GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)
(Deemed to be University)
VISAKHAPATNAM * HYDERABAD * BENGALURU

Accredited by NAAC with A^+ Grade

CURRICULUM AND SYLLABUS

OF

B.Tech. Electrical and Electronics Engineering

(w.e.f. 2021-22 admitted batch)

Academic Regulations

Applicable for the Undergraduate programmes in the Faculties of **Engineering, Humanities, Management and the Sciences**

https://www.gitam.edu/academic-regulations

Department of Electrical, Electronics and Communication Engineering
GITAM (Deemed to be University)

VISION

To excel in higher education by imparting quality teaching and research to meet the challenges in Electrical, Electronics and Communication Engineering

MISSION

1. To impart technical skills, value-based education to students, to enable them to face the demands of the industry

2. To create innovative and instructional learning methods to hone the skills for solving problems of society

3. To carry out research through constant interaction with R & D organizations and industry

4. To motivate the students to develop expertise in multidisciplinary technologies for a sustainable growth.

B Tech (Electrical and Electronics Engineering)

PROGRAM EDUCATIONAL OBJECTIVES

PEO 1 To impart knowledge of mathematics and science concepts as tools to device and deliver efficient solutions to problems of Electrical and Electronics Engineering

PEO 2 To inculcate analytical ability in the students to keep pace with changing technologies and to imbibe skill and research culture to meet the industrial and societal needs.

PEO 3 To provide a platform for the graduate to be successful in technical and professional careers or develop as an entrepreneur.

PEO 4 To instill teamwork, leadership, and communication skills in the student with professional, ethical and human values to be responsible citizen of the society.

PROGRAMME OUTCOMES

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, 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 TEAMWORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 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.

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 multi-disciplinary environments.

PO12 LIFELONG 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.

Program Specific Outcomes (PSO)

Upon successful completion of BTech Electrical and Electronics Engineering Programme, student will be able to

PSO1 design and develop electrical, control and power systems for engineering applications in the fields of electrical appliances, industrial automation, power distribution and allied interdisciplinary areas.

PSO2 demonstrate the use of modern tools and techniques for solving contemporary real-world problems in electrical and electronics engineering

PSO3 research and devise appropriate technologies for implementation of the electrical and power systems as an entrepreneur/researcher with professional ethics & concern for societal wellbeing

PROGRAMME STRUCTURE

BTech Programme consists of courses which could be grouped under University Core (UC), Faculty Core (FC), Major/Programme Core (PC), Major/Programme Electives (PE) and University Electives (UE) as the below breakup

Category	Credits	% of Program (in credits)
University Core (UC)	12	8%
Faculty Core (FC)	57	36%
Major Core (PC)	52	32%
Major Electives (PE)	15	9%
Open Electives (UE)	24	15%
Total	**160**	

Courses offered under University Core are common to all undergraduate level programmes offered by GITAM. Courses offered under Faculty core are common to all BTech programmes offered by GITAM and are meant to acquaint the student with general engineering principles in all disciplines of engineering. Based on the chosen BTech Programme, the student shall complete courses under Major Core (specific to be chosen branch of engineering).
Each course is assigned a certain number of credits depending upon the number of contact hours (lectures/tutorials/practical) per week. In general,

- **Theory:** A student attending classroom lecture/ tutorial/ skill development activity of 50 minutes' duration per week, spread over the entire semester is awarded one credit.
- **Practical:** A student attending a minimum of 100 minutes per week of laboratory session/ practical is awarded - one credit.
- **Project Work:** A student working for 50 minutes of project work per week with 3 hours of work performed independent of the instructor during the entire semester is awarded - one credit
- **Internship:** 8 hours in a day for four weeks is required for earning internship credits.

The list of courses to be taken by Students under **University Core** are listed below

University Core (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools^	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Softskills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Softskills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Softskills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Softskills 4)	0	0	2	0	0	1
VEDC1001	1	Venture Development	0	0	0	2	0	2
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies^	3	0	0	0	0	3*
MFST1001	1	Health and Welbeing#	0	0	2	0	0	1*
CLAD20XX	2	Softskills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Softskills 6A/6B/6C	0	0	2	0	0	1
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*

* Pass/Fail courses

\# Opt any three courses among the five

^ Online/Swayam/NPTEL Courses

Softskills courses 5 and 6

Course code	Level	Course title	L	T	P	S	J	C
CLAD2001	2	Preparation for Campus Placement - 1 (Softskills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation For Higher Education (GRE/ GMAT) - 1 (Softskills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT - 1 (Softskills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation For Campus Placement - 2 (Softskills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation For Higher Education (GRE/ GMAT) - 2 (Softskills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT - 2 (Softskills 6C)	0	0	2	0	0	1

Sports courses

Course code	Level	Course title	L	T	P	S	J	C
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

Club activity courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1001	1	Club Activity (participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of CLub)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

Community service courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1041	1	Community Services - Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services - Mobilizer	0	0	0	0	2	2

The list of courses to be taken by students under **Faculty Core** are listed below

Faculty Core (FC)

Course Code	Level	Course Name	L	T	P	S	J	C
		Management Basket	3	0	0	0	0	3
PHYS1001		Physics Basket 1	2	1	2	0	0	4
PHYSXXXX		Physics Basket 2	3	1	0	0	0	4
CHEM1001		Chemistry	2	1	2	0	0	4
MATHXXXX		Maths Basket 1	2	0	0	0	0	2
MATHXXXX		Maths Basket 2	2	0	0	0	0	2
MATHXXXX		Maths Basket 3	2	0	0	0	0	2
MATHXXXX		Maths Basket 4	2	0	0	0	0	2
MATHXXXX		Maths Basket 5	2	0	0	0	0	2
MATHXXXX		Maths Basket 6	2	0	0	0	0	2
		Design Thinking	0	0	2	0	0	1
		Artificial Intelligence Applications	0	0	2	0	0	1
		Probability and Statistics	3	0	0	0	0	3

MECH1011		Engineering Visualization and Product Realization	0	0	4	0	0	2
MECH1021		Workshop	0	0	4	0	0	2
EECE1001		Basic Electrical and Electronics Engineering	2	1	2	0	0	4
CSEN1011		Problem Solving and Programming in C	0	0	6	0	0	3
CSEN1021		Programming with Python	0	0	6	0	0	3
		Internship 1	0	0	0	0	1	1*
		Internship 2	0	0	0	0	1	3
		Comprehensive Examination	1	0	0	0	0	1*
		Capstone Project - Introduction	0	0	0	0	2	2
		Capstone Project - Final	0	0	0	0	6	6
		Universal Human Values	3	0	0	0	0	3*
		Project Exhibition 1	0	0	0	0	1	1*
		Project Exhibition 2	0	0	0	0	1	1*

* Pass/Fail courses

Courses Offered under Mathematics Basket

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	MATH1001	Single variable calculus	All BTech branches						
2	1	MATH1011	Several variable Calculus							
3	1	MATH1021	Transform Techniques							
4	1	MATH1031	Differential Equations							
5	1	MATH1041	Discrete Mathematics	CSE						
6	1	MATH1051	Graph Theory	CSE						
7	1	MATH1061	Introduction to Mathematics - I	BT						
8	1	MATH1071	Introduction to Mathematics - II	BT						

Courses Offered for BioTechnology Department

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	BTEN1001	Introduction to Biotechnology-I	BT						
2	1	BTEN1011	Biotechnology Workshop	BT						
3	1	BTEN1021	Introduction to Biotechnology-II	BT						
4	1	BTEN1031	Process Calculations	BT						

Courses Offered under Physics Basket

S. No	Level	Course code	Course name	Offered to	L	T	P	S	J	C
1	1	PHYS1001	Physics	All B.Tech branches						
2	1	PHYS1011	Mechanics and Properties of Matter	AE, CE, ME						
3	1	PHYS1021	Principles of Quantum Mechanics	CSE						
4	1	PHYS1031	Physics of Semi Conducting devices	ECE, EEE						
5	1	PHYS1041	Mechanics and Modern Physics	BT						

The list of courses to be taken by students under **Major Core (Programe Core)** are listed below

S.No.	Program Core	L	T	P	S	J	C
PC0	Electrical Workshop	0	0	2			1
PC1	Signals and Systems	2	1	0			3
PC2	Electrical Circuit Analysis	2	1	2			4
PC3	Electronic Devices and Amplifier Circuits	3	0	2			4
PC4	Electromagnetic Fields	3	0	0			3
PC5	Digital Logic Design	3	0	2			4
PC6	Analog Circuits	3	0	2			4
PC7	Linear Control Systems	2	0	2			3
PC8	DC Machines and Transformers	2	0	2			3
PC9	Electrical Measurements	2	0	2			3
PC10	AC Machines	3	0	2			4
PC11	Electrical Power Generation	2	1	0			3
PC12	Microprocessors and Microcontrollers	3	0	2			4
PC13	Electrical Power Transimission and Distribution	2	1	0			3
PC14	Power Electronics	2	0	2			3
PC15	Power System Protection	2	0	2			3
	Total						**52**

The list of courses to be taken by students under **Major Electives (Programe Electives)** are listed below

S.No.	Program Electives	L	T	P	S	J	C
1	Electrical Machine Design	3	0	0	0	0	3
2	Electrical Distribution systems	3	0	0	0	0	3
3	High Voltage Engineering	3	0	0	0	0	3
4	Wind & Solar Energy Systems	3	0	0	0	0	3
5	Artificial Intelligence application to power systems	3	0	0	0	0	3
6	Electrical Drives	3	0	0	0	0	3
7	Industrial Electrical Systems	3	0	0	0	0	3
8	Power Quality & FACTS	3	0	0	0	0	3
9	HVDC Transmission systems	3	0	0	0	0	3
10	Hybrid Electric Vehicles	3	0	0	0	0	3
11	Process Control and Automation	3	0	0	0	0	3
12	Digital Control systems	3	0	0	0	0	3
13	Advanced Control systems	3	0	0	0	0	3
14	Modern control systems	3	0	0	0	0	3
15	Non -linear control systems	3	0	0	0	0	3
16	Robotics	3	0	0	0	0	3
17	Fundamentals of Mechatronics (ME)	3	0	0	0	0	3
18	Robot Dynamics (ME)	3	0	0	0	0	3
19	Robot Kinematics (ME)	3	0	0	0	0	3
20	Robot Motion Planning and Control (EECE)	3	0	0	0	0	3
21	Robotic Control Systems (EECE)	3	0	0	0	0	3
22	Robot Simulation Using Open-Source Tools (EECE)	3	0	0	0	0	3
23	Robotic Operating Systems (EECE)	3	0	0	0	0	3

24	Internet of Things (19EID232)	3	0	0	0	0	3
25	Embedded System Design and Development (EEC350)	3	0	0	0	0	3
26	Computer Vision (CSE)	3	0	0	0	0	3
27	Introduction to AI in Robotics (CSE)	3	0	0	0	0	3
28	Introduction to ML in Robotics (CSE)	3	0	0	0	0	3
29	Smart Grid Architectural Design (EEE)	3	0	0	0	0	3
30	Fundamentals of power systems (EEE)	3	0	0	0	0	3
31	Renewable Energy Systems (EEE)	3	0	0	0	0	3
33	Data Acquisition and Measurements (ECE)	3	0	0	0	0	3
34	Smart grid communication systems (EEE)	3	0	0	0	0	3
35	Energy managemnt in smart grids (EEE)	3	0	0	0	0	3
36	Cyber security (CSE)	3	0	0	0	0	3

Opt any five courses from Programme Elective basket

Open Elective (PE)#

Opt eligible PC/PE courses from other programmes as an open elective courses and earn 24 credits

CSEN1001: IT Productivity Tools

L	T	P	S	J	C
0	0	2	0	0	1*

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

Course Objectives

- to enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- to involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- to create awareness in analysing data using pivot tables, query manager etc.
- to create awareness in composing emails, mail merge, e-mail merge etc.
- to provide the exposure to work with collaborative tools.

List of Experiments

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures, table of tables, bibilography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates with animation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference and mixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination studentwise, teacherwise, coursewise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: www.draw.io or smartdraw
10. Create a website of his interest.

Text Books:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. https://drawio-app.com/tutorials/video-tutorials/
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics Fourth Edition ISBN-13: 978-1449319274

References/Online Resources

1. https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software
2. https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets
3. https://www.coursera.org/learn/excel-advanced#syllabus
4. https://www.coursera.org/learn/how-to-create-a-website
5. https://support.microsoft.com/en-us/office
6. https://www.diagrams.net/
7. https://edu.google.com/

Course Outcomes

- Create / alter documents / Technical Paper / Project report with text, pictures, graphs of different styles.
- Create / modify power point presentations with text, multimedia and to add animation using / creating templates.
- Perform basic calculations / retrieve data / createpivot tables / chart using a spreadsheet application.
- Create simple diagrams / charts using online tools like: www.draw.io .
- Manage documents, presentations, spreadsheets and websites in collaborative mode.

LANG1001: Communication Skills in English - Beginners

L	T	P	S	J	C
0	0	4	0	0	2*

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with an awareness for social and personality-based variations in communication. In addition to the LSRW skills, the focus of the course is on schematic thinking skills. This course is activity-based and practice-oriented in terms of procedural knowledge of vocabulary and grammatical structure. This syllabus is carefully developed to enable learners to engage in communication in English avoiding errors and be prepared for next level of learning English.

Course Objectives

- Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally, there may be a need to ask for repetition or clarification. (Bloom's Taxonomy Level/s: 2 & 3)

- Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s. (Bloom's Taxonomy Level/s: 2 & 4)

- Help learners apply their knowledge and language skills to make mini oral presentations, and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary and grammatical structures. (Bloom's Taxonomy Level/s:3)

- Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns. (Bloom's Taxonomy Level/s: 2 & 3)

List of Activities & Tasks for Assessment

1. Listening to others and getting to know their experiences, interests and opinions
2. Introducing oneself: Salutation, basic information, relating to the context
3. Starting a conversation: Salutation, expressing purpose, expressing gratitude
4. Sharing one's experiences, interests and opinions
5. Reading short newspaper articles for gist
6. Picking new words from an article and working on them to know the meaning and usage
7. Using the new (unknown) words in own sentences
8. Sharing news with others - initiate, sustain and conclude
9. Understanding the relevance of intonation to meaning from recorded conversations, and applying the learning in pair work (role play)
10. Writing a summary of a story/personal narrative after listening to it twice and making individual notes
11. Reading graphs, charts and maps for specific information, making note of the important information and talking briefly about it within a small peer group
12. Writing a paragraph about oneself: a brief profile including major successes, failures, and goals. Giving compliments/gratitude to others

13. Writing a paragraph (descriptive, complimentary) about others (Family, friends, role model, etc.)
14. Correcting each other's' drafts: errors in language - word choice, structure, and conventions/etiquette
15. Writing a short structured descriptive/narrative essay in 3 paragraphs, reading others' essays and sharing feedback

References

1. V. Sasikumar, P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Listening and Speaking - Foundation Books Cunninhum, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambrdige Academic English: An Integrated Skills Course for EAP (Intermediate) By Craig Thaine, CUP (2012)
3. Rutherford, Andrea J. (2007). Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education.
4. McCarthy, M., O'Dell, F., Mark, G. (2005). English Vocabulary in Use. Spain: Cambridge University Press.
5. New Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-1 by Sarah Philpot. OUP
6. Philpot, S. & Curnick, L. (2017). Headway: Academic Skills: Reaing, Writing, and Study Skills. Introductory Level. OUP.
7. Thaine, C. (2012). Cambridge Academic English: An Integrated Skills for EAP . Intermediate. CUP.

Online References

- www.teachingenglish.org.uk
- learnenglishteens.britishcouncil.org
- https://eslflow.com/
- https://www.englishclub.com/
- https://www.oxfordlearnersdictionaries.com/
- https://dictionary.cambridge.org/
- learnenglishteens.britishcouncil.org
- https://freerice.com/categories/english-vocabulary

Course Outcomes

- Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech. (Bloom's Taxonomy Level/s: 2 & 3)
- Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest. (Bloom's Taxonomy Level/s: 2 & 3)

- Speak clearly with some confidence on matters related to his/her interests and academic work, and make short structured oral presentations on topics of personal interest. (Bloom's Taxonomy Level/s: 3)
- Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas. (Bloom's Taxonomy Level/s: 3)

- Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times. (Bloom's Taxonomy Level/s: 2 & 4)

LANG1011: Communication Skills in English

L	T	P	S	J	C
0	0	4	0	0	2

Communication Skills in English (Intermediate) is the second of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equip them with next level skills (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course also includes inferential level of comprehension (listening and reading) that involves analysis and application of the language skills and decision-making skills while speaking/writing with an awareness for social and personality-based variations in communication. This course emphasizes guided writing through adequate tasks with pre and post context building. The focus is on stimulation and application of critical thinking in addition to schematic thinking for communication in real-life situations.

Course Objectives

- Train learners to actively listen to short audio texts with familiar content; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom's Taxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, and enabling them to develop their presentation skills by providing training in using the tips and strategies given. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/ explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related to the content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting their roles)

3	Information transfer: Verbal to visual (familiar context), demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pair work for discussion & feedback, Presentations, question-answer
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in small groups, individual writing, and feedback
5	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
6	Introducing friends to family and vice versa - Informal context	Teacher modelling/AV support, noticing structure & note-taking, Introducing friends and family in an informal context
7	Vocabulary in context: Find clues in a text and use them to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts and listening to discussions/talks
8	A five-day journal (diary) writing based on learners reading from newspaper on a single relevant/current social issue. Individual oral presentation and feedback from peers and instructor.	Note-making (group work), Discussion, Feedback
9	Follow the essentials of lectures, talks, discussions, reports and other forms of academic presentations and mak2 individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group by listening to academic lectures/talks/ discussions, etc.
10	Self-reflection: Re-reading one's own drafts, identifying errors, correcting the errors, and giving rationalize the changes	Pre-task discussion/modelling, Editing the texts by careful reading and identifying the errors, peer-exchange (Pair work), feedback/consolidation
11	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline, assigning specific roles to members of the group; and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
12	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual), oral questioning, discussion
13	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context, coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
14	Writing instructions: Guidelines - Flowcharts - Procedures to be followed	Pre-task reading, pair work, teacher/peer-discussion, feedback
15	Speaking spontaneously on topics of interest and writing short structured essays on the same topics adopting appropriate academic conventions and grammatical accuracy.	Reading for task preparation, note-making, speaking, reflection and corrective peer and teacher feedback

Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. Foundation Books. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition. By Peter Lucantoni. CUP (2014).
5. Cambrdige Academic English: An Integrated Skills Course for EAP (Upper Intermediate) By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 by Sarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxfor: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

Online Resources

1. https://www.grammarly.com/blog/
2. https://www.nationalgeographic.org/education/
3. https://www.bbc.co.uk/teach/skillswise/english/zjg4scw
4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specific topics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)

- "Read and demonstrate understanding of articles and reports on limited range of contemporary issues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"

- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)

- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or give reasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)

- Reflect on others' performance, give peer feedback on fellow learners' presentations, responses to writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

LANG1021: Advanced Communication Skills in English

L	T	P	S	J	C
0	0	4	0	0	2

Communication Skills in English (Advanced) is the third of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher level of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes advanced level of comprehension i.e. anaytical, evaluative and extra-polative processing (listening and reading) and involves problem-solving, logical reasoning and decision-making skills in terms of application of the learning (speaking/writing) with an awareness for social and personality based variations in communication. This course provides opportunities with activity-based practice of advanced oral and written communicative skills besides building awareness on the finer nuances of language use for various purposes. This course emhasizes free writing through meaningfully engaging tasks with a pre and post context building. There is ample scope for application of critical thinking through simulated activities for effective communication in real life situations.

Course Objectives

1. Enable learners to listen actively become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)

2. Enable learners to become aware of tone and attitude in written texts, and demonstrate their comprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skills and strategies. (Bloom's Taxonomy Level/s:2 & 3)

3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument. (Bloom's Taxonomy Level/s: 3 & 4)

4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations. (Bloom's Taxonomy Level/s:3 & 5)

List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a long text/short texts on a current topic related to technology and society, identifying and questioning the author's intention, post-reading discussion in small groups, maintaining group dynamics, arriving at a consensus	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflection and brief presentation of thoughts/ideas/opinions on the theme of the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening, student checklist for noticing key words/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Verbal to visual (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification and feedback before the final version is done	Pair work for discussion and feedback, presentations, question-answer	2
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification, editing, proofreading, and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
5	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions of formal and polite speech, and managing bias	Listening to group discussions/debates, reading news-paper articles on the current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
6	Role-play (complex social and academic/professional situations): Focus on significant aspects of delivery including clarity, tone, and use of contextually appropriate vocabulary and conventions, observation, reflective discussion, and self-reflective writing	Reading newspaper/magazine articles/blog posts on current social issues, listening to talks/discussions/debates etc. and participating in role-plays using expressions appropriate to the context.	1
7	Collborative writing in groups of 3 -4 on topics that would require data collection and reading followed by recorded peer-reflection and peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work (collaboration), presnetation, peer feedback, Open-class discussion	5
8	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence to the conventions of formal GD	Noticing strategies from AV modelling, teacher scafolding though open-house discussion, Note-making (Group work), Group Discussion (free), post perfromance discussion, Feedback	2

9	Mind-mapping for advanced reading, making correlations across texts, extending author's point of view	Reading texts on abstract topics and comprehending the author's perspective by inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
10	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disgreeing with rationale	Listening to some lectures, talks, and presentations in the academic seminars and adapting some strategies to handle the Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
11	Modelling an interview: with a panel of four judges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
12	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrataions/events etc. by actively involving in such events and giving a short oral presentation on the same.	4
13	Speaking on abstract and complex topics beyond his/her own area of interest/field of study, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharing views and opinions.	3
14	Self-relfection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas to others	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some general topic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance of the content, etc.	1
15	Collaborative and individual task: planning, preparing (preparing an outline, structure, setting objectives and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), oral corrective, task distribution, presentation, feedback	5

Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambrdige Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)

4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence toParagraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunninghum, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP.

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4. https://www.englishclub.com/
5. https://www.oxfordlearnersdictionaries.com/
6. https://dictionary.cambridge.org/
7. learnenglishteens.britishcouncil.org
8. https://freerice.com/categories/english-vocabulary
9. http://www.5minuteenglish.com/
10. https://breakingnewsenglish.com/
11. https://www.digitalbook.io/
12. https://librivox.org/

Course Outcomes

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)
- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5)

CLAD1001: Emotional Intelligence & Reasoning Skills (Soft Skills 1)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self-management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with their own emotions as well as the emotions of others and relate better with both. Using better knowledge of EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas and methods to solve questions in reasoning and data sufficiency

Course Objectives:

1. Use EI to relate more effectively to themselves, their colleagues and to others. Apply self awareness and self assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
2. Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
3. Manage conflicts and work in teams in an emotionally intelligent manner.
4. Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

Unit	Topics	Hours
1	Self Awareness & Self Regulation: Introduction to Emotional Intelligence, *Self Awareness:* Self Motivation, Accurate Self Assessment (SWOT Analysis), Self Regulation: *Self Control, Trustworthiness & Adaptability*	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy and Unhealthy Relationships, Relationship Management Competencies- Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3
3	Social Media: Creating a blog, use of messaging applications, creating a website to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and IneffectiveTeams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction,Coding-decoding, Blood relations, Ranking, Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2
	Total Hours	30

Course Outcomes

- Students will be able to relate more effectively to themselves, their colleagues and to others
- Students will be able to set their short term and long term goals and better manage their time
- Students will be able to manage conflicts in an emotionally intelligent manner and work in teams effectively
- Students will be able to solve questions based on non-verbal and analytical reasoning, data sufficiency and puzzle

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1011: Leadership Skills & Quantitative Aptitude
(Soft Skills 2)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging message to a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs. Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

Course Objectives:

1. Learn and apply, through different individual and group activities, different ideas and skills to communicate in a positive and impressive manner.
2. Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
3. Apply different concepts in numbers, numerical computation and numerical estimation to solve questions that often appear in various competitive examinations and admission tests.
4. Apply different concepts for tackling questions based on data interpretation, progression and series that are frequently given in various competitive examinations and admission tests.

Unit	Topics	Hours
1	Communication Skills: *The Communication Process*, Elements of Interpersonal Communication, *Non-Verbal Communication:* Body Language, Posture, Eye Contact, Smile, Tone of Voice, *Barriers to Communication.* Effective Listening Skills: Active Listening, Passive Listening, Asking Questions, Empathizing, Being Non Judgemental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	5
2	Focus on Audience Needs, Focus on the Core Message, Use Body Language and Voice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, Effective Opening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in Rational Approach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementing and Following-Up, Case Studies	3

4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, Structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I : Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problems on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line-graphs, Pie-graphs, Box-plots, Scatter-plots and Data Sufficiency	3
8	Mental Ability: Series(Number, Letter and Alphanumeric), Analogy(Number, Letter and Alphanumeric) and Classifications	3
	Total Hours	30

Course Outcomes

- Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
- Students will be able to apply the the rational model of problem solving and decision making in their problem solving and decision making efforts.
- Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
- Students will be able to solve questions based on data interpretation, progressions and series.

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1021: Verbal Ability & Quantitative Ability (Soft Skills 3)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

Course Objectives:

1. List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc
2. Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, parajumbles, etc. that are frequently asked in various competitive exams and admission tests.
3. Solve different types of questions based on vocabulary, such as word analogy; structure, grammar and verbal reasoning; introduce common errors and their detection and correction.
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2 & 3 dimensional mensuration.

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms

2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages, Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions

3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specify, Specify to General, Idea-Example, Idea-Explanation, Etc.

4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles

5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest & Compound Interest

6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles

7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

Course Outcomes:

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD1031: Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies (Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

Course Objectives:

1. Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
2. Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
3. Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmetic & Modular Arithmetic (Cryptarithmetic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7)]
4. Explain how to solve questions in Mental Ability (Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)

1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
2. Error Detection: Tenses and their Uses
3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & Word Order, and Degrees of Comparison
5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24), Clocks (Base 24), Calendars (Base 7)

7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations, Progressions, Statistics

Course Outcomes:

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmetic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

VEDC1001: Venture Development

L	T	P	S	J	C
0	0	0	2	0	2

Course Description

In this course, you will discover your deeper self in terms of how you might contribute to society by creating exciting new products and services that can become the basis of a real business. Your efforts, creativity, passion, and dedication to solving challenging problems are the future of our society, both in your country and worldwide.

The course is divided into four sections:

1. Personal discovery of your core values and natural skills
2. Ideation and improving the impact
3. Business model design for the innovation
4. Presenting your idea in a professional manner suitable for a new venture pitch

Each section has key frameworks and templates for you to complete, improving your idea step by step until the final presentation.

First, you will discover your personal values and emerging areas of knowledge that are the foundations of any successful company. Next, you will learn how to develop insight into the problems and desires of different types of target customers and identify the design drivers for a specific innovation. Then, you will learn specific design methods for new products and services. And as important as the product or service itself, it is a strategy for monetizing the innovation – generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward.

This project is intended to be for teams of students. Innovation and entrepreneurship are inherently team-based. This course will give you that entrepreneurial experience.

This is the beginning of what might be the most important journey of personal and career discovery so far in your life, one with lasting impact. This is not just a course but potentially an important milestone in your life that you remember warmly in the years to come.

Course Objectives

Students will have the opportunity to:

- Discovery who you are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

Course Materials

- Meyer and Lee (2020), Personal Discovery through Entrepreneurship, The Institute for Enterprise Growth, LLC. Boston, MA., USA
- Additional readings

- Additional videos, including case studies and customer interviewing methods.

Expectations of you in the classroom: Each student is expected to be prepared to discuss the readings/exercises assigned for each class. It's not optional! Students will be randomly asked to discuss and summarize the material. Your learning – and your success—in this course are heavilydependent upon your willingness to participate actively in class discussion. Your class participation will be assessed on the quality and consistency of your effort in each and every class.

Late assignments: Late assignments are subject to grade penalty. Lateness will only be considered for grading if prior notice was given to the instructor before the due date.

Presentation: Achieving success with an innovative idea requires you to package and present the idea in a crisp, creative, and powerful manner. The activity of presenting helps you to internalize your idea -- as you talk about it and obtain feedback – and improve upon it. There would be two major presentations during the course, plus a series of other smaller unscheduled presentations of work in progress or course material. Prepare, practice, and succeed!

Time spent outside of class: The course is hands-on and requires students to conduct field research through direct interactions with people (interviews/surveys) and online/in the library. Specifically, the course requires that students conduct studies with potential target users and stakeholders. You must be prepared to go out of your comfort zone to dig for information. You will need to search for information online and arrange to meet or talk to relevant people who may have the information you need.

Group Project Overview

This is a semester length project and the cornerstone component of the course. The group project will give you the opportunity to apply the course concepts to a real situation. You will learn about the entrepreneurship for your own business or your work in organizations. Even if you are not going to be an entrepreneur, you need to know how to identify the opportunities, who to persuade people, and how to create economic and social values in many different contexts.

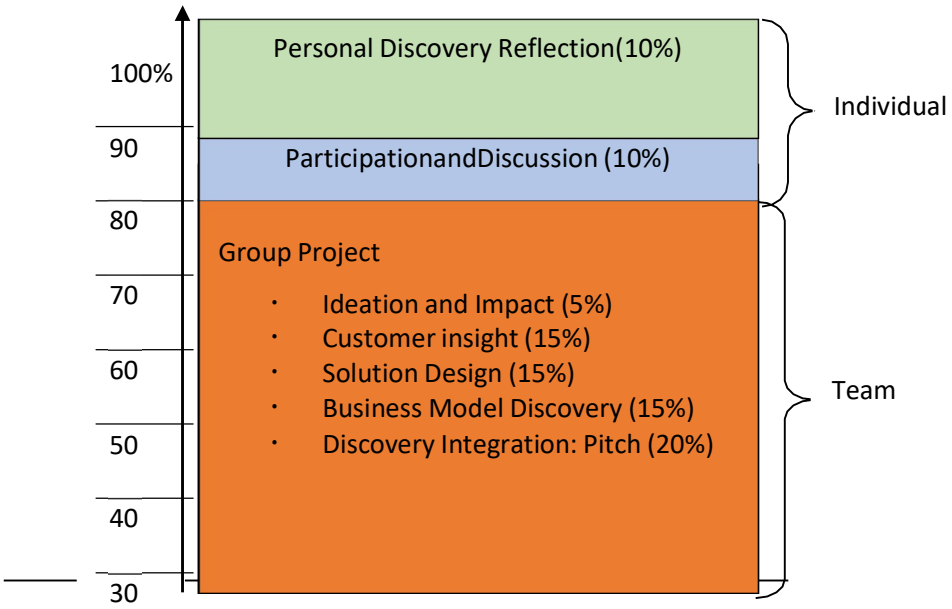
Talking to customers is one of the most important steps in investigating your business because your entrepreneurial vision must correspond to a true market opportunity. With your group, select 5-6 potential customers willing to be interviewed. They should represent a cross-section of our target market and should provide information that helps you refine your opportunity. This is not a simple survey: you are seeking in-depth understanding of the lifestyle and behaviors of your customer that can help you shape your opportunity. Please remember, you are not simply looking to confirm you have a great idea, but to shape your idea into a great opportunity. You will maximize your chances for success and your ability to execute your business cost-effectively by making early (rather than later) changes to your concept.
"Design" is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

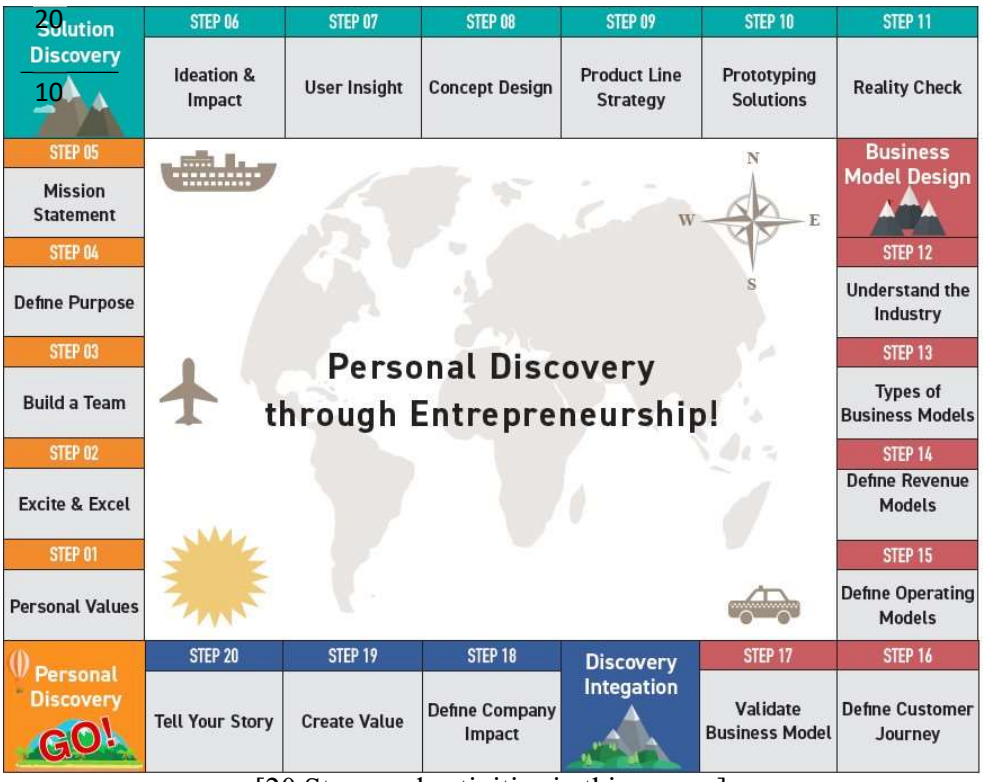
Business modeling is not as hard as it might sound. This is the design of your business – how it charges customers, what is spent producing and selling products or services, and the money that can be made for each unit sold. We keep it simple – so should you.

For the final outcome, you will be required to come up with Pitch that can used as the basis for actually starting a company based on an impactful innovation. Once again, we provide a specific format and tools for creating a compelling Pitch. We also want you to think about an exciting proposition that is more than just making money, but rather, one that helps society. This will give

you innovation and venture concept greater lift with customers – and it will also make you feel better, deep inside.

Project Components and Grading





[20 Steps and activities in this course]

Deliverables

There are a number or different deliverables for the course that follow the templates presented in the book, as applied to your own venture idea. Do your best to keep up with the timeline of the

class; do not fall behind! Later templates build on the learnings from prior templates. Make the most of your team! Everyone needs to pitch in. In no case, should one person be taking the lead on all templates.Rather,different team members should take the lead on specific deliverables. Coordinate well. Let your teacher know if a team member is not carrying his or her load.

Specific Deliverables

Ideation and Impact Hand-in Package: 5% of total grade
clearly written, with a one-page explanation for the team's decision

- Problem to Solve Templates, Step 4, Page 62 and 63
  (with a page of additional explanation if needed)
- Idea Impact Template, Step 6, Page 69 (with a page of explanation)

Customer Interviews and Insight Hand-in Package: 15%
(1st Round of Customer Interviews)

- Customer Interviews Template, Step 7, Pages 75-78,plus add additional template forms for each additional customer interview. The more, the better.
- Idea Reshaping Template, Step 7, Pages 84 and 85. Integration into overall conclusions. How have you improved your original idea through customer research?
- Latent Needs Template, Step 7, Page 93 – what are the frustrations of users that are not solved by current products or services?
- Full Use Case Template, Step 7, Page 99 – how do you customers' needs change over the full use case, and what innovative ideas can you propose at each step of the way?

Concept Design (and Test) Hand-in Package: 15%

- Customer Value Proposition Template: Step 8, Page 107. This becomes the landing point for what you learned in your customer interviews.
- Competitive Analysis Template: Step 8, Page 109. (Use the Web or actual stores/dealers)
- Product Vision and Subsystem Design Templates:Step 10, Pages 121 and 126 (You can add additional pages with design illustration and explanations of your bubble chart)
- Reality Check Survey Template and Results: Step 11, Page 141, 143-144
  (You can use more than 2 pages for reporting the results.)

Business Model Design Hand-in Package: 15%

- Industry Analysis Templates: Step 12, Pages 153 and 154
- Illustrate the Business Model Template: Step 13, Page 170
  (Use different colours or line patterns to show the flows of product, money, and information)
- Revenue Model Template: Step 14, Page 177
- Operating Model Template: Step 15, Page 187
- Customer Journey Template: Step 16, Page 195
- Validating the Business Model Template: Step 17, Pages 199 and 200

Discovery Integration Hand-in Package: 20%

- Business and Social Vision Impact Statement Template: Step 18, Page 210.
- Per Unit Profitability Template: Step 19, Page 229
- Your Venture Story Pitch: Step 20(PowerPoint)
- Overall Pitch Design Template:Page 264

Assemble the templates from all your work above, plus any others that you found particularly meaningful, and from these, create your Team's Innovation Pitch.The book has lists specific templates that fit for each part of the final presentation.

Do not just regurgitate the templates in your pitch; rather, take the key points from them to create your own, unique presentation. The templates help you think – but most are toocomplex to present to outside people who have not taken the course. Therefore, design thispitch as if you presenting to a new set of investors.

And don't forget to add an attractive title page with your team members names and email addresses!You can also add an Appendix at the very back with particularly interesting information, such as industry data or the results of your customer interviews and Reality Check.

Individual Innovation Assignments

You will be required to submit two Reflection Journalsas well as a maximum two pages double spaced Synthesis, Integration and Application paper by email at the Week 4 and Week 14 respectively. Please note, this exercise is not about regurgitating the course concepts.

(1) Personal Discovery Reflection Journal (10%)

At the beginning of this semester, you will have a time to think about your self (who you are, what you are good at, what areas you want to contribute on) using a couple of templates. After that sessions, you will have a quiet moment to think about yourself, yourcareer, and your happiness in your life. Please write 2-page reflectional journal what you feel and learning through the personal discovery sessions.

(2) Insight Learning Reflection Journal (10%)

At the end of this semester, you are to prepare a short reflection of impressive sessions aswell as related activities outside the classroom. Specially, (1) reflect on the key points from lectures, reading, discussion, guest speakers, and interviews, (2) apply this to your own situation, and (3) outline ways that you intend to use this knowledge in the future.

Course Schedule

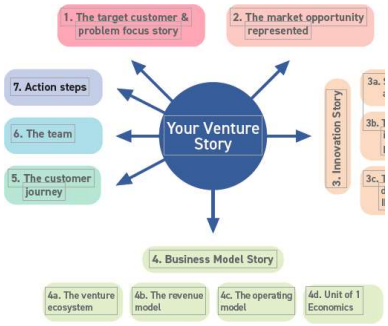
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
1	1	**Course Overview**	1. Why is entrepreneurship important? 2. What is Personal Discovery through Entrepreneurship? 3. Four Stages; Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration 4. Preparation (finding interesting areas)	**Lecture and Discussion**
	2	**Personal Discovery** (Step 01, Step 02)	1. Personal Values 2. Strength and Weakness	Individual: · Work with the templates provided on pages: · Core values: 22, 23 · Skills: 27, 28, 29, 30, 31 · Societal Contribution: 33, 34
2	3	**Find Teammates** (Step 03)	1. Review Problem Area Template at the beginning of the book to find classmates who want to work on the same problem area. 2. Findteammates (1) Shared values (2) Levels of commitment (3) Skills and experiences (Same or Different?)	Problem template: Page 9 · Talk to your classmates and find teammates. See who wants to work on in the same problem space, with a shared vision of solutions, and complementary skill sets. · Sit back and assess: Team templates on Pages 44, 45, and 46. · Prepare to present your team, the problem it is going to tackle, and its collective skills.
	4	**Define Purpose** (Step 04) **Create Mission** (Step 05)	1. Methods for defining and refining a venture's purpose 2. Defining a Venture's Purpose 3. Creating a Vision Statement	Team: · Purpose and Mission Templates: Pages 49 and 52 · Be prepare to present to the class. · Personal Discovery Reflection Journal Due

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
3	5	**Ideation & Impact** (Step 06)	Ideation Methods · An in-class ideation exercise	Team: · Problem to Solve Templates, Step 4, Page 62, and 63
	6		Increasing the Impact of an Idea. (The Eat-Your-Coffee Video – a good example of ideation)	Team: · Idea Impact Template, Step 6, Page 69
4	7	**User Insights Frameworks** (Step 07)	· Identifyand find the right target users. · Interview style and methods · The Customer Interview template.	Team: · Customer Interviews Template, Step 7, Pages 75 · Edit interview template for your project.
	8		Laddering methods for interviews	Team: · Latent Needs Template, Step 7, Page 93
5	9	**User Insights Customer Interviews** (Step 07)	· Finding latent needs · Field work check-in	Team: · Latent Needs Template, Step 7, Page 93 · Field work – customer interviewing
	10		· Think about innovation across the entire use case · Field work check-in	Team: · Full Use Case Template, Step 7, Page 99 · Field work – customer interviewing
6	11	**User Insights Interpreting Results** (Step 07)	· Interpreting customer interview results · Field work check-in	Team: · Field work – customer interviewing · Also talk to retailers/dealers if appropriate
	12		· Idea Reshaping based on Customer Interviews · Field work check-in	Teams prepare results of results from customer interviews and how the original ideas have been reshaped& improved.
7	13	**User Insights Interpreting Results** (Step 07)	· Customer Research Reports · Implications for product and service design	· Teams prepare PPTs for class presentation · **Customer Insight Template Hand-in Package**
	14			

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
8	15	**Concept Design** (Step 08)	· Defining Customer Value · Understanding Customer Value Proposition	Team: · Customer Value Proposition · Template: Step 8, Page 107 · Draft the CVP
	16		· Presentation and review of CVPs	Team: · Complete CVP
9	17	**Competitive Analysis and Positioning** (Step 08)	· Understanding of Competitive Matrix · Competitive positioning: creating your separate space	Team: · Identify major competitors, and dimensions for analysis · Template: Step 8, Page 109
	18		· Presentations of Competitive Analyses and Positionings	Team: · Perform the competitive analysis and present results, including positioning
10	19	**Product Line Strategy** (Step 09)	· Product line framework: good, better, best on underlying platforms, plus application to Services.	Team: · Identify good, better, best variations based on the underlying concept. · Product line template: Page 115
	20	**Product Visioning Subsystem Design, and Prototype Sketch** (Step 10)	· The structured bubble chart, showing implementation options and the team's choices · Prototype sketching (The Bluereo Video is a good example of iterative prototyping driven by customer discovery.)	Team: · Prototype sketch, and for Web apps, a wireframe. For physical products, an initial bill of materials. · Underlying bubble chart showing your decision process. · Product Vision and Subsystem Design Templates: Step 10, Pages 121 and 126
Week	**Session**	**Topics and Steps**	**· Key CONCEPTS Introduced in Class**	**Team or Individual Activity**
11	21	**Reality Check** (Step 11)	· The purpose of the Reality Check, testing the product concept, channel preferences, and much other.	Team: · Reality Check Survey Template and Results: Step 11, Page 141, 143-144

	22		・ Guidance on the number or additional customers for the reality check survey ・ How to analyze and interpret the results	・ Customize the Reality Check template for your venture. ・ Do a quick round of customer surveying. Aim for 12 more interviews.
12	23	**Industry Analysis** (Step 12)	・ Team reports on Reality Check Results ・ Examine major components of an Industry Analysis ・ Review Templates	Team: ・ Prepare and present the results of your reality check, plus any pivots you wish to make. ・ **Concept Design (and Test) Hand-in Package** ・ Industry Analysis Templates: Step 12, Pages 153 and 154s
	24	**Business Model** (Step 13)	・ Defining the Business Model: ・ Lecture on basic structure and different types. ・ Illustrating it as the flow of product, money, and information.	Team: ・ Business Model Illustration Template, Step 13, Page 170

Week	Session	Topics and Steps	· Key CONCEPTS Introduced in Class	Team or Individual Activity
13	25 26	**Business Model** (Steps 14, 15, 16, 17)	· Revenue and Expenses · The key decision points in the Revenue Model · The key decision points in the Operating Model · Designing the Customer Journey · Validating the Business Model (The Polka Dog Bakery Video: an example of creating a new retail experience, plus new products.)	Team · Step 14, Page 177 · Step 15, Page 187 · Step 16, Page 195 · Step 17, Pages 199 and 200 · Validate the Revenue and Operating Model by trying to have phone calls with a few Sellers and Manufacturers to validating pricing, channels, and costs.
14	27	**Impact Visioning** (Step 18)	· Develop clear statements for business and societal impact. · Look at good existing examples of companies that do both.	Team: · Start integrating your research and templates towards the final presentation, provided in Step 20, Page 264 · **Business Model Design Hand-in Package**
	28	**Creating Value** (Step 19)	· Develop a project of the profitability in make low volumes for a product, a service, and a Web app. · Discuss applications of the framework to your venture.	Team: · Develop and present Unit of 1 Economics Template, Step 19, Page 229 · Keep working on the Final presentation

Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Team or Individual Activity
15	29 30	**Tell Your Story**	· Presentation Format and Style · Format: (1) Title Slide with names and contact information (2) The Target Customer and the Problem to be Solved (3) The Market Opportunity (4) The Innovation Story (5) The Business Model Story (6) The Customer Journey (7) The Team (8) The Proposed Action Steps. (9) Appendices (if needed or desired) · If you have built a prototype during the class, please bring it and show it to us! (The Fortify Video is a good example of how a good technical idea can translate into a business model, and next, into a well-funded venture.)	Team: · The PPT Presentation  · Practice, practice, practice! · Not too many words on one slide · Use pictures · Use template to develop your thinking, but try to create slides that are not just the templates.
Final Course Deliverables			Due on the Monday after the weekend of the final class meeting.	**Team: Your Venture PPTs** **Individual: Insight Learning Reflection Journal**

Course Outcomes

5. Identify one's values, passions, skills and their will to contribute to society
6. Formulate an idea and validate it with customers
7. Demonstrate prototyping and analyze the competition for the product
8. Create business models for revenue generation and sustainability of their business
9. Come up with a pitch that can used as the basis for actually starting a company based on an impactful innovation and societal impact

DOSP1001: Badminton

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

Reference:

1. Handbook of the Badminton World Federation (BWF)

DOSP1011: Chess

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

Reference:

1. International Chess Federation (FIDE) Handbook

DOSP1031: Football

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

Reference:

1. FIFA Laws of the Game

DOSP1041: Volleyball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

Reference:

1. FIVB - Official Volleyball Rules

DOSP1051: Kabaddi

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

Reference:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules
2. Rules of Kabadddi - International Kabaddi Federation

DOSP1091: Basketball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

Reference:

1. FIBA Basketball Official Rules

DOSP1111: Throwball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

Reference:

1. World Throwball Federation - Rules of the Game

DOSL1001: Club Activity – Participant

L	T	P	S	J	C
0	0	0	2	0	2*

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

Course Objectives

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Participation in various club based activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Identify personal interest areas
- Learn from diverse perspectives and experiences
- Gain exposure to various activities and opportunities for extra-curicular activities
- Learn to manage time effectively
- gain confidence

DOSL1011: Club Activity – Member of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curicular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

DOSL1021: Club Activity – Leader of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

DOSL1031: Club Activity – Competitor

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curicular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

References

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

Course Outcomes

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

POLS1001: Indian Constitution and History

L	T	P	S	J	C
2	0	0	0	0	2*

Course Description:
This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

Course Objectives:
1. To introduce constitutional history of India.
2. To explain the process of making Indian constitution
3. To analyze Fundamental of Rights, Duties and other principles in constitution
4. To create familiarity with political developments which shaped the constitution.

Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance is carried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as the Obligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the Constitution and amended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on Indian Constitution

Unit I: India as a Nation **6 hrs**

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.
Rowat, D. (1950). 'India: The Making of a Nation', *International Journal, 5*(2), 95-108. doi:10.2307/40194264
Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1. *The Politics of Idea since independence*, New Delhi: Cambridge University Press. pp. 1-30.

Module Learning Outcomes

1. Understand ideas of India
2. Explain the story behind making constitution and its future.
3. Articulate the differences between pre and post-colonial governments.

Unit 2: Understanding the Constitution **6 hrs**

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.
Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.
Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly,* Vol 43, Issue No 40
Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

Module Learning Outcomes
Understand the concept of constitutionalism. Demonstrate strength or weakness of constitutional morality in India
Evaluate constituent assembly debates in framing Indian Constitution.

Unit 3: The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hrs

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5.
Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.
Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.
Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.
Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.
Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

Module Learning Outcomes

1. Explain the relationship between 'Preamble' and 'The constitution'.
2. Interpret the key concepts of preamble
3. Analyzes the dynamic nature of Indian constitution
4. Understanding Fundamental Rights
5. Evaluate Directive Principles of State Policy
6. Interpret case studies on Fundamental Rights.

Unit 4: Citizenship **6 hrs**

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of South Asian Studies*, pp.33-58.
Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.
Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies,* Vol 15, pp 319-333.
Valerian Rodrigues

Module Learning Outcomes

1. Explain different dimensions of citizenship in Indian context
2. Evaluate the basis of citizenship
3. Compare 'claim' and 'status'of citizenship

Unit 5: Separation and Distribution of Powers 6 hrs

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.
Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal, 42*(6), 553-595.
Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research, 37*(1), 113-122.
Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy," *Economic and Political Weekly*, Vol 51, Issue 15
Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp. 1-30.
Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government and Politics*, New Delhi: Sage Publications. pp. 35-53.
Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in Indian Federalism', in *Studies in Indian Politics*, pp. 1-7.
Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and Political Weekly,* Vol 55, Issue No 26

Module Learning Outcomes

1. Explain the importance of separation of powers in a democracy
2. Understand the relation between three organs of the government
3. Evaluate the system of 'checks and balances'
4. Understand the difference between unitary and federal political systems
5. Critically analyze the Indian model of Federalism
6. Evaluate the distribution of responsibilities between union and state governments.

Recommended Readings:

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA: Princeton University Press.
Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.
Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: Eastern Book Company.
Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, New Delhi, 2008.
Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.
Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.
Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices, Controversies*, Permanent Black, New Delhi, 2002.

PHPY1001: Gandhi for the 21st Century

L	T	P	S	J	C
2	0	0	0	0	2*

Course Description
This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

Course Objectives

The objectives of the course are;
1. To provide the students with the basic knowledge on Gandhi's life and his philosophies
2. To understand the early influences and transformations in Gandhi
3. To analyse the role of Gandhi in India's national movement
4. To apply Gandhian Ethics while analysing the contemporary social/political issues
5. To appreciate the conflict resolution techniques put forward by Gandhi and its significance in the current scenario.

Module I : MK Gandhi: Childhood and Education
M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

Module II: From Mohan to Mahatma-South African Experiences
Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

Module III: Gandhi and Indian National Movement
Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non-cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

Module IV: Gandhi and Sustainable Development
Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

Module V: Gandhi and Contemporary Issues
Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

Learning Outcomes
1. To understand the life of Gandhi
2. To understand the role of Gandhi in Indian national movement
3. To analyse the origin and significance of Satyagraha
4. To understand the eleven vows of Gandhi which he followed through-out his life.

5. To examine the significance of constructive programs today

Course Outcomes

After the successful completion of the course the students will be able to;
1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmental issues, moral degradation and ethical dilemmas.

References

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan Publishing House
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur: NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007).Gandhi as Disciple and Mentor. New Delhi: CUP

DOSL1041: Community Services - Volunteer

L	T	P	S	J	C
0	0	0	0	2	2*

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

Course Objectives

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and Sheryl WuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

Course Outcomes

- Experience of volunteering in a variety of Community service activities
- Gaining empathy for lesser privileged sections of society by experience
- Understanding the process of generating community awareness
- Understanding Disaster management and relief through training and experience
- Developing environmental and sustainability awareness

DOSL1051: Community Services - Mobilizer

L	T	P	S	J	C
0	0	0	0	2	2*

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

Course Objectives

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

List of Activities

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

References

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and SherylWuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and and other Government and non-government community serviceorganizations organizations

Course Outcomes

- Experience of mobilizing and executing Community service activities
- Providing opportunities for community service volunteering for other fellow students
- Understanding the process of mobilizing cash, kind and volunteer support
- Building leadership and management skills
- Building empathy and citizenship behavior

ENVS1001: Environmental Studies

L	T	P	S	J	C
3	0	0	0	0	3*

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Objectives

1. To impart knowledge on natural resources and its associated problems.
2. To familiarize learners about ecosystem, biodiversity, and their conservation.
3. To introduce learners about environment pollution.
4. To acquaint learners on different social issues such as conservation of water, green building concept.
5. To make learners understand about the present population scenario, its impacts and role of informational technology on environment and human health.
6. To make learners understand about the importance of field visit.

Course Outcomes

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).
4. Function of green building concept.
5. Adapt value education

UNIT – I **Multidisciplinary nature of environmental studies & Natural Resources:** No of Hours: 10

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

UNIT – II **Ecosystem and biodiversity** No of Hours: 10

Ecosystem: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

Biodiversity: Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity"

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

UNIT – III **Environmental Pollution** No of Hours: 10

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

Learning Outcomes:

After completion of this unit, the student will be able to

UNIT – IV **Social Issues and the Environment** No of Hours: 10

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

UNIT – V **Human Population and the Environment and Environment Protection Act and Field work** No of Hours: 10

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

Text Book(s)

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses-Universities Press, India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age International Publishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2nd Edition. Cengage Learning India. 2012.

Additional Reading

1. Benny Joseph. Textbook of Environmental Studies 3rd edition, McGraw Hill Publishing company limited. 2017.

Reference Book(s):

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems and Solutions. Jones and Bartlett Publishers. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th edition. 2005.

Journal(s):

1. https://www.tandfonline.com/loi/genv20
2. https://library.lclark.edu/envs/corejournals

Website(s):

https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

From Climate Science to Action | Coursera

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

1-Low, 2-Medium and 3-High Correlation

MFST1001: Health & Wellbeing

L	T	P	S	J	C
0	0	2	0	0	1*

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how to exercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

Course Objectives

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

UNIT-I

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

UNIT-II

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

UNIT-III

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

UNIT-IV

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

Course outcomes:

By the end of the course, student will

- Learn the role of nutrition and diet in maintaining a good health
- Will understand how the exercise, sports and physical activities will improve health
- Will learn mindfulness practices for reducing stress
- Will know the importance of yoga and meditation

CLAD2001: Preparation for Campus Placement-1

(Soft Skills 5A)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

Course Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.

2. Verbal Ability: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.

3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems

4. Reasoning: Logical and Verbal Reasoning

Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2011: Preparation for Higher Education (GRE/ GMAT)-1 (Soft Skills 5B)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve questions from all four broad areas of GRE/ GMAT
2. Orient the students for GRE/ GMAT through mock tests

1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning

2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis

3. Analytical Writing Assessment: Issue/ Argument

4. Integrated Reasoning

Course Outcomes:

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2021: Preparation for CAT/ MAT - 1
(Soft Skills 5C)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve questions from all four relevant areas of CAT/ XAT/ MAT, etc.
2. Orient the students for CAT/ XAT, etc. through mock tests

1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry

2. Data Interpretation: Data Interpretation and Data Sufficiency

3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

Course Outcomes:

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2031: Preparation for Campus Placement-2

(Soft Skills 6A)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude and logical reasoning.

Course Objectives:

1. To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
2. To sharpen the test-taking skills in all four major areas of all campus drives

1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness

2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning

3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems

4. Reasoning II: Logical and Verbal Reasoning

Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2041: Preparation for Higher Education (GRE/ GMAT)-2

(Soft Skills 6B)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
2. Orient the students for GRE/ GMAT through mock tests

1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning

2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis

3. Analytical Writing Assessment II: Issue/ Argument

4. Integrated Reasoning II

Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

CLAD2051: Preparation for CAT/ MAT - 2
(Soft Skills 6C)

L	T	P	S	J	C
0	0	2	0	0	1

Course Description:

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

Course Objectives:

1. Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.

1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

Course Outcomes:

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

FINA3001: Personal Financial Planning

L	T	P	S	J	C
0	0	2	0	0	1*

Course Overview

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non-medical problems. There are certain planned and unplanned events in our life. On the one hand, education of our children, their marriage, our retirement etc. are some of the planned events of our life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.
This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

Course Objectives:

1. To build students' ability to plan for long-term financial comfort of individual and family through goal setting, developing financial and life strategies.
2. To provide students with knowledge on terms, techniques to evaluate investment avenues.
3. To build the skill set of the student to enable them to file their tax returns.

Course Outcome:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

Unit 1: Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

Unit 2: Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

Unit 3: Investment Products and Measuring Investment Returns

Investment Products: Small Saving Instruments, Fixed Income Instruments, Alternate

Investments, Direct Equity
Measuring Investment Returns: Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

Unit 4: Retirement Planning
Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

Unit: 5 Tax Planning
Income Tax: Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

Text Books

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

Reference Books

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. National Insurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking and Finance.

PHYS1001: PHYSICS

L	T	P	C
3	0	2	4

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibres and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives

- To introduce mathematical principles to estimate forces, fields and waves.
- To familiarize students with electromagnetics in modern communication systems.
- To impart knowledge concerning the electrical behaviour of dielectric materials.
- To demonstrate the properties of magnets.
- To introduce semiconductor physics and devices.

UNIT I: Basics of Electromagnetics 9 L

Electrostatic field: Coulomb's law and Gauss 'law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations.

Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

Learning Outcomes:

- apply Coulomb's and Gauss' laws to electric field configurations from charge distributions (L3)
- apply the Biot-Savarts' law to derive magnetostatic field distributions (L3)
- use vector calculus to describe electromagnetic phenomena(L2)
- relate the law of conservation of charge to continuity equation(L3)
- illustrate the Maxwell's equations, Maxwell's displacement current and correction of Ampere's law(L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT II: Fiber Optics 7 L

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply the principle of propagation of light in optical fibers(L3)
- explain the working and classification of optical fibers(L2)
- analyse propagation of light through optical fibers based on the concept of modes (L4)
- summarize applications of optical fibers in medical, communication and other fields(L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT III: Dielectric, Magnetic and superconducting Materials 10 L

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only). Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Superconductivity: definition –Meissner effect –type I & II superconductors –BCS theory (qualitative) –high temperature superconductors –Josephson effects applications.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the concept of dielectric constant and polarization in dielectric materials (L2)
- interpret dielectric loss, Lorentz field and Claussius-Mosotti relation (L2)
- classify the magnetic materials(L2)
- explain the phenomenon of hysteresis for a ferromagnetic material and summarize the properties of hard and soft magnetic materials (L2)
- understand the concept of superconductivity (L2)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT IV: Semiconductor Physics 8 L

Introduction, origin of energy band, intrinsic and extrinsic semiconductors, mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p- type semiconductors, Drift and diffusion currents in semiconductors.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline the properties of semiconductors(L2)
- interpret expressions for carrier concentration in intrinsic and extrinsic semiconductors(L2)
- assess the variation of carrier concentration in semiconductors with temperature (L5)

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT V: Semiconductor Devices 8 L

Zener Diode, Tunnel diode, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the drift and diffusion currents and formation of junction layer (L2)
- state Einstein's relations(L1)
- explain Hall effect and its applications(L3)
- illustrateandinterprettheV-Icharacteristicsofap-njunctiondiode(L2)
- describe applications of p-n junction diodes in photodiodes, LEDs and solar cells (L3).

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

Text Book(s)

1. David J.Griffiths, “Introduction to Electrodynamics”, 4/e, Pearson Education, 2014.
2. Charles Kittel, “Introduction to Solid State Physics”, Wiley Publications, 2011.
3. M. N. Avadhanulu, P.G. Kshirsagar, “A Text book of Engineering Physics”, 11/e, S. Chand Publications, 2019.

Reference book(s)

1. Principles of Physics, 10ed, ISV, Jearl Walker, David Halliday, Robert Resnick, Wiley India.
2. Gerd Keiser, “Optical Fiber Communications”, 4/e, Tata Mc Graw Hill, 2008.
3. S.O.Pillai, “Solid StatePhysics”, 8/e, New Age International, 2018.
4. S.M. Sze, “Semiconductor Devices-Physics and Technology” , Wiley, 2008.

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.5144798
3. https://aapt.scitation.org/doi/abs/10.1119/1.1511591

PHYSICS LABORATORY

List of Experiments

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
3. To determine magnetic susceptibility by Quincke’s tube method
4. To determine the Hall coefficient using Hall effect experiment
5. To determine the resistivity of semiconductor by Four probe method
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode
12. To study the characteristics of Solar Cell
13. To study the characteristics of Zener diode
14. To study the resonance of LCR circuit

Text Book:

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers,2017

PHYS1031: MECHANICS AND PROPERTIES OF MATTER

L	T	P	C
3	1	0	4

This course is designed for students of Aerospace, Civil and Mechanical Engineering. It introduces fundamentals of elasticity and thermal properties – the essentials for understanding the behaviour of materials. Mechanics of solids is taught to acquaint them with the behaviour of rigid objects. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Objectives

- To acquaint the basic concepts of sound waves and principles in acoustic design.
- To introduce the concepts of elasticity, strain hardening and failure in materials and impart the relation between stress and strain.
- To impart the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems.
- To demonstrate the use of Newton's laws of motion for understanding the mechanics of a particle.
- To explain the working principle and construction of different types of sensors.

UNIT-I Mechanics: 10 Hours

Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.

Learning Outcomes:

After completion of this unit, the student will be able to

- Explain forces and moments in mechanical systems using scalar and vector techniques L2
- interpret the equation of motion of a rigid rotating body (torque on a rigid body) L3
- apply the Newton's second law for inertial and non inertial frame of reference L3
- summarize harmonic motion in undamped, damped and forced oscillations L2

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT-II Elasticity 8 Hours

Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the basic concepts of elasticity, plasticity, strain hardening and failure in materials L2
- determine graphically a material's mechanical properties in terms of its one dimensional stress-strain curve L2
- derive the generalized Hooke's law by recognizing the basic stress-strain response of isotropic materials L3
- Define several elastic constants and determine the relationship between them L1
- evaluate strain energy under different loadings L3

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - III Thermal Properties 10 Hours

Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints -bimetallic strips; Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the process of thermal expansion in solids and liquids L3
- distinguish fundamental laws related to conduction, convection and radiation of heat L1
- determine the thermal conductivity of a material by Forbes and Lee's disc method L4
- summarize the working of heat exchangers, refrigerators, ovens and solar water heaters L2

UNIT - IV Acoustics 8 Hours

Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of buildings, Acoustic requirements of a good auditorium.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the basic concepts in acoustics and describe Weber-Fechner Law L2
- determine absorption coefficient and reverberation time L3
- derive Sabine's formula using growth and decay method L4
- solve problems involving the intensity of a sound wave L4
- summarize the principles of acoustics in designing an acoustically good auditorium L3

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT– V: Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors- Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the principle of strain and pressure sensors L1
- explain the principle and working of magnetostrictive and piezoelectric sensors L3
- illustrate the fibre optic methods of pressure sensing L3
- infer the functioning of temperature sensors like bimetallic strip and pyroelectric detectors L2
- outline the principle and working of Hall-effect sensor, smoke and fire detectors L2

Text Book(s)

1. D.Kleppner and Robert Kolenkow"An Introduction to Mechanics- II" Cambridge University Press,2015.
2. M.N. Avadhanulu & T.V.S. Arun Murthy, S Chand A Textbook of Engineering Physics, Volume-I 2018.
3. Ian R Sinclair, Sensor and Transducers 3/e,Elsevier (Newnes), 2001.

Reference Book(s)

1. M K Varma, "Introduction to Mechanics"-Universities Press, 2015
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., McGraw Hill Education (India) Private Limited, 2013.

Course Outcomes:

After completion of this course, the student will be able to

- describe the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships L1
- apply the concepts of strain, internal force, stress and equilibrium to deformation of solids L3
- explain the fundamental theory for the analysis of heat transfer processess in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters L4
- estimate forces and moments in mechanical systems using scalar and vector techniques L4
- outline the basic principle and operation of different types of sensors L2

PHYS1011: PRINCIPLES OF QUANTUM MECHANICS

L	T	P	C
3	1	0	4

This course is designed with principles of Quantum mechanics for advanced courses in their respective engineering branches. It introduces Quantum mechanics with relevant mathematical tools and provides a basis for further study of quantum mechanics. It also introduces basics of Qubits for Quantum computing applications.

Course Objectives

- To introduce the basic principles of quantum mechanics.
- To introduce wave equation and significance of wave function.
- To teach solving the Schrödinger's equation for spinless particles moving in one-dimensional potential.
- To develop an understanding of concepts of angular momentum.
- To introduce Dirac bra-ket formalism and the concept of QUBITs.

UNIT – I: Introduction to Quantum Physics (10 Hours)

Introduction, Classical Mechanics vs Quantum Mechanics, Planck's quantum theory (qualitative), Photo-electric effect. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them, Wave-particle duality, Heisenberg uncertainty principle: ground state energy of hydrogen atom.

Learning Outcomes:

After completion of this unit, the student will be able to

- Get a grasp on the elementary aspects of energy and momentum of a photon and de Broglie wavelength of a particle.
- Know about the uncertainty principle for position and momentum and for energy and time.
- To study the basic principles of quantum mechanics

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – II: Properties of Matter Waves (8 Hours)

Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization.

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the significance of Schrodinger's time independent wave equation.
- explain the operator formulation of quantum mechanics.
- learn the concept of wave function

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT – III: Quantum Tunneling (8 Hours)

One dimensional infinitely rigid box-energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimensional rectangular potential

barrier, 1D linear harmonic oscillator (no derivation required, only eigen function, eigen values and zero-point energy).

Learning Outcomes:

After completion of this unit, the student will be able to

- Derive wave functions with reflection and transmission coefficients
- The concept of quantum mechanical tunneling
- solve time-independent Schrödinger equation for simple potentials

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - IV Quantum Properties of Electrons (9 Hours)

Electron angular momentum, angular momentum operator, Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect, Stark Effect, Gyromagnetic Ratio and Bohr Magneton (qualitative)

Learning Outcomes:

After completion of this unit, the student will be able to

- understand spin magnetic moment and total angular momentum
- relate the eigenvalue problems for energy, momentum and angular momentum explain the idea of spin
- explain the interaction between spin of electron and magnetic field
- understand the interaction between electron and electric field

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – V: Qubits for Quantum Computing (10 Hours)

Introduction to Dirac Bra-Ket notation, Introduction to Pauli spin matrices, Quantum Superposition, Interference, Quantum Measurement, Decoherence, Entanglement, Bloch sphere, Qubits, and multiple qubits, Qubits Vs classical bits, representation of a qubit probability.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply Bra-Ket notation in obtaining eigen values
- understand quantum entanglement
- describe the fundamentals of the quantum computing

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

Textbook(s):

1. Quantum Mechanics, G. Aruldhas, 2ndEdn. 2002, PHI Learning of India.
2. Quantum Mechanics, Satya Prakash, 2016, Pragati Prakashan.
3. Quantum Computing for Everyone, Chris Bernhardt, 2019, The MIT Press,

Reference Book(s):

1. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education.
2. Quantum Computing: An Applied Approach, Jack D. Hidary, 2019,

Springer Journal(s):

1. https://aapt.scitation.org/doi/full/10.1119/1.4897588
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

Websites:

1. https://www.intechopen.com/online-first/73811
2. https://www.quantum-inspire.com/kbase/what-is-a-qubit/

PHYS1021: PHYSICS OF SEMICONDUCTING DEVICES

L	T	P	C
3	1	0	4

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibers and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives

- To introduce nature light and its properties.
- To familiarize students with different semiconductors and its energy band gaps.
- To introduce semiconductor physics and devices.
- To impart knowledge about the semiconducting optical devices.
- To demonstrate the properties of different semiconducting optical devices.

UNIT I Elements of light (8 hours)

Nature of light, Light sources, Black body, Colour temperature, Units of light, Radio metric and photometric units, Light propagation in media and waveguides, Electro-optic effects. Overview of luminescence: Photoluminescence, Cathodoluminescence, Electroluminescence, Injection-luminescence.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understanding the dual nature of light L2
- Understanding different law for energy spectrum emitted by black body. L3
- To explain the concepts of electro-optics effects L1
- To summarize the overview of different luminescence L2

UNIT II: Semiconductor Materials (10 hours)

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- Know the bands structure of metals and semiconductors L3
- Understand the electronic structure of interfaces between different types of materials L2
- To determine the different band gaps of direct and indirect band gap materials L5
- To explain the occupation probability and Fermi level variation in different electronic materials L1

UNIT III: Light-semiconductor interaction (10 hours)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect.

Learning Outcomes:

After completion of this unit, the student will be able to

- To summarize the optical transition in bulk semiconductors L2
- To explain the concepts of absorption, spontaneous emission and stimulated emission L1
- To outline the population inversion in semiconductor lasers L2
- To evaluate the transition rates and optical loss and gain in materials L5

UNIT IV: Solar cells and Photovoltaic devices: (9 hours)

Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and Light, Device Physics of Solar Cells, Principle of solar energy conversion, Conversion efficiency, Type of solar cells in use: Dye Sensitized Solar Cells, Thin film solar cells.

Learning Outcomes:

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- Know about the interaction of light with materials and its optical properties L3
- Illustrate and interpret the voltage and current characteristics of p-n junction diodes model L1
- Explain the conduction mechanism in semiconducting and optical devices. L5
- To describe the applications of p-n junction diodes in types of solar cells L3

UNIT V: Semiconductor devices (8 hours)

Radiative recombination devices: Light-emitting diodes (LED), Organic Light Emitting Diodes (OLED) and its types, Photoelectric devices: Photodiodes. Photoconducting devices: Photodetectors and photoconductors, Photoresistors, Photo transistors, Stimulated emission devices: Injection laser diodes, Quantum cascade lasers.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe applications of light emitting diodes and its radiative recombination process L2
- explain the concepts of photoconductive devices and its applications in different devices L3
- to define the concepts of Photodetectors and photoconductors, Photoresistors, Photo transistors, L1
- to access the variation of stimulated emission in injection and quantum lasers L5

Text Books:

1. Schubert, E., Light-Emitting Diodes, 2/e, Cambridge: Cambridge University Press, 2006.

2. Physics of Solar Cells: From Basic Principles to Advanced Concepts, 3rd Edition Peter Würfel, UliWürfel (2016) Wiley.
3. Solid State Physics, Neil W. Ashcroft, N. David Mermin (2003) Cengage Learning India

Reference Books:

1. Quantum Cascade Lasers by Vasilios N. Stavrou: https://www.intechopen.com/books/5389.
2. Optoelectronic materials and device concepts; Manijeh Razeghi, SPIE, 1991
3. Introduction to Organic Electronic and Optoelectronic Materials and Devices; Sun and Dalton, CRC Press, 2008.
4. Semiconductor Physics and Devices, 3ed, An Indian Adaptation, S. M. Sze, M. K. Lee, Wiley India.
5. Semiconductor optoelectronics; Jasprit Singh, McGraw-Hill, 1995.

Course Outcomes

After completion of this unit, the student will be able to

- Outline the properties of semiconductors L2
- explain the occupation probability and Fermi level variation in different electronic materials L1
- Know about the interaction of light with materials and its optical properties L3
- Explain the conduction mechanism in semiconducting and optical devices. L5

PHYS1041: MECHANICS AND MODERN PHYSICS

L	T	P	C
3	1	0	4

This course designed for students of Biotechnology to impart principles of Newtonian mechanics will help the students in understanding the oscillatory behavior of materials. It also introduces fundamentals of quantum mechanics – the essentials for understanding the behavior of properties of materials. Fundamentals of optics and electromagnetism in understanding the use in spectroscopy. An introduction to sensors will be useful for all the branches as an application of modern technology.

Course Objectives

- To impart knowledge on damped and forced oscillations.
- To familiarize students with the concepts of quantum mechanics
- To impart knowledge concerning the wave properties of electromagnetic waves
- To familiarize the students about the Maxwell's equations and its propagation
- To outline the principles and working of few common sensing devices

UNIT - I Fundamentals of Dynamics and Oscillations 10 Hours

Fundamentals of Dynamics: Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Review of Newton's Laws of Motion.

Oscillations: SHM, Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor

Learning Outcomes:

After completion of this unit, the student will be able to

- Differentiate between inertial and non-inertial frames of reference
- Solve the differential equation of simple harmonic oscillator
- Distinguish between forced and damped oscillators
- Estimate the resonance and its properties
- Describe the Newton's laws of motion

Pedagogy tools: Blended learning, Case let, video lectures, self-reading

UNIT - II Modern Physics (Quantum Physics) 8 Hours

Introduction, matter waves and its properties, Davisson-Germer experiment, GP Thomson experiment, Heisenberg's uncertainty principle, Schrodinger's time independent wave equation, physical significance of wave function, particle in a one-dimensional infinite well, rectangular potential barrier (transmission coefficient), band theory of solids (qualitative), distinction between metals, insulators and semiconductors, introduction to Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstien statistics.

Learning Outcomes:

After completion of this unit, the student will be able to

- Get a grasp on the elementary aspects of energy and momentum of a photon and de Broglie wavelength of a particle.
- Know about the uncertainty principle for position and momentum and for energy and time.

- Understand the significance of Schrodinger's time independent wave equation and apply it to a restricted particle.
- Derive wave functions with reflection and transmission coefficients.
- Differentiate between the Maxwell-Bolzmann, Fermi-Dirac and Bose-Einstien statistics

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – III: Optics 10 Hours

Interference: Introduction, interference in thin films due to reflected light: interference in parallel-sided film and wedge-shaped film, Newton's rings. Diffraction: Introduction; Fraunhofer diffraction at single slit (qualitative only), diffraction due to N-slits (diffraction grating) (qualitative only), determination of wavelength of light with a plane transmission grating.

Polarisation: Introduction; Double refraction –double refraction in calcite crystal, negative and positive crystals, Nicol's prism, Retarders (quarter and half¬wave plates).

Learning Outcomes:

After completion of this unit, the student will be able to

- Develop the ability to determine the conditions for constructive and destructive interference
- Figure out the position and intensity variation of the dark fringes in single-slit diffraction (Fraunhoffer Diffraction).
- Acquire a basic understanding of diffraction gratings with dispersive nature.
- Comprehend the concepts and meaning of Polarization.
- Know about polarization of light, polarizer and methods of producing polarized light.

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT – IV: Maxwell`s equations and Electromagnetic wave propagation 8 Hours

Maxwell's equations (both differential and integral forms) and its physical significance, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization of EM waves.

Learning Outcomes:

After completion of this unit, the student will be able to

- Relate the Maxwell's equation in differential and integral forms
- Interpret the behavior of plane electromagnetic waves in vacuum
- Summarize the significance of Maxwell's equations
- Evaluate the energy density of electromagnetic wave
- Describe the wave propagation in vacuum and medium

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

UNIT - V Sensors 9 Hours

Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors -Piezoelectric, magnetostrictive sensors, ultrasonic sensors; Fibre optic methods of pressure sensing; Temperature sensor -bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors

Learning Outcomes:

After completion of this unit, the student will be able to

- Illustrate the principle of strain and pressure sensors

- explain the principle and working of magnetostrictive and piezoelectric sensors
- Evaluate the fibre optic methods of pressure sensing
- Infer the functioning of temperature sensors like bimetallic strip and pyroelectric detectors
- State the principle and working of Hall-effect sensor, smoke and fire detectors

Pedagogy tools: Blended learning,Case let, video lectures, self-reading

Textbook(s):

1. Mechanics, D.S. Mathur, S.Chand and Company Limited, 2000.
2. A Text Book of Optics, 25/e, Brij Lal, M N Avadhanulu & N Subrahmanyam, 2012, S. Chand Publishing.
3. Ian R Sinclair, Sensor and Transducers 3rd eds, 2001, Elsevier (Newnes)
4. David J. Griffiths, "Introduction to Electrodynamics"-4/e, Pearson Education,2014
5. M.N. Avadhanulu, P.G. Kshirsagar, A Textbook of Engineering Physics, S.Chand, 2014.

Reference Book(s):

1. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
2. Prithwiraj Purkait, Budhaditya Biswas and Chiranjib Koley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1st eds., 2013 McGraw Hill Education (India) Private Limited.
3. Elements of Properties of Matter, D. S. Mathur, S. Chand Publishing

Journal(s):

1. https://aapt.scitation.org/doi/abs/10.1119/1.3317450
2. https://aapt.scitation.org/doi/full/10.1119/1.3639154

CHEM1001: CHEMISTRY

L	T	P	C
3	0	2	4

This course enables the students to gain knowledge on various aspects of Water and its treatment, electrochemical energy systems, Construction of batteries, renewable energy sources, Semiconductors, Steel, Cement and Polymers, Corrosion and its control, nano-materials, Analytical instruments and applications. The knowledge gained in this course can be applied to the latest developments in technology.

Course objectives

- To impart knowledge on various aspects of water and its treatment.
- To study about electrochemical energy systems, renewable energy sources, solar cells and their applications.
- To gain knowledge on materials such as steel, cement and polymers
- To create awareness on corrosion and its control.
- To introduce different types of nano-materials.
- To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

Unit-1: Water and its treatment **9L**

Water and its treatment: Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness. Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization- industrial water treatment- Boiler feed water and its treatment -internal conditioning– Calgon and Phosphate conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis.

Learning outcomes:

After the completion of the Unit I, the student will be able to

- list the differences between temporary and permanent hardness of water. (L-1)
- explain the principles of reverse osmosis. (L-2)
- compare the quality of drinking water with BIS and WHO standards. (L-2)
- illustrate problems associated with hard water. (L-2)
- demonstrate the Industrial water treatment processes. (L-2)

Unit-2: Electrochemical Energy Systems **9L**

Battery Technology: Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, Lead-acid storage battery, lithium cells- Lithium ion cell, Li MnO_2 cell. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell. **Renewable energy sources – Types of renewable energy sources. Semiconductors:** Definition, types of semiconductors: doping- n type and p – type semiconductors and applications.- **Solar cells:** Introduction, harnessing solar energy, Photovoltaic cell, solar water heaters.

Learning outcomes:

After the completion of the Unit II, the student will be able to

- define electrode potential. (L-1)

- explain Nernst's equation. (L-2)
- illustrate difference between primary and secondary cells. (L-2)
- summarize the applications of solar energy. (L-2)
- construct different cells. (L-3)

Unit-3: Engineering materials and Polymer Chemistry 8L

Steel – Types of Steel, chemical composition – applications of alloy steels

Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations).

Polymer Chemistry: Concept of polymerization – Types of Polymerization, Chain growth polymerization – mechanisms of free radical and cationic polymerizations, Thermoplastic resins and Thermosetting resins: examples- Polyethylene, Styrene, Nylon 6,6 and Bakelite. and applications, Conducting polymers:– Examples – and applications.

Learning outcomes:

After the completion of the Unit IV, the student will be able to

- classify the types of steel. (L-2)
- illustrate the chemical reactions involved in the manufacturing of cement. (L-2)
- identify preparation and properties of polymers. (L-3)
- distinguish between thermoplastic and thermo setting resins. (L-4)

Unit-4: Corrosion and its control 8L

Corrosion and Its Prevention: Electrochemical theory of corrosion, Corrosion due to dissimilar metal cells (galvanic cells), Corrosion due to differential aeration cells, Uniform corrosion, pitting corrosion and stress corrosion cracking, Effect of pH, temperature and dissolved oxygen on corrosion rate. Corrosion prevention and control by cathodic protection- protective coatings-paints.

Learning outcomes:

After the completion of the Unit III, the student will be able to

- explain theories of corrosion. (L-2)
- classify different corrosion methods. (L-2)
- summarize the various factors affecting corrosion. (L-2)
- identify different organic coatings. (L-3)
- apply the principles of corrosion control. (L-3)

Unit-5: Nanomaterials and Analytical Instrumental Techniques 8L

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM)

Analytical Instrumental Techniques

Review of electromagnetic spectrum, Quantization of energy. Absorption of radiation: Beer-Lambert's law. Principle and applications of pH metry, potentiometry, conductometry, IR and UV-spectroscopy with examples.

Learning outcomes:

After the completion of the Unit V, the student will be able to

- classify nanomaterials. (L-2)

- explain the synthesis and characterization methods of nano materials. (L-2)
- describe the principles of different analytical techniques. (L-3)
- compare the principles of SEM and TEM. (L-4)

Course outcomes

After the completion of the course, the student will be able to

- list the important purification methods of water. (L-1)
- illustrate the principles and applications of batteries, solar energy. (L-2)
- explain the importance of materials such as steel, cement and polymers
- identify different protective coatings. (L-3)
- analyze the importance of nano materials and the principles of SEM and TEM. (L-4)

Text Books:

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill Education Private Limited, (2009).

Reference Books:

1. Sashi chawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand & Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications (2014).
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

CHEMISTRY LABORATORY

The course enables the students to gain knowledge on various, instrumental methods of analysis, measurements of physical parameters, volumetric analysis, preparation of polymers, analysis of water, and chromatographic separation techniques.

Course objectives

- To familiarize the students with the basic concepts of Chemistry lab.
- To train the students on how to handle the instruments.
- To demonstrate the digital and instrumental methods of analysis.
- To expose the students in practical aspects of the theoretical concepts.

List of experiments

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate

8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resin
12. Preparation of Urea-Formaldehyde resin
13. Thin layer chromatography
14. Preparation of TiO2/ZnO nano particles
15. SEM analysis of nano materials

Course Outcomes:

After the completion of the laboratory course, the student will be able to

- explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods. (L-2)
- identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods). (L-3)
- experiment with the physical parameter of organic compounds. (L-3)
- compare the viscosities of oils. (L-4)
- list the preparation of polymers and nano materials. (L-4)

Text Books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, Dhanpat Rai Publishing Company (2007).

MATH1001 - SINGLE VARIABLE CALCULUS

L	T	P	C
2	0	0	2

This course is designed to impart knowledge on differentiation and integration of function, emphasizing their inter-relationship and applications to engineering.

Course Objectives:

- To familiarize the students in the concepts the derivatives and its underlying concepts like limits and continuity.
- To explain the concept of derivative and calculation of extreme values of extreme values of various functions.
- To impart knowledge on integration for the computation of areas, arc lengths.
- To demonstrate various techniques of integrations.

Unit I: Limits and continuity of single and several variables (6 hours)

Limit of a Function and Limit Laws, The Precise Definition of a Limit, One-Sided Limits, Continuity (Without proofs). Functions of Several Variables, Limits and Continuity in Higher Dimensions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- define and calculate limits and one-sided limits of single variables
- define and calculate limits of several variables.
- define continuity and determine whether a function is continuous of single and several variables.

Unit II: Derivatives and applications (7 hours)

The Derivative as a Function, Differentiation Rules, The Chain Rule, Extreme Values of Functions on Closed Intervals, Monotonic Functions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- know the definition of derivative and how to use the most common rules of derivatives
- apply various rules to obtain the derivatives of different functions.
- find the extreme values of various functions.

Unit III: Integrals and applications (7 hours)

The Definite Integral, The Fundamental Theorem of Calculus, Indefinite Integrals and the Substitution Method, Definite Integral Substitutions and the Area between Curves, Arc Length (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- know about anti-derivative and the Fundamental Theorem of Calculus and its applications
- apply concept of integration to evaluate geometric area and solve other applied problems
- apply substitution to compute definite integrals.

Unit IV: Techniques of integration (6 hours)

Using basic Integration Formulas, Integration by Parts, Trigonometric Integrals, Trigonometric Substitutions, Integration of Rational Functions by Partial Fractions (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate integrals using integration by parts.
- evaluate indefinite and definite integrals using by the method of substitution.
- evaluate integrals of trigonometric and rational functions.

Textbook:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
4. Hyghes-Hallett, Gleason, McCallum et al. Single Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.

Course Outcomes:

At the end of the course, the student will be able to

- determine limit, one sided limit, continuity of single and several variable functions.
- solve problems in a range of mathematical applications using the derivative or the integral.
- apply the fundamental theorem of calculus.
- evaluate integrals using various techniques.

MATH1011- SEVERAL VARIABLE CALCULUS

L	T	P	C
2	0	0	2

This course is designed to impart knowledge on calculus of functions of more variables which are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Course Objectives:

- To teach basic concepts of partial derivatives.
- To explain the evaluation of double integrals and its applications.
- To demonstrate the evaluation and applications of triple integrals.
- To acquaint the knowledge of line and surface integrals and applications.

Unit I: Partial derivatives and applications (7 hours)

Partial Derivatives of a Function of Two Variables and More Than Two Variables, Second-order Partial derivatives, The Chain Rule for Functions of Two and Three variables, Extreme Values and Saddle Points, Lagrange Multipliers, Taylor's Formula for Two Variables (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find partial derivatives of various functions
- apply chain rule for functions of two and three variables
- evaluate maxima and minima of functions

Unit II: Double integrals (6 hours)

Double and iterated Integrals over Rectangles, Double Integrals over General Regions, Area by Double Integration : Area of bounded region in a plane, Double Integrals in Polar Form. (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate double integrals of functions of several variables in two dimensions in Cartesian and polar coordinates.
- calculate the areas bounded by a region using double integration techniques.

Unit III: Triple integrals (5 hours)

Triple Integrals in Rectangular Coordinates: Triple Integrals, Volume of a Region in Space, Finding limits of integration, Triple Integrals in Cylindrical and Spherical Coordinates. (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find limits of integration
- evaluate multiple integrals in Cartesian, cylindrical and spherical geometries.
- find volumes using triple integrals.

Unit IV: Integrals and Vector fields (8 hours)

Vector Fields and Line Integrals: Line Integrals of Vector Fields, Line Integrals with Respect to dx, dy, or dz, Work Done by a Force over a Curve in Space, Green's Theorem in the Plane: Tangential form, Using Green's Theorem to Evaluate the Line Integral and Verification, Surface Integrals: Surface Integrals of Vector Fields, Stokes' Theorem (Without proofs)

Learning Outcomes:

At the end of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field.
- find the rate of flow of a fluid across a surface.
- apply Green's and Stokes' theorem in evaluation of line, surface and volume integrals.

Textbook:

1. Joel Hass, Christopher Heil, Maurice D. Weir, Thomas' Calculus, Fourteenth edition, Pearson Addison Wesley (2018).

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
3. Hyghes-Hallett, Gleason, McCallum et al. Multivariable Variable Calculus (6th Edn) John Wiley and Sons New York, 2013.
4. James Stewart. Multivariate Calculus, Concepts and Contexts. (3rd Edn) Thomson/Brooks/Cole, Canada, 2005.

Course Outcomes:

At the end of the course, the student will be able to

- utilize functions of several variables in optimization.
- employ the tools of calculus for calculating the areas.
- calculate volumes using multiple integrals.
- determine the work done and rate of flow of a fluid using vector calculus

MATH 1021: TRANSFORM TECHNIQUES

L	T	P	C
2	0	0	2

Preamble

This course is designed to impact the knowledge on (Laplace, Fourier) transforms and applications of these transforms on differential equations.

Course Objectives:

- To introduce and explain the concepts of Laplace transforms and properties.
- To demonstrate the evaluation of Laplace transforms of special functions and additional properties.
- To impart knowledge on obtaining Fourier series
- To introduce and explain the concepts of Fourier transforms and properties.
- To explain the evaluation of Fourier transforms of various function and then applications to boundary value problem.
- To demonstrate and understand the transform techniques using available software

Unit-1: Laplace transforms (5 hrs)

Introduction, transforms of elementary functions, properties of Laplace transforms, Transforms of derivatives, transforms of Integrals, Multiplication by t^n, Division by t.

Learning Outcomes:

After completion of this unit student able to

- find Laplace transform of a function (L3).
- examine the properties of Laplace transforms(L4).
- determine Laplace transform of functions like transforms of Integrals, Multiplication by t^n, Division by t (L4).

Unit-2: Applications of Laplace transforms (5 hrs)

Evaluation of integrals by Laplace transforms, Inverse transforms, Solution of Differential equations.

Learning Outcomes:

After completion of this unit student able to

- find the inverse Laplace transform of a function(L3)
- Solve ordinary differential equations by using Laplace transformation technique(L3).

Unit-3: Fourier Series (6 hrs)

Introduction, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval.

Learning Outcomes:

After completion of this unit student able to

- find the Fourier series of a given function (L3)

- find the Fourier series by changing the given interval (L3)

MATH1031: DIFFERENTIAL EQUATIONS

L	T	P	C
2	0	0	2

Preamble

This course is designed to impact the knowledge on ordinary, partial differential equations and their applications.

Course Objectives:

- To familiarize the students with the basic concepts of ordinary differential equations.
- To demonstrate the evaluation and applications of first order differential equations.
- To explain the evaluations of linear homogeneous and non-homogeneous differential equations.
- To familiarize the students with the basic concepts of partial differential equations.
- To explain the concepts of first order partial differential equations.
- To demonstrate the evaluation of differential equations using math software

Unit-1: First Order Ordinary Differential Equations (5 hrs)

Order and Degree of an Ordinary Differential Equation(ODE),ODE's of first order and first degree, Variable separable method, Linear Equations, Bernoulli's Equations.

Learning Outcomes:

- apply various methods to solve first order and first degree differential equations (L3).
- distinguish between linear and non linear differential equations (L4).
- solve linear differential equations (L3).

Unit-2: Linear Ordinary Differential Equations of High Order (6 hrs)

Definitions, Complete Solution, Operator D, Complimentary function, Inverse operator, Rules for finding particular integral (e^{ax}, sinbx/cosbx, x^m& $e^{ax}v(x)$)

Learning Outcomes:

- classify the solutions of linear differential equations of higher order (L3)
- identify the essential characteristics of linear differential equations with constant coefficients (L3)
- solve the linear differential equations with constant coefficients by appropriate methods (L3)

Unit-3: Applications of Linear Ordinary Differential Equations of Higher Order (5 hrs)

Method of Variation of Parameters, Simple Harmonic Motion, Oscillations of a Spring

Learning Outcomes:

- solve the linear differential equations with Method of Variation of Parameters (L3)

- Solve application problems such as Simple Harmonic Motion and Oscillations of a string using linear ordinary differential equations of higher order (L3).

Unit-4:Introduction to Partial Differential Equations (5 hrs)

Introduction, Formation of Partial Differential Equation(PDE), Solutions of a PDE, Equations solvable by direct integration, Linear equations of the first order.

Learning Outcomes:

- find the partial differential equation (L3).
- find the solution of a partial differential equation (L3).
- solve PDE by direct integration (L3)

Unit-5: Partial Differential Equations of Second Order (5 hrs)

Homogeneous linear equations with constant coefficients, Rules for finding the complementary function and particular integral,Working procedure to solve the equations.

Learning Outcomes:

- apply a range of techniques to find solutions of PDEs (L3)
- identify the basic properties of PDEs (L3)
- find the solutions of homogenous and non-homogenous linear partial differential equations (L3).

Text Books:

1. Simmons, G.F., Differential Equations with Applications and Historical Notes, Second Edition, McGraw-Hill, Inc., 1991.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984
2. Sneddon, *Elements of Partial Differential Equations*, McGraw-Hill, International Edition, 1967.
3. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.

Course Outcomes:

- form and find the solution of an ordinary differential equation (L3).
- apply the concept of differential equations to solve real world problems (L3).
- evaluate linear homogeneous and non homogeneous differential equations (L4)
- form and find the solution of a partial differential equations of first order (L3).
- evaluate second order partial differential equations (L4).
- evaluate solution of differential equations using computational tool (L4)

MATH1041: DISCRETE MATHEMATICS

L	T	P	C
2	0	0	2

Preamble :

Discrete Mathematics introduces students to the mathematics of networks, social choice, and decision making . This course provides students with a hands-on exploration of the relevancy of mathematics in the real world. This course reflects the rigor taught in many entry-level mathematics courses.

Course Objectives:

- To introduce basics of mathematical logical operators and connectives
- To impart knowledge on normal forms and rules of inference.
- To impart knowledge on partially ordered and total ordered sets.
- To familiarize closed form solution of linear recurrence relations by various methods.
- To impart knowledge on basic concepts of algebraic structures.
- To write program structures, and understand when programming is most applicable

Unit-1: Logic Operators and Connectives (5 hrs)

Negation, conjunction, disjunction, conditional and bi-conditional, well formed formulae, tautologies, equivalence of formulae, duality, tautological implications.

Learning outcomes:

After completion of this unit, student will be able to

- construct the truth table for given expressions (L3)
- identify tautologies, Contradiction or at least satisfiable and solve the decision problem. (L3)
- find equivalence formulas (L3)

Unit-2: Mathematical logic (5 hrs)

Conjunctive and disjunctive normal forms- principal disjunctive and conjunctive normal forms, Rules of inference for propositional calculus (Rule P, Rule T and CP rule).

Learning Outcomes:

After completion of this unit, student will be able to

- implement logic for mathematical proofs (L4)
- apply inference theory to verify the consistence of data (L3)

Unit-3: Sets and Relations (5 hrs)

Basic concepts of set theory, Power set, relations, properties of binary relations in a set, Equivalence relations, composition of binary relations, Partial ordering, Partially ordered set.Hasse diagram.

Learning Outcomes:

After completion of this unit, student will be able to

- identify different types of sets and relations (L3)
- test the given set is an equivalence relation or not (L4)

Unit-4: Recurrence relations (5hrs)

Recurrence relations, solving linear recurrence relations by characteristic roots method, system of recurrence relations.

Learning Outcomes:

After completion of this unit, student will be able to

- construct recurrence relations of the sequences (L3)
- solve homogeneous linear recurrence relations (L3)
- solve complementary function and particular integral for non-homogeneous linear recurrence relations (L3)

Unit-5: Algebraic Structures (6 hrs)

Algebraic Structures-Semi group, Monoid ,Groups, subgroups, cosets((definition and examples) Lagrange's theorem on finite groups

Learning Outcomes:

After completion of this unit, student will be able to

- test the given algebraic structure is a group or not (L3)
- identify different types of groups (L2)
- understand the significance and applications of Lagrange's theorem (L3)

Text Books:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Reference books:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Discrete Mathematical Structures,Sixth edition-Kolman,Busby,Ross

Course Outcomes:

Upon successful completion of this course the student should be able to

- Check the validity of a statement formula (L2)
- analyze the concepts in set theory and relations (L3)
- find a general solution of recurrence equation (L3)
- build the algebraic structures (L3)
- Apply Lagrange's theorem on finite groups (L3)
- Convert problem solving strategies to procedural algorithms (L3)

MATH1051: GRAPH THEORY

L	T	P	C
2	0	0	2

Preamble

This course introduces basic concepts in Graph Theory, including properties and characterization of graph/trees and graph theoretic algorithms, which are widely used in Mathematical modelling and has got applications across Computer Science and other branches in Engineering.

Course Objectives:

- To introduce basics of group theory and its applications
- To impart knowledge on basic concepts of paths and circuits
- To impart knowledge on Trees, spanning trees, shortest spanning trees
- To familiarize in the matrix representation of graphs
- To transform scientific problems into generic computational models

Unit-1: Basics of graphs (5 hrs)

Finite and Infinite Graphs, Incidence and Degree, Isolated Vertex, Pendant Vertex, and Null Graph, complete graph, Bi-partite and complete Bi-partite graphs.

Learning Outcomes:

After completion of this unit, student will be able to

- understand the basic terminology of the graph theory (L2).
- find the vertex of the graph and identify the types of vertices of the graph(L3).

Unit-2: Matrix representation of graphs: (5hrs)

Adjacency Matrix, Incidence Matrix, Path Matrix(Definition and examples),

Learning Outcomes:

After completion of this unit, student will be able to

- identify the types of matrix representation of graph (L3)
- Find a path matrix of a connected graph (L3)

Unit-3: Paths and circuits (6 hrs)

Paths, and Circuits, Connected Graphs, Disconnected Graphs, and Components, Euler Graphs,Hamiltonian graphs(Definition,examples and without proofs)

Learning Outcomes:

After completion of this unit, student will be able to

- identify different types of paths and their properties (L3)
- construct Euler and Hamiltonian graphs (L3)

Unit-4: Trees (5 hrs)

Trees and their properties, spanning trees, minimal spanning trees,
Kruskal's algorithm for finding a minimal spanning tree,

Learning Outcomes:

After completion of this unit, student will be able to

- construct the spanning trees from graphs (L3)
- build minimal spanning tree by Kruskal's algorithms (L3)

Unit 5: Applications of Trees and Fundamental circuits (5 hrs)

Preorder, in order and post order traversals, Prefix and Postfix notations of an arithmetic expression, parsing trees.

Learning Outcomes:

After completion of this unit, student will be able to

- Identify tree traversals (L3)
- construct parsing trees for algebraic expressions (L3)

Text Book:

1. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 1997.
2. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2006.

Reference Book:

1. Bhishma Rao, Mathematical Foundations of Computer Science, SciTech Publications (India) Pvt Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and Applications, Seventh edition, Tata McGrawHill,2012.

Course Outcomes:

Upon successful completion of this course the student should be able to

- analyse the concepts in graph theory (L4)
- apply graph theory concepts in core subjects such as data structures and network theory effectively (L3)
- Identify different types of paths (L3)
- Construct minimum spanning tree using some algorithms (L3)
- Identify tree traversals (L3)
- Solve the graphical problems which are accessed in available software (L3)

MATH1061 - INTRODUCTION TO MATHEMATICS I

L	T	P	C
2	0	0	2

This course is designed to provide an introduction to the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Objectives:

- To explain the concepts of Trigonometry.
- To explain the basic concepts of differentiation and differential equations
- To teach the evaluation of definite and indefinite integrals.

Unit- I : **3 hrs**

Representations for Scalars, Vectors, Matrices and Tensors.
Coordinate systems: cartesian and polar coordinate systems.

Learning Outcomes:

At the end of this unit, the student will be able to

- Describe representational forms (L1)
- Understand the basis of coordinate systems (L1)

3 hrs

Unit- II : Trigonometry

Trigonometric functions, periodicity, trigonometric ratio of compound angles, multiple and sub multiple angles, transformations, brief introduction of inverse trigonometric, hyperbolic and inverse hyperbolic functions.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify trigonometric functions and their properties (L3)
- apply the trigonometric ratio techniques of compound angles, multiple and sub multiple angles in calculations (L3)
- find inverse trigonometric and hyperbolic functions (L3)

8 hrs

Unit- III : Differential Calculus

Limits and Continuity: Definition of right hand limit, left hand limit, standard limits

1) $\lim_{x \to a} \frac{x^n - a^n}{x - a}$ 2) $\lim_{\theta \to 0} \frac{\sin\theta}{\theta}$ 3) $\lim_{n \to 0} \left(1 + n\right)^{\frac{1}{n}}$ 4) $\lim_{x \to 0} \frac{e^x - 1}{x}$

5) $\lim_{x \to 0} \frac{a^x - 1}{x}$

(without proofs)**,** definition of continuity and simple illustrations.

Differentiation: Introduction, definition, differentiation of a function at a point and on an interval, derivative of a function, differentiation of sum, difference, product and quotient of functions, differentiation of algebraic, exponential, logarithmic functions, composite, implicit, parametric, hyperbolic, inverse hyperbolic functions, logarithmic differentiation, derivatives of first and second order.

Learning Outcomes:

After completing this unit, the student will be able to

- find derivative of sum, difference, product and quotient of functions (L3)
- apply differentiation techniques in different forms of functions (L3)
- calculate the derivatives of simple functions (L4)

8 hrs

Unit IV: Integration

Indefinite Integrals: Integration as the inverse process of differentiation, standard forms, properties of integrals, integration by the method of substitution covering algebraic, trigonometric, exponential functions, integration by parts, logarithmic functions, inverse trigonometric functions.

Definite Integrals: Definition of a definite integral and its properties (without proof), formulae

$\int_0^{\pi/2} Sin^n\theta\, d\theta$, $\int_0^{\pi/2} \cos^n\theta\, d\theta$ $\int_0^{\pi/2} \cos^n\theta\, Sin^m\theta\, d\theta$

Of and (without proofs).

Learning Outcomes:

After completing this unit, the student will be able to

- find integrals of special functions (L3)
- apply partial fractions technique on evaluation of integrals of rational functions (L3)
- solve definite integrals in trigonometric functions (L3)
    - solve simple integrals (L3)
    - apply substitution and by parts techniques in evaluation of integrals (L3)
    - find logarithmic, inverse trigonometric functions (L3)

10 hrs

Unit V: Introduction to differential equations and Multivariable calculus

Linear first order differential equations with constant coefficients, linear second order differential equations with constant coefficients (Definitions only). Only basic concepts of Partial differentiation. Only basic concepts of Differential forms: gradient, divergence and curl. Introduction to line, surface and volume integrals (without problems) illustrated with Stokes, Gauss, and Green's theorems (Only statements).

Learning Outcomes:

- solve problems involving trigonometric functions (L3)
- understand the principles of differential and integral calculus (L3)
- solve first order linear differential equations with constant coefficients (L3)
- solve first order linear differential equations with constant coefficients (L3)
- understand the basic concepts of vector calculus (L1)

Course Outcomes:

After the completion of the course the student should be able to

- solve problems involving trigonometric functions (L3)
- understand the principles of differential and integral calculus (L3)
- solve first order linear differential equations with constant coefficients (L3)
- solve first order linear differential equations with constant coefficients (L3)
- understand the basic concepts of vector calculus (L1)

Text Books:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IA, IB & IIA, 2018.
2. NCERT class XI and XII (part 1) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S.Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

MATH1071 - INTRODUCTION TO MATHEMATICS II

L	T	P	C
2	0	0	2

This course is designed to provide an introduction to the mathematics required for basic physics, engineering mathematics, and introductory engineering courses.

Course Objectives:

- To describe the basic concepts of matrices
- To introduce complex numbers and their properties.
- To teach the technqiues based on partial fractions
- To explain the concepts of straight lines and circles

Unit I: Matrices **8hr**

Matrices, determinants, definition, types of matrices, algebra of matrices, properties of determinants of 2 X 2, 3 X 3 matrices, inverse of a matrix, solving simultaneous linear equations in two and three variables using matrix inverse method, Cramer's rule and Gauss Jordan method. Eigenvalues and Eigenvector of matrices.

Learning Outcomes:

At the end of this unit, the student will be able to

- find determinants of matrices (L3)
- apply crammer"s rule for solving linear equations (L3)
- find inverse of a matrix (L3)

Unit- II : Complex Numbers **6 hrs**

Complex number as an ordered pair of real numbers, representation of $z \equiv (a, b)$ in the form $(a + ib)$ conjugate complex numbers, modulus and amplitude of a complex number, geometrical representation of a complex number, Argand diagram.

Learning Outcomes:

- solve arithmetic problems involving complex numbers (L3)
- find the conjugate, modulus and amplitude of a complex number (L3)
- describe the relationship between a complex number and Argand plane (L3)

Unit III: Partial Fractions **6 hrs**

Introduction, resolving $g(x)$ into partial fractions when $g(x)$ contains non repeated linear factors, repeated linear factors, repeated and non-repeated irreducible quadratic factors.

Learning Outcomes:

After completing this unit, the student will be able to

- find a fractional function and resolve it into partial fractions (L3)
- make use of resolving techniques of repeated and non repeated linear factors (L3)
- apply this technique in evaluation of integrals (L3)

Unit IV: Co-ordinate Geometry **14 hrs**

Straight lines: Recapitulation of general equation of a straight line, forms of equation of a straight line: slope intercept form, intercept form, point -slope form, two point form, normal form $x \cos \alpha + y \sin \alpha = p$, point of intersection of two straight lines, line passing through the point of intersection of two given lines, condition for concurrency of three straight lines, angle between two intersecting lines, condition for perpendicularity and parallelism, length of the perpendicular from a point to a straight line, distance between two parallel lines (without proofs).

Circles: Equation of a circle, standard form, centre and radius, equation of a circle with a given line segment as diameter, equation of a circle through three non collinear points, parametric equations of a circle, position of a straight line in the plane of the circle.

3D Geometry: Equation of a plane, Intersection of two planes, Equation of a sphere in spherical and cartesian coordinates, Intersection of a plane and a sphere.

Learning Outcomes:

After completing this unit, the student will be able to

- identify the equation to straight line in different forms(L3)
- find the length of permutation from a point to a straight line(L3)
- find the equation of a circle passing through three non collinear points(L3)

Course Outcomes:

After the completion of the course the student should be able to

- describe the properties of matrices (L3)
- describe the properties of complex numbers (L3)
- illustrate straight line and circle properties(L3)

Text Books:

1. Text book for Intermediate Mathematics, Board of Intermediate Education, AP, Volumes IB, IIA & IIB, 2018.
2. NCERT class XI and XII (part 1 & 2) Mathematics text books.

References:

1. V. Venkateswara Rao, N. Krishna Murthy, B.V.S. Sharma, Intermediate Mathematics, S. Chand & Company Ltd., Volume I & II.
2. Chandrika Prasad, A first Course in Mathematics.
3. Text book for Intermediate Mathematics, Deepti Publications.

DIFFERENCE EQUATIONS

L T P C
2 0 0 2

Preamble: Difference equations is the study of equation which involves the difference of a discrete function. In this course, the student can form a difference equation, solving linear higher order difference equations using analytical techniques, simultaneous linear difference equations and also find the solution of linear higher order difference equations and simultaneous difference equations using Z-transforms.

Course Objectives:

1. Student is able to know how to find the order of a difference equation and complementary function of a difference equation.
2. Student is able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Student is able to know how to find Z-transforms a discrete function using properties and using to basic theorems.
4. Student is able to know how to find the inverse Z-transforms a function and also using convolution theorem.
5. Student is able to know how to find the solution of a difference equation using Z-transforms

UNIT-I: (Difference equations-I) (5 hrs)

Introduction, definition of order, and solution of difference equation, formation of difference equations, linear difference equations, complementary function, rule for finding complementary function.

Learning outcomes:

- Student will be able to know how to find the order of a difference equation and complementary function of a difference equation.

UNIT-II: (Difference equations-II) (5 hrs)

Particular integrals, Rule for finding particular integrals, simultaneous linear difference equations.

Learning outcomes:

- Student will be able to know how to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.

UNIT-III: (Z-transforms) (5 hrs)

Introduction, Definition, some standard Z-transforms, linear property, damping rule, Shifting U_n to the **right and to the left, Multiplication by n, two basic theorems.**

Learning outcomes:

Student will be able to know how to find Z-transforms a discrete function using properties and using to basic theorems.

UNIT-IV: (Inverse Z-transforms) (5 hrs)

Convergence of Z-transforms, evaluation of inverse Z-transforms, properties, convolution theorem.

Learning outcomes:

Student will be to know how to find the inverse Z-transforms a function and also using convolution theorem.

UNIT-V: (Applications of Z-transforms) (5 hrs)

Solving difference equations and simultaneous linear difference equations with constant coefficients by Z-transforms.

Learning outcomes:

Student will be able to know how to find the solution of a difference equation using Z-transforms.

Text Book:

1. "Higher Engineering Mathematics" by B.S. Grewal published by Khanna Publishers

Reference books:

1. Advanced Engineering mathematics by Irvin Kreyszig

Course Outcomes:

1. Able to find the order of a difference equation and complementary function of a difference equation.
2. Able to find the particular solution of a difference equation and also find the solutions of simultaneous linear difference equations.
3. Able to find Z-transforms a discrete function using properties and using to basic theorems.
4. Able to find the inverse Z-transforms a function and also using convolution theorem.
5. Able to find the solution of a difference equation using Z-transforms

NUMERICAL TECHNIQUES

L	T	P	C
2	0	0	2

Preamble
This course is designed to enhance problem solving skills of engineering students using a powerful problem-solving tool namely numerical Techniques. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

Course Objectives:

- To familiarize the students with numerical solutions of nonlinear and systems of linear equations.
- To get exposed to finite differences and interpolation.
- To demonstrate the numerical differentiation and integration.
- To explain the numerical solutions of ordinary differential equations

Unit-1: (6 hours)
Solution of algebraic and transcendental equations: Regula-falsi method and Newton-Raphson method. **Solution of linear system of equations**-Iterative methods: Gauss Jacobi method, Gauss Seidel method, and finding the eigenvalues of a matrix by Power method.
Learning Outcomes:
At the end of this unit, the student will be able to

- find approximate roots of an equation by using different numerical methods (L3).
- solve system of linear equations using various techniques (L3).
- find eigenvalues of a matrix (L3).

Unit-2: (5 hours)
Interpolation: Difference operators (shifting, delta, del) and difference tables, Newton's forward and backward interpolation formulae, Divided difference formula, and Lagrange's interpolation formula.
Learning Outcomes:
At the end of this unit, the student will be able to

- find a function using various methods (L3).

Unit-3: (5 hours)
Numerical Differentiation: Derivatives using forward, and backward difference formulae.
Numerical Integration: Trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule.
Learning Outcomes:
At the end of this unit, the student will be able to

- find differentiation of a function by using different numerical methods (L3)
- find integration of a function by using different numerical methods (L3)

Unit-4: (5 hours)

Numerical solutions of ordinary differential equations-1: Picard's method, Taylor's series method, Euler's method, and Modified Euler's method.

Learning Outcomes:

At the end of this unit, the student will be able to

- solve first order differential equation using various methods (L3).

Unit-5: (5 hours)

Numerical solutions of ordinary differential equations-2: Runge-Kutta method (second and fourth order), Predictor-Corrector methods-Adams-Bashforth and Milne's methods.

Learning Outcomes:

At the end of this unit, the student will be able to

- solve first order differential equation using predictor-corrector methods (L3).

Text Book(s):

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.

References:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5/e, New Age International(P) Limited, 2007.
2. S.S. Sastry, Introductory methods of Numerical Analysis,4/e,PHI Learning Publications,2009.
3. H.C Saxena, Finite Differences and Numerical Analysis, Chand and Company Pvt. Ltd., New Delhi.

Course Outcomes:

At the end of the course, the student will be able to

- analyze how root finding techniques can be used to solve practical engineering problems (L4).
- apply various interpolation techniques to solve practical problems (L3).
- apply numerical differentiation and integration whenever and wherever routine methods are not applicable (L3).
- solve differential equations using various numerical methods (L3).
- know the strengths and weaknesses of the various methods and be able to decide which ones are appropriate for a particular problem (L3)

OPERATIONS RESEARCH

L	T	P	C
2	0	0	2

Preamble:
Operations Research (OR), also known as management science, has become an indispensable tool in scientific management. Operations Research focuses on developing and analyzing strategic and tactical levels to aid in decision-making and decision-making on the operational level. The essential tools of OR are algorithms, procedures that create and improve solutions to a point at which optimal or, at least, satisfactory solutions have been found.

Course Objectives: This course is designed to:

- introduce the fundamentals of Operations Research to the students at the undergraduate level
- solve different types of optimization problems of various categories and applying modern methodologies in the area of optimization
- help students to develop a deep understanding of the classical and numerical optimization techniques and problem-solving capabilities

Unit – I **4 hours**

Linear Programming: Formulation of LPP, convex sets and their properties, slack and surplus variables, Basic solution, Basic feasible solution, non-degenerate and degenerate basic feasible solutions, optimal solution, General, Standard, and Canonical form of LPP.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the problem of linear programming problem (L2)
- understand the definitions of Basic solution(BS), Basic Feasible Solution(BFS), Non-degenerate BFS, Degenerate BFS, and optimal solution of LPP (L2)
- know convex sets and some essential theoretical concepts about convex sets (L2)
- writing standard and canonical forms of LPP (L3)

Unit – II **8 hours**

Simplex Method: Simplex method, Degeneracy in LPP, Artificial variables techniques-Two Phase method, Big M-method.

Learning Outcomes:

After completion of this unit, the student will be able to:

- prepare simplex table (L4)
- apply the simplex algorithm for finding the optimal solution of given LPP (L2)
- know the cases of existence of degeneracy in LPP (L4)
- solving LPP by artificial variable techniques like II-phase and Big M-methods (L3)

Unit – III **5 hours**

Duality: Duality in linear programming, primal-dual relationships, weak duality theorem, strong duality theorem, and dual simplex method.

Learning Outcomes:

After completion of this unit, the student will be able to:

- find the relation between primal and dual problems (L3)
- know the advantage of writing the dual problem (L4)
- apply dual simplex method (L2)
- know the properties of duality (L4)

Unit – IV **4 hours**

Integer Programming: Gomory's cutting plane method, Branch and Bound method for solving integer linear programming problems.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the problem of Integer programming problem (L2)
- apply the technique of cutting plane methods (L2)
- apply Gomory's cutting plane method to solve ILPP (L2)
- apply branch and bound method to solve ILPP (L2)

Unit – V **5 hours**

Sensitivity Analysis: Introduction to sensitivity analysis, variations in the price vector, variations in the requirement vector, addition of a new decision variable to the existing problem.

Learning Outcomes :

After completion of this unit, the student will be able to:

- understand the meaning of sensitivity analysis (L2)
- apply sensitivity analysis to find variations in price vector (L2)
- find variations in requirement vector (L3)
- find the extent to which an additional decision variable can be introduced to the problem (L3)

Course outcomes:

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

- understand the linear programming problem, its formation, and basic definitions of solutions
- understand the simplex method, which is a very efficient algorithm to solve a linear programming problem
- understand the dual primal relationship, properties of duality, and the dual simplex algorithm
- find integer solutions to LPP by cutting plane methods
- find variations in price and requirement vectors and retaining optimality

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

Reference Books:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009.

COMPLEX VARIABLES

L T P C
2 0 0 2

Preamble

This course is designed to familiarize the students with complex analysis, nature of a series, evaluation of integrals using Cauchy's theorem.

Course Objectives

- To explain the concept of complex functions and analytic functions.
- To explain the concept of conformal mapping.
- To explain the concept of Cauchy's theorem and residue theorem.
- To explain the convergence of series such as Taylor's and Laurent.
- To explain the concept of Cauchy's theorem and residue theorem.

MODULE – I **6 hours**

Functions of a Complex variable: Limit and continuity, Differentiation, Analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugates- applications to flow problems.

After completion of this unit student able to

- Identify continuous and differentiable complex functions (L3)
- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- give an account of the concepts of analytic function and harmonic function and to explain the role of the Cauchy-Riemann equations(L3).

Module - II **5 hours**

Geometrical representation of f(z) – Some standard transformations – Bilinear transformation - Conformal mappings. Special conformal transformations ($w = z^2$, $w= z+1/z$, $w = e^z$, $w= \cosh z$) .

Learning Outcomes:

After completion of this unit student able to

- To know the geometrical representation of an analytical functions(L2)
- explain the concept of conformal mapping, describe its relation to analytic functions, and know the mapping properties of the elementary functions(L3)

MODULE – III **5 hours**

Complex Integration: Integration of complex functions - Cauchy's theorem - Cauchy's integral formula.

Learning Outcomes:

After completion of this unit student able to

- define and evaluate complex contour integrals(L3);
- give an account of and use the Cauchy integral theorem, the Cauchy integral formula and some of their consequences(L3);

MODULE – IV **5 hours**

Series representation of analytic functions
convergent series of analytic functions, Laurent 's and Taylor series, zeros and singularities of an analytic function

Learning Outcomes:
After completion of this unit student able to

- analyze simple sequences and series of functions with respect to uniform convergence, describe the convergence properties of a power series, and determine the Taylor series or the Laurent series of an analytic function in a given region (L3);
- Determining the nature of the singularities and calculating residues (L2)

MODULE – V **5 hours**
Calculus of residues – Residue- Cauchy Residue theorem – Calculation of residues (All theorems without proof).

Learning Outcomes:
After completion of this unit student able to

- make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Text Book:

1. B.S.Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers, New Delhi, 2012.

Reference Books:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics Narosa Publishing House, New Delhi, 2014.
2. N. P. Bali and Manish Goyal, A Text Book of Engineering Mathematics, 8th Edition, Lakshmi Publications, New Delhi, 2012.

Course Outcomes

1. Make use of differentiation and integration of complex functions in engineering problems (L3)
2. Concept of conformal mappings (L3).
3. Use Cauchy's theorem and Cauchy's integral formula to evaluate the line integrals (L3)
4. Apply Taylor's and Laurent's series to expand complex functions and know about the convergence region (L3).
5. Evaluation of integrals using Residue theorem(L3).

NUMBER THEORY

L	T	P	C
2	0	0	2

PREAMBLE

This course is designed to explain the basics and applications of number theory for the students of Computer Science. The core courses of these branches encounter with concepts like prime factorization, modular arithmetic, and quadratic reciprocities in number theory. The first unit of the course provide a strong platform for such encounters and the other units focuses on applications of number theory.

Course Objectives

- To teach basic concepts of number theory focusing on Computational aspects.
- To teach the concepts of factorization of integers.
- To teach Format's theorem and quadratic residues.
- To explain Chines remainder theorem and Euclidean algorithm.
- To explain polynomial arithmetic.

Unit 1 **(5 hrs)**

Basic Concepts in Number Theory: Topics in elementary number theory, Divisibility, Greatest Common Divisor

Learning Outcomes:

After completion of this unit, student will be able to

- develop the basics of number theory: (L3)
- perceive the concept of divisibility: (L5)

Unit 2 **(5 hrs)**

Euclidean Algorithm, Factorization of integers, Congruence, Modular arithmetic**,** some applications to factorizing, finite fields

Learning Outcomes: After completion of this unit, student will be able to

- understand the basics modular arithmetic: (L3)
- know some concepts on factorization: (L5)

Unit 3 **(5 hrs)**

Quadratic residues, Fermat's theorem, Euler ϕ function, Cauchy 's theorem

Learning Outcomes:

After completion of this unit, student will be able to

- learn some theorems on number theory: (L3)
- perceive the concept of quadratic residues (L5)

Unit 4 **(5 hrs)**

Chinese Remainder theorem, Primality testing algorithm, Euclid's algorithm for integers

Learning Outcomes:

After completion of this unit, student will be able to

- learn some theorems on number theory: (L3)
- apply primality testing algorithm (L5)

Unit 5 **(5 hrs)**

Polynomial Arithmetic, Primitive roots, Legendre symbol, Jacobi symbol

Learning Outcomes:

After completion of this unit, student will be able to

- learn polynomial arithmetic: (L3)
- perceive the Legendre and Jacobi symbols (L5)

Text Book

1. Elementary Number Theory | 7th Edition by David Burton, Mc Graw Hill Education

References

1. Basic Number Theory by S.B. Malik,S. Chand publishers

LINEAR ALGEBRA

L	T	P	C
2	0	0	2

Preamble

This course is designed to gain knowledge in the concepts of Linear Algebra focusing on basics of matrices, vector spaces and singular value decomposition to understand the basic concepts of Linear Algebra in the applications of image processing and machine learning.

Course Objectives:

- To familiarize with theory of matrices and tools for solving system of linear equations
- To impart knowledge on Eigen values and Eigen vectors.
- To teach basic concepts of vector spaces and their properties.
- To explain the concepts of inner product spaces.
- To familiarize with concept of singular value decomposition and its applications.

Unit-1: Fundamentals of Matrices: (5 hours)

Introduction to Matrices and Rank of a matrix, Echelon form, solving system of linear equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- Reduce given matrices to Echelon form, (L3)
- solve the system of linear equations (L3)

Unit-2: Eigen values and Eigen vectors: (5 hours)

Eigen values and Eigen vectors, positive definite matrices, Linear dependence and Linear independence.

Learning Outcomes:

At the end of this unit, the student will be able to

- calculate Eigen values and Eigen vectors(L4)
- examine the definiteness of the matrix (L3)

Unit-3: Vector Spaces: **(6 hours)**

Vector space, linear combination of vectors, linear span, basis and dimension, linear Transformation.

Learning Outcomes:

At the end of this unit, the student will be able to

- examine whether a set of vectors form a basis(L3)
- analyze properties of a linear transformations(L4)

Unit-4: Inner Product Spaces (5 hours)

Inner Product Spaces, examples of inner product spaces, norm and length of a vector cauchy-schwarz's inequality.

Learning Outcomes:

At the end of this unit, the student will be able to

- understand an inner product(L3)
- apply Cauchy-Schwartz's inequality(L3)

Unit-V: **Singular value decomposition** **(5 hours)**

Singular values, computing singular value decomposition and Introduction to principal component analysis.

Learning Outcomes:

At the end of this unit, the student will be able to

- singular value decomposition and computing. (L4)
- understand singular value decomposition and principal Component analysis(L5).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal.
2. Linear Algebra, Schaum's Outline,4^{th} edition, Seymour Lipchutz,Marc Lipson

Reference Books:

1. Advanced Engineering Mathematics, 7th Edition, Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2nd Edition, Michael. D. Greenberg.
3. Introduction to linear algebra, 5th Edition, Gilbert Strang.
4. Applied Mathematics (Vol. I & II) , by P. N. Wartikar& J. N. Wartikar.
5. Digital Image Processing, R C Gonzalez and R E Woods.

Course Outcomes:

At the end of the course the student will be able to

- solve the system of linear equations (L3)
- calculate Eigen values and Eigen vectors(L4)
- Finding the basis(L4)
- learn Singular value decomposition and principal Component analysis (L5)

PROBABILITY THEORY AND RANDOM VARIABLES

L	T	P	C
2	0	0	2

Preamble

To expose the students to the basics of probability theory and random processes essential for their subsequent study of analog and digital communication.

Course Objectives:

- To know about various random life length models and their uses in finding the reliability of different electronic devices.
- To learn about basic properties and characteristics of various random processes with reference to signal and trunk processes.

Unit 1: Probability **5 hours**

Axioms of probability theory. Probability spaces. Joint and conditional probabilities. Bayes' Theorem- Independent events.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand events and how to assign probabilities to outcomes (L3)
- Solve applications involving probabilities (L4)

Unit 2: Random Variable **5 hours**

Random variables and random vectors. Distributions and densities. Independent random variables. Functions of one and two random variables.

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate moments and cumulative distribution functions for both discrete and continuous random variables (L3)
- characterize functions of random variables (L5)

Unit 3: Multiple Random Variables **6 hours**

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem.

Learning Outcomes:

At the end of this unit, the student will be able to

- describe conditional and independent events and conditional random variables (L3)
- describe independent events and independent random variables and their sums (L3)

Unit 4: Expected Value of a Function of Random Variables **6 hours**

Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

Learning Outcomes:

At the end of this unit, the student will be able to

- characterize jointly multiple discrete and continuous random variables (L5)

- describe N Random variables independent events and independent random variables and their sums (L3)
- characterize jointly multiple discrete and continuous random variables (L5)

Unit 5: Random Process **6 hours**

Temporal characteristics - the random process concept, stationarity and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Learning Outcomes:

At the end of this unit, the student will be able to

- explain basic concepts of a random process, calculate the mean, variance, autocorrelation, and power spectral density of a stationary random process (L3)
- apply the knowledge of random variables in real life situations (L5)

Text Book(s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

Course Learning Outcomes:

Upon successful completion of this course, the student should be able to

- Analyze the outcomes of random experiments and develop the concept of random variables and obtain probabilities through them (L3)
- define single random variables in terms of their PDF and CDF, and calculate moments such as the mean and variance (L3)
- explore the random experiments specified by multiple random variables and study the Distribution of them (L4)
- apply the fundamentals of probability theory and random processes to practical engineering problems, and identify and interpret the key parameters that underlie the random nature of the problems (L5)

RANDOM PROCESSES

L	T	P	C
2	0	0	2

Preamble

This course is designed to impart knowledge on random processes needed in applications such as signal processing, digital communications, speech processing, data modelling, etc.

Course Objectives:

1. To familiarize the students in the concepts of probability and random variables.
2. To study Random Processes, its types, distribution, and density functions.
3. To study Gaussian and Poisson processes.
4. To apply random process to signal processing in communication systems.
5. To apply skills in analysing random phenomena which occur in Electrical and Electronics Engineering applications.

Unit-1: Random Processes: (6 hours)

Temporal characteristics - the random processes concept, Classification of random processes, stationarity and statistical independence. Time averages and Ergodicity.

Learning Outcomes:

At the end of this unit, the student will be able to:

- solