials/ assignments are compulsory

202054 B : Road Safety

Prerequisites:

1. Awareness about traffic rules and road accidents.
2. Understanding the need of studying such topics.
3. Considerations to other, sensitivity and care while travelling/ driving.

Course Objectives:

- To acquire knowledge and understanding of the road environment.
- To inculcate decision making and behavioral skills necessary to survive in the road environment.
- To impart knowledge and understanding of the causes and consequences of accidents.
- To understand roles and responsibilities in ensuring road safety.

Course Outcomes:

On completion of the course, learner will be able to–

- Generate awareness about number of people dyeing every year in road accidents, traffic rules and characteristics of accident.
- Gain information and knowledge about people responsible for accidents and their duties
- Understand the importance of multidisciplinary approach to planning for traffic safety and rehabilitation
- Acquire a certificate of coordination/ participation in compulsory events based on the topic under study

Course Contents

Unit I: Introduction to Road Safety **(2 Hrs)**

Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash.

Unit II: Planning for Road safety **(2 Hrs)**

Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.

Unit III: Responsibility of Road accidents and Safety measures **(2 Hrs)**

People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering - by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.

Unit IV: Road Safety Education (2 Hrs)

Introduction to Road Safety Education. 5 P's of Road safety education: 1. Pre-school road safety education 2. Practical rather than theory education 3. Principles of own development as regards to road safety education 4. Presentations on road safety education 5. Place for road safety education in syllabus

Unit V: Road Safety Events (2 Hrs)

Discussions on efforts done by Government on Road Safety. Celebration of Road Safety week or Workshop on Road Safety week/ Organization of seminar on Road Safety. This is to be entirely organized by students under the mentorship of concerned Head of the Department.

Books:

Text:

4. Kadiyali L.R., Traffic Engineering & Transport Planning, Khanna Publishers, 2003
5. CROWN AGENTS Ref: TEA/A369, 1995. (Unpublished contractors report for Ministry of Transport and Communications, Ghana). Road safety study and the institutional strengthening of the vehicle examination and licensing division.
6. TRRL OVERSEAS UNIT, 1991. Towards safer roads in developing countries: a guide for planners and engineers. Crow Thorne: Transport and Road Research Laboratory.

Reference:

3. Indian Roads Congress, Highway Safety Code, IRC: SP-44:1996
4. Indian Roads Congress, Road Safety Audit Manual, IRC:SP-88-2010

List of Tutorials/ Assignments:

6. Discussion and presentations on: Road traffic accidents scenario in India. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash.
7. Discussion and presentations on: Assisting Traffic control authorities, Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.
8. Discussion and presentations on: People responsible for accident prevention, 4 E's of Accidents Prevention.
9. Introduction to Road Safety Education. 5 P's of Road safety education
10. Organization of One Day seminar/ workshop by students on Road Safety. Participation for every student is compulsory. They are expected to prepare brief report of about 3 to 4 pages of this event.

Notes: All above 5 tutorials/ assignments are compulsory

202054 C: Value Education

Course Contents

UNIT 1: Introduction of Value Education **(2 Hrs)**

Value Education: Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection.

UNIT 2: Salient values for life **(2 Hrs)**

Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking.

UNIT 3: Human Rights **(2 Hrs)**

Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building.

UNIT 4: Environment and Ecology **(2 Hrs)**

Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment...

UNIT 5: Social values & Ethical values **(2 Hrs)**

Social values - Social consciousness and responsibility, Consumer rights and responsibilities.

Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development.

Books:

Text:

3. Dr. N. Venkataiah, "Value Education", APH Publishing Corporation, 2007

4. M. Govindarajan, S. Natarajan, V. S. Senthil Kumar, "Professional Ethics & Human Values", PHI Learning Press, 2013.

References:

10. Chakravarthy S. K., “Values and ethics for Organizations: Theory and Practice”, Oxford University Press, New Delhi, 1999.
11. Man Singh Das, Vijay Kumar Gupta, “Social values among young adults: A changing scenario”, MD Publications Pvt. Ltd, 1995.
12. Ram Ahuja, “Social Problems in India”, Rawat Publications, 2012.
13. Leah Levin, “HUMAN RIGHTS Questions and Answers”, UNESCO Publishing, 2012.
14. P D Sharma, Ecology and Environment, Rastogi publications, 2005.
15. Kalam A P J, Arun Tiwari, “Wings of Fire”, University Press Publications, 2003.
16. http://www.ncert.nic.in/recent/env_edu.html
17. http://www.unipune.ac.in/pdf_files/Final%20Book_03042012.pdf
18. https://engineering.purdue.edu/MSE/Academics/Undergrad/ethics.pdf

SEMESTER-II

202045: Fluid Mechanics

Teaching Scheme:		Credits	Examination Scheme:		
TH:	04 hr/week	Th:04	TH	In-Sem:	50
				End-Sem:	50
PR:	02 hrs/week	PR/OR/TW:01		PR:	50
				OR:	--
				TW:	--

Prerequisites: -

1. Engineering Mathematics
2. Engineering Physics

Course Objectives:

- To understand of various properties of fluids
- To learn fluid statics and dynamics.
- To understand of Boundary layer, Drag, and Lift
- To understand of Bernoulli's equation
- To Know of various applications of Bernoulli's equation

Course Outcomes:

On completion of the course, learner will be able to–

- Use of various properties in solving the problems in fluids
- Use of Bernoulli's equation for solutions in fluids
- Determination of forces drag and lift on immersed bodies

Course Contents

Unit I Fundamentals of Fluid Mechanics (8 Hrs)

Properties of Fluids:- Definition of fluid, concept of continuum, Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Newton's law of viscosity, types of fluid, Rheological diagram, Surface Tension, Capillarity, Compressibility, Vapour pressure

Fluid Statics: - Pascal's Law, Pressure at a point, Total Pressure & Centre of pressure for inclined flat plate, Buoyancy, metacenter and floatation.

(No numerical treatment for Buoyancy, metacenter and floatation)

Unit II: Kinematics of Fluid Motion	**(8 Hrs)**

Eulerian and langragian approach of fluid flow, total or material derivative for velocity field, Continuity equation, types of flows (One, two, three dimensional, steady unsteady, uniform, non-uniform, laminar, turbulent, compressible, incompressible, rotational, Irrotational) . Visualization of flow field (Stream, Path and Streak line), vorticity in two dimensional flow, stream function and velocity potential function

Unit III: Fluid Dynamics **(8 Hrs)**

Introduction to flow models- control volume and infinitesimally small element, Linear momentum Equation using differential Approach, Introduction to Navier – Stokes Equation,

Euler equation of motion, derivation of Bernoulli's equation along stream line , concept of HGL and THL or TEL, application of Bernoulli's equation to venture meter, Pitot tube, Submerged Orifices, Orifice meter, V-notch

Unit IV: Internal Flow **(8 Hrs)**

Laminar and Turbulent flow physics, entrance region and fully developed flow. Velocity and shear Stress distribution for laminar flow in a pipe, fixed parallel plates and Couette flow, hydro dynamically smooth and rough boundaries, Velocity profile of Turbulent flow.

Unit V: Flow through Pipes **(8 Hrs)**

Energy losses through pipe-Major and Minor losses, Darcy-Weisbach equation, pipes in series, pipes in parallel and concept of equivalent pipe, Moody's diagram, Siphons, Transmission of power, (No derivations for minor losses)

Dimensional Analysis: Dimensions of Physical Quantities, dimensional homogeneity, Buckingham $\boldsymbol{\pi}$ Theorem and important dimensionless numbers.

Unit VI: External flows **(8 Hrs)**

Boundary layer formation for flow over Flat plate, boundary layer thickness:-displacement, momentum and energy, Separation of Boundary Layer and Methods of Controlling.Forces on immersed bodies: -Lift and Drag (No derivation on lift), flow around cylinder and aerofoil (Pressure distribution and Circulation).

Books:

Text:

1. Fundamentals of Fluid Mechanics- Munson, Young and Okiishi- Wiley India
2. Fluid Mechanics- Potter Wiggert –Cengage Learning
3. Introduction to Fluid Mechanics- Fox, Pichard , McDonald- Wiley
4. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
5. Hydraulics and Fluid Mechanics, - Modi P. N. and Seth S. M -Standard Book House.
6. Fluid Mechanics,- Cengel&Cimbla- TATA McGraw-Hill
7. Fluid Mechanics- White- TATA McGraw-Hill

Reference:

1. Fluid Mechanics- Kundu, Cohen, Dowling- Elsevier India
2. Fluid Mechanics – Chaim Gutfinger David Pnueli-Cambridge University press.
3. Introduction to Fluid Mechanics-Edward Shaughnessy, Ira Katz James Schaffer- OXFORD University Press.

List of Practical

(Any ten of the following out of which experiment number 3 is compulsory)

1. Pressure measurement using any two types of manometer.
2. Determination of viscosity of liquids and its variation with temperature.
3. Determination of metacentric height of floating object.
4. Laminar and Turbulent flow by Reynolds's apparatus.
5. Draw flow net using electrical analogy apparatus.
6. Verification of modified Bernoulli's equation.
7. Calibration of Orifice meter/ Venturimeter.
8. Determination of hydraulic coefficients of orifice.
9. Calibration of V-notch
10. Determination of minor losses due to pipe fittings.
11. Determination of Major losses through metal & non-metal pipes.

Notes:

3. Minimum 10 experiments should be performed.
4. Experiment No. 3 is compulsory.

202047: Soft Skills

Teaching Scheme:		**Credits**		**Examination Scheme:**	
TH:	**-- hr/week**	**Th/Tut: --**	**TH**	**In-Sem:**	**--**
				End-Sem:	**--**
PR:	**02 hrs/week**	**PR: 01**		**PR:**	**--**
				OR:	**--**
				TW:	**25**

Course Objectives:

- To develop students overall personality.
- To understand and aware about importance, role and contents of soft skills through instructions, knowledge aquisitiion, demonstration and practice.To improve his writing and documentation skills.

Course Outcomes:
On completion of the course, learner will be able to–

- Improved communication, interaction and presentation of ideas.
- Right attitudinal and behaviouralchange
- Developed right-attitudinal and behavioral change

Course Contents

Term Work/Assignments
Term work will consist the record of any 6 assignments of following exercises

1. **SWOT analysis** **(4 Hrs)**
Student should do his/her SWOT analysis & submit the report.
Method of Execution
Explain the meaning & benefits of SWOT analysis to students. Give them time to think on their strength, weakesses, opportunities & threats. Ask them to write their own SWOT anlalysis

2. **Listening Skills** **(4 Hrs)**
Listen to a short audio book and make notes out of it & make a report.
Method of Execution
Ask every students to download any freely available english audio book of one hour duration. Also ask them to listen it carefully and write it's review on journal paper

3. Oral presentation skills/Speaking Skills **(4 Hrs)**
Hold the poster of any inspirational personality & speak about his/her life for five minutes.
Method of Execution
The personality can be from the fields like sports, politics, literature, entertainment etc. Ask every students to read & study about therespective personality & deliver the oral presentation infront of his/her batchmates.

4. **Resume writing** **(4 Hrs)**
Design a cover letter & resume for yourself.
Method of Execution
Show some of the different resumes according to respective job profiles to students & ask them to prepare their own resume. Also guide them to write a cover letter for any job application.

5. **Corporate / Business Etiquettes** **(4 Hrs)**
Apply to any five internship openings over internet by writing an email to the company HR. Students must submit email print.
Method of Execution: Tell students about any five recent internship openings & ask them to apply for same through email with resume as an attachment. Ask students to take a sent mail print for submission record

6. **Group Discussion** **(4 Hrs)**
Organize the group discussion on a current topics in a batch of ten students & ask every student to make minutes of meeting & submit.
Method of Execution: Take some of the current topics for group discussion, divide students in two batches of ten students in each, Allot 10 minutes time & one topic for discussion, meanwhile instructor have to assess each student's performance & give feedback to respective student. Also ask students to write the minutes of the meeting from same GD

7. **Team Activity** **(4 Hrs)**
Make a 20 minutes english video documentary & post it on a social media. Also provide the link of the same as submission record.
Method of Execution: Make a group of four students & guide them to choose a topic for making a video documenatry. Video can be posted on facebook, twitter or youtube.The video can be recorded on cellphone as well

Books:

Text:

1. Basics Of Communication In English : Francis Sounderaj, MacMillan India Ltd.2
2. English for Business Communication : Simon Sweeney , Cambridge University Press
3. An Introduction to Professional English And Soft Skills : Das , Cambridge University Press

Reference:

1. A course in Listening and Speaking Vol I &Vol II, V.Sasikumar, P. Kiranmai, Geetha Rajeevan, Cambridge University Press
2. Cambridge English For Job Hunting : ColmDownes, Cambridge University Press
3. The Complete Letter Writer :MacMillan India Ltd
4. E Writing – 21st Century Tools for Effective Communication :Booher , MacMillan India Ltd
5. NASSCOM-Global Business Foundation Skills: Cambridge University Press

202048: Theory of Machines – I

Teaching Scheme:		Credits	Examination Scheme:		
TH:	04 hr/week	Th: 04	TH	In-Sem:	50
				End-Sem:	50
Tutorial:	01 hr/week	Tut: 01		PR:	--
				OR:	25
				TW:	25

Prerequisites: -

1. Engineering Mathematics
2. Engineering Physics
3. Engineering Mechanics

Course Objectives:

- To make the student conversant with commonly used mechanism for industrial application.
- To develop competency in drawing velocity and acceleration diagram for simple and complex mechanism.
- To develop analytical competency in solving kinematic problems using complex algebra method.
- To develop competency in graphical and analytical method for solving problems in static and dynamic force analysis.
- To develop competency in conducting laboratory experiments for finding moment of inertia of rigid bodies,

Course Outcomes:

On completion of the course, learner will be able to–

- Identify mechanisms in real life applications.
- Perform kinematic analysis of simple mechanisms.
- Perform static and dynamic force analysis of slider crank mechanism.
- Determine moment of inertia of rigid bodies experimentally.
- Analyze velocity and acceleration of mechanisms by vector and graphical methods.

Course Contents

Unit I Fundamentals of Kinematics and Mechanisms **(10 Hrs)** Kinematic link, Types of links, Kinematic pair, Types of constrained motions, Types of Kinematic pairs, Kinematic chain, Types of joints, Mechanism, Machine, Degree of freedom (Mobility),Kutzbach crieterion, Grubler's criterion. Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions. Straight line mechanisms such as: Peaucellier Mechanism, Scott Russell Mechanism, Grasshopper Mechanism, watt mechanism. Equivalent linkage of mechanisms., Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism.
Unit II: Static and Dynamic Force Analysis **(8Hrs)** Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension. Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T-θ diagram. Friction: Friction in turning pair, friction circle, friction axis, friction in slider crank mechanism.
Unit III: Friction Clutches, Brakes and Dynamometer **(8 Hrs.)** Pivot and collar friction, Classification of Clutches, torque transmitting capacity of - plate clutch, cone clutch and centrifugal clutch, Classification of brakes, braking torque of - shoe brakes, internal shoe brake, disc brake, brake power of absorption and transmission type dynamometers – prony brake, rope brake, belt transmission, epicyclic train and Bevis-Gibson torsion
Unit IV: Kinematic Analysis of Mechanisms: Analytical Method **(8 Hrs)** Analytical method for displacement, velocity and acceleration analysis of slider crank Mechanism. Position analysis of links with vector and complex algebra methods, Loop closure equation, Chase solution, Velocity and acceleration analysis of four bar and slider crank mechanisms using vector and complex algebra methods. Hooke's joint, Double Hooke's joint.
Unit V: Velocity and Acceleration Analysis of Simple Mechanisms: Graphical Methods-I (8 Hrs) Relative velocity method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. Relative acceleration method: Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple mechanisms. (limit to only 4 link mechanisms) Instantaneous center of rotation (ICR) method: Definition of ICR, Types of ICRs, Methods of locating ICRs (limit to only 6 link mechanisms), Kennedy's Theorem, Body and space centrode.
Unit VI: Velocity and Acceleration Analysis of Mechanisms: Graphical Methods-II (8 Hrs) Velocity and acceleration diagrams for the mechanisms involving Coriolis component of acceleration. (limit to only 4 link mechanisms) Klein's construction.

Books:

Text:

5. Thomas Bevan, "Theory of Machines" CBS Publisher and Distributors, Delhi.
6. S. S. Ratan, "Theory of Machines", Tata McGraw Hill.
7. Ashok G. Ambekar, "Mechanism and Machine Theory", Prentice Hall, India
8. Sadhu Singh, "Theory of Machines", Pearson

Reference:

1. Shigley J. E., and Uicker J.J., "Theory of Machines and Mechanism", McGraw Hill Inc.
2. Shigley J. E 'Mechanical Engineering Design', McGraw Hill Inc.
3. Ghosh Amitabh and Mallik A. K. "Theory of Machines and Mechanism", East- West Press.
4. Wilson C.E., Sandler J. P. Kinematics and Dynamics of Machinery", Person Education.
5. Erdman A.G. and Sandor G.N., "Mechanism Design, Analysis and Synthesis" Volume-I, Prentice –Hall of India

Term Work based on following Tutorials to be submitted in the form of Journal:

1. Draw (any 4) configurations of mechanisms and determine types of pairs, links, degree of freedom.
2. To determine experimentally the mass moment of inertia of a connecting rod using a compound pendulum method.
3. To determine experimentally the mass moment of inertia of a flat bar using bifilar suspension method or to determine experimentally the mass moment of inertia of a flywheel/gear/circular disc using trifilar suspension method.
4. Numerical based on Friction Clutches, Brakes and Dynamometer Or to measure torque transmitting capacity of friction clutch experimentally.
5. Numerical based on - single and double Hooke's joint.
6. One problem on velocity and acceleration analysis using: Vector algebra and Complex algebra and comparison of results.
7. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method.
8. **Two problems** on velocity analysis using ICR method.
9. **Two problems** on velocity and acceleration analysis using relative velocity and acceleration method involving Coriolis component.
10. Problems on velocity and acceleration analysis using Klein's construction for uniform and non-uniform crank velocity.

Note: 1. **Sr. No. 1,7,8,9 and 10 Problems based on Graphical methods are to be solved on half imperial drawing sheets.**
2. **Oral based on above Term work conducted in the tutorial class.**

202048: Engineering Metallurgy

Teaching Scheme:	Credits	Examination Scheme:		
TH: 03 hr/week	Th:03	TH	In-Sem:	50
			End-Sem:	50
Tutorial: 01 hr/week	PR/OR/TW:01		PR:	--
			OR:	25
			TW:	--

Course Objectives:

- To acquaint students with the basic concepts of Metal Structure
- To impart a fundamental knowledge of Ferrous & Non Ferrous Metal Processing
- Selection and application of different Metals & Alloys
- To Know Fundamentals of Metallography
- To develop futuristic insight into Metals

Course Outcomes:

On completion of the course, learner will be able to–

- describe how metals and alloys formed and how the properties change due to microstructure
- apply core concepts in Engineering Metallurgy to solve engineering problems.
- conduct experiments, as well as to analyze and interpret data
- select materials for design and construction.
- possess the skills and techniques necessary for modern materials engineering practice
- recognize how metals can be strengthened by alloying, cold-working, and heat treatment

Course Contents

Unit I Overview of Metallurgy (6 **Hrs)**

Methods of metal extraction (Principle only of pyro , hydro & electro metallurgy), cast v/s wrought products, Related terms and their definitions : System, Phase, Variable, Component, Alloy, Solid solution, Hume Ruther's rule of solid solubility, Allotropy and polymorphism, Concept of solidification of pure metals & alloys, Nucleation : homogeneous and heterogeneous,

Dendritic growth, super cooling, equiaxed and columnar grains, grain & grain boundary effect.

Cooling curves, Plotting of Equilibrium diagrams, Lever rule, Coring, Eutectic system, Partial eutectic and isomorphous system.

Unit II: Micro & macroscopic study of Metals **(6 Hrs)**

Classification of metal observations: their definition, difference & importance.

Microscopy: Various sampling techniques, specimen preparation, specimen mounting (hot & cold mounting) electrolytic polishing, etching procedure and reagents, electrolytic etching.

Microscopic techniques : optical microscopy, electron microscopy, transmission electron microscopy (TEM),scanning electron microscopy (SEM), scanning probe microscopy (SPM), AFM etc. (principal & application only)
Study of Metallurgical microscope .Measurement of grain size by different methods & effect of grain size on various mechanical properties.
Macroscopy: Sulphur printing, flow line observations, spark test.

Unit III: Iron-Carbon alloy system & Cast Iron **(8 Hrs.)**

Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, structure & property relationship, classification and application of steels.

Cast Irons: Classification, Manufacturing, Composition , Properties & applications of white C.I., Grey cast iron, malleable C.I., S.G. cast iron, chilled and alloy cast iron, effect of various parameters on structure and properties of cast irons. Specific applications such as machine tools, automobiles, pumps, valves etc.

Introduction to non-equilibrium cooling of steels, widmanstaten structure

Unit IV: Heat- treatment Of Steels **(6 Hrs)**

Transformation products of Austenite, Time Temperature Transformation diagrams, critical cooling rate, continuous cooling transformation diagrams. Heat treatment of steels: Annealing, Normalising, Hardening & Tempering, quenching media, other treatments such as Martempering, Austempering, Patenting, Ausforming. Retention of austenite, effects of retained austenite. Elimination of retained austenite (Subzero treatment). Secondary hardening, temper embrittlement, quench cracks, Hardenability & hardenability testing, Defects due to heat treatment and remedial measures.

Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening.

Unit V: Engineering Alloy Steels & designation **(4 Hrs)**

Classification of alloy steels & Effect of alloying elements, examples of alloy steels, stainless steels, sensitization & weld decay of stainless steel, tool steels, heat treatment of high speed steel, special purpose steels with applications, super alloys. Heat affected zone. Designation (for plane & alloy steels) : IS, AISI, SAE, DIN etc.

Unit VI: Non Ferrous Metals (6 Hrs)

Classification of nonferrous metals. Importance of nonferrous metals in engineering applications & compositions, study of different mechanical properties: Cu & Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium & its alloys, Tin & Lead base alloys, Bearing materials: important properties & applications.

Books:

Text:

1. "Material Science & Metallurgy For Engineers", Dr. V.D. Kodgire & S. V. Kodgire , Everest Publication.
2. "Mechanical Behaviour & Testing Of Materials ", A . K. Bhargava, C.P. Sharma P H I Learning Private Ltd.

Reference:

1. "Engineering Metallurgy", Higgins R. A., Viva books Pvt. Ltd., 2004.
2. "Material Science & Engg." Raghvan V., Prentice Hall of India , New Delhi. 2003
3. Introduction to Physical Metallurgy, Avner, S.H., Tata McGraw-Hill, 1997.
4. Engineering Metallurgy Dr. O.P. Khanna

Term Work based on following

1 Study & Demonstration of Specimen Preparation for microscopic examination.
2 Study of Optical Metallurgical microscope.
3 Study and Drawing of Microstructure of Steels of various compositions.
4 Study and Drawing of Microstructure of Cast Irons.
5 Study and Drawing of Microstructure of Non Ferrous Metals.
6 Heat treatment of Plain Carbon Steel and determination of relative hardness.
7 Study and Drawing of Microstructure of Heat Affected Zone in Welding.
8 Jominy End Quench Test for hardenability.
9 Spark Test.
10 Sulfur Printing Test.
11 Flow Line Observation Test.
12 Characterization techniques like SEM, TEM.

Note : Out of above Twelve practical , any Eight practical should be conducted .

202050: Applied Thermodynamics

Teaching Scheme:		**Credits**	**Examination Scheme:**		
TH:	**04 hr/week**	**Th:04**	**TH**	**In-Sem:**	**50**
				End-Sem:	**50**
PR:	**02 hrs/week**	**PR/OR/TW:01**		**PR:**	**50**
				OR:	**--**
				TW:	**--**

Prerequisites: - 1. Engineering Thermodynamics.

2. Engineering Mathematics

Course Objectives:

- To get familiar with fundamentals of I. C. Engines, Construction and working Principle of an Engine and Compare Actual, Fuel-Air and Air standard cycle Performance.
- To study Combustion in SI and CI engines and its controlling factor in order to extract maximum power.
- To study emission from IC Engines and its controlling method, Various emission norms.
- Perform Testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies
- To understand theory and performance Calculation of Positive displacement compressor.

Course Outcomes:

On completion of the course, learner will be able to–

- Classify various types of Engines, Compare Air standard, Fuel Air and Actual cycles and make out various losses in real cycles.
- Understand Theory of Carburetion, Modern Carburetor, Stages of Combustion in S. I. Engines and Theory of Detonation, Pre-ignition and factors affecting detonation.
- Understand Fuel Supply system, Types of Injectors and Injection Pumps, Stages of Combustion in CI Engines, Theory of Detonation in CI Engines and Comparison of SI and CI Combustion and Knocking and Factors affecting, Criteria for good combustion chamber and types.
- Carry out Testing of I. C. Engines and analyze its performance.
- Describe construction and working of various I. C. Engine systems (Cooling, Lubrication, Ignition, Governing, and Starting) also various harmful gases emitted from exhaust and different devices to control pollution and emission norms for pollution control.
- Describe construction, working of various types of reciprocating and rotary compressors with performance calculations of positive displacement compressors.

Course Contents

Unit I Basics of IC Engines **(5 Hrs)**

Heat Engine, IC and EC engines, I.C. Engine construction - components and materials, Engine nomenclature, Valve timing diagram, Intake and exhaust system, Engine classification, Applications.

Fuel Air Cycle and Actual Cycle **(5 Hrs)**

Fuel air cycle, Assumptions, Comparison with air standard cycle, Effect of variables on performance,
Actual cycle and various losses, Comparison of Air standard Vs Fuel Vs Actual cycle.

Unit II SI Engines **(5 Hrs)**

Theory of Carburetion, Types of carburetors, Electronic fuel injection system, Combustion in spark
Ignition engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion,
Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion chambers, Rating of fuels in SI engines, Additives.

Unit III CI Engines **(5 Hrs)**

Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, Methods of knock control, Types of combustion chambers, rating of fuels in
CI engines. Dopes & Additives, Comparison of knocking in SI & CI engines.

Unit IV Testing of IC Engines **(6 Hrs)**

Objective of testing, Various performance parameters for I.C. Engine - Indicated power, brake power, friction power, SFC, AF ratio etc. Methods to determine various performance parameters, characteristic curves, heat balance sheet.

Supercharging **(**2 Hrs)

Supercharging and turbo-charging methods and their limitations

Unit V I.C. Engine Systems **(6 Hrs)**

Cooling System, Lubrication System, Ignition System, Governing system, Starting System

I.C. Engine Emissions and Control **(**4 Hrs)

Air pollution due to IC engine and its effect, Emissions from petrol/gas and diesel engines,
Sources of emissions, Euro norms, Bharat stage norms, Emission control methods for SI and CI engines

Unit VI Positive Displacement Compressors (Reciprocating and Rotary) (10 Hrs)

Reciprocating Compressor - Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual
indicator diagram, Multistaging of compressor, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter-cooling and after cooling, Capacity control of compressors

Rotary Compressor – Introduction, vane compressors, roots blower, screw compressor. **(Numerical treatment on Reciprocating compressor single stage and multistage only)**

Books:

Text:

1) V. Ganesan: Internal Combustion Engines, Tata McGraw-Hill
2) M.L. Mathur and R.P. Sharma: A course in Internal combustion engines, Dhanpat Rai
3) H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Pvt. Ltd.

Reference:

1. Heywood: Internal Combustion Engine Fundamentals, Tata McGraw-Hill
2. Domkundwar & Domkundwar: Internal Combustion Engine, Dhanpat Rai
3. R. Yadav: Internal Combustion Engine, Central Book Depot, Ahmedabad.
3. S. Domkundwar, C. P. Kothandaraman, A. Domkundwar, Thermal Engineering, Dhanpat Rai & Co.

List of Practical's:

1. Study of Carburetor
2. Study of Fuel pump and injector
3. Study of Ignition System
4. Demonstration & study of commercial exhaust gas analyzers.
5. Morse Test on Multi cylinder Petrol/ Diesel engine for determination of Friction power.
6. Variable load test on diesel engine to determine various efficiencies, SFC and Heat balance sheet.
7. Test on variable compression ratio engine.
8. Visit to Automobile service station
9. Test on Positive Displacement Air Compressor
10. Assignment on any one advanced technology related to I.C. Engine such as VVT, VGT, HCCI
11. Assignment on alternative fuels used in I.C. Engines.

Notes:

1. Minimum 8 experiments should be performed.
2. Perform any 3 from 1 to 4.
3. Perform any 2 from 5, 6, and 7.
4. Experiment 8 and 9 are compulsory.

203152: Electrical and Electronics Engineering

Teaching Scheme:	Credits	Examination Scheme:
TH: 03 hr/week	Th:03	TH In-Sem [Online]: 50 End-Sem: 50
PR: 02 hrs/week	PR/OR/TW:01	PR: -- OR: -- TW: 25

Prerequisites: - 1. Basic Electrical Engineering 2. Basic Electronics Engineering

Course Objectives:
To understand
1. Principle of operation and speed control of DC machines
2. Induction motor principle and its applications
3. Working principle of special purpose motors
4.Microcontrollers
5. Embedded systems terminologies and sensors
6. Data acquisition system for mechanical applications

Course Outcomes:
Student should be able to
1.Develop the capability to identify and select suitable DC motor / induction motor / special purpose motor and its speed control method for given industrial application.
2. Program Arduino IDE using conditional statements
3. Interfacing sensors with Arduino IDE

Course Contents

Electrical Engineering

Unit I D. C. Machines (6Hrs)

Construction, working principle of D.C. generator, emf equation of D. C. generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, back emf, torque equation for D.C. motor, characteristics of D.C. motor (series and shunt only), three-point starter for D.C shunt motor, methods for speed control of D.C. shunt and series motors, industrial applications.

Unit II Three Phase Induction Motors (6Hrs)
Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency, starters (auto transformer starter, star delta starter); methods of speed control and industrial applications.

Unit III Special Purpose Motors (6 Hrs)
Construction, working principle, characteristic and applications of stepper motors, A.C. and D.C servomotors, universal motors, industrial applications, brushless DC motors, linear induction motors, single phase induction motors,(types, construction, working principle of split phase and shaded pole type induction motors), descriptive treatment for AC series motor (difference between AC series and DC series motor, construction and working).

Electronics Engineering

Unit IV Introduction to Microcontrollers (6 Hrs)
Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega 328P- features, architecture, portstructure, sensors and actuators, data acquisition systems, introduction to Arduino IDE- features, IDE overview, programming concepts: variables, functions, conditional statements.

Unit V Peripheral Interface-1 (6 Hrs)
Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE

Unit VI Peripheral Interface-2 (6Hrs)
Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, concept of PWM, DC motor interface using PWM

Books:

Text:

[T1] Edward Hughes “Electrical Technology”, ELBS, Pearson Education.
[T2] Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Sons.
[T3] S. K. Bhattacharya, “Electrical Machine”, Tata Mc Graw Hill publishing Co. Ltd, 2nd Edition.
[T4] Nagrath & Kothari, “Electrical Machines”, Tata Mc Graw
[T5]Electrical Machines, R. K. Rajput, Laxmi Publications, 2002
[T6] Ajay Deshmukh, ‘Microcontrollers Theory and Applications’, TATA McGraw Hill
[T7]Arduino microcontroller processing for everyone-Steven F Barret,Morgan and Claypool Publisher.
[T8] C programming with ardino-Warwick Smith Elektor Publication.

Reference:
[R1] Electrical Machines, Lowe, Nelson Publications.
[R2] A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd. Fifth Edition.
[R3]Permanent Magnet Synchronous and Brushless DC Motor Drives, R. Krishnan, CRC press.
[R4]Smarajit Ghosh, "Electrical Machines", Pearson Education, New Delhi.
[R5]Kenneth J. Ayala, 'The 8051 Microcontroller', Cengage Learning.
[R6]Started with Arduino by Massimo Banzi and Michael Shiloh Published by Maker Media, Inc.
[R7]Getting Started With Arduino: A Beginner's Guide by by Brad Kendall (Author), Justin Pot (Editor), Angela Alcorn (Editor)
[R8]Arduino Cookbook, 2nd Edition by Michael Margolis published by O'Reilly Media.
[R9] Application notes from "ATMEL micro controller data book."
[R10]

Web References

1) www. alldatasheet.com
2) w ww.atmel.com/products

Unit	Textbooks	Reference books
1	T1,T2,T3,T4	R1,R2,R4
2	T1,T2,T3,T4,T5	R1,R2,R4
3	T1,T2,T3,T4	R1,R2,R3,R4
4	T6,T7,T8	R5,R6,R7,R10
5	T7,T8	R6,R7,R8,R9,R10
6	T7,T8	R6,R7,R8,R9,R10

List of Practicals:
(Any 4 out of 1 to 6 and any 4 out of 7 to 12)
Electrical Engineering

01) Speed control of DC shunt motor.
02) Brake test on DC shunt motor.
03) No load and blocked rotor test on 3 phase Induction Motor.
04) Load test on 3 phase Induction Motor.
05) Load test on single phase Induction Motor.
06) Study of starters for AC and DC motors.

Electronics Engineering

07) Interfacing of LED to blink after every 1 sec.
08) Display data using serial communication.
09) Interfacing of LCD to display the message and interface with keypad to display the key pressed.
10) Interfacing of temperature sensor (LM35) and show output on LCD/serial terminal.
11) Interfacing of strain gauge sensor and LVDT to measure the parameters.
12) Study of interfacing accelerometer to change the speed of DC Motor.

Guidelines for Instructor's Manual

Practical Sessions -

The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used(if any)

Guidelines for Student's Lab Journal

For Electrical Practical

1. Lab journal should be hand written
2. All the diagrams should be drawn on graph paper
3. Specifications of the instrument used for conduction of practicalshould be mentioned in respective write up.

For Electronics Practical:

1. Title of the program.
2. The program has to be written in the following format.
Address- Instruction- Comment
3. Input data has to be specified.
4. Result of the program.
5. Flow Chart for each program has to be drawn on separate page.

Guidelines for Lab /TW Assessment

1. There is **Term Work** for the subject, so continuous assessment should be carried out such as checking of previous experiment.
2. While assessment, teacher should put the remark by writing word “Complete” and not simply “C”. Put the signature along with date at the end of experiment and in the index.
3. Assign 10 marks for each experiment as per following format.
Timely completion = 03 marks
Neat and clean writing = 02 marks
Depth of understanding = 03 marks
Regular attendance = 02 marks

Maintain continuous assessment sheet. At the end of semester, convert these marks out of as prescribed in syllabus structure.

Guidelines for Laboratory Conduction

Electrical Engineering Practicals

1. Check whether the MCB / ELCB / main switch is off.

2. Make connections as per circuit diagram. Use flexible wire for connection of voltmeter and pressure coil connection of wattmeter. For rest of the connections, usethick wire. Do not keep loose connection. Get it checked from teacher / Lab Assistant.

3. Perform the experiment only in presence of teacher or Lab Assistant.
4. Do the calculations and get it checked from the teacher.

5. After completion of experiment, switch off the MCB / ELCB / main switch.

6. Write the experiment in the journal and get it checked within the week.

Electronics Engineering Practicals

1. The instructor is expected to shortlist necessary experiments from the suggested list of experiments.
2. During the practical session the instructor may divide the total students in groups of 4 to 5 students and assign them with different experiments to be performed.
3. Each student within the group has to enter and execute the program turn wise.

4. Staff member has to check the result of all the groups after the execution of the program.

203153 : Machine Shop - I

Teaching Scheme:		Credits	Examination Scheme:	
TH:	-- hr/week	Th/Tut:--	TH In-Sem [Online]:	--
			End-Sem:	--
PR:	02 hrs/week	PR/OR/TW:01	PR:	--
			OR:	--
			TW:	25

List of Practical's:

1. Manufacture of spur gear on milling machine using indexing head.
2. Surface grinding using table grinder.
3. Manufacturing any one sheet metal component involving minimum three different operation (use dies and press).
4. Any two plastic component like bottle, bottle caps, machine handles, etc.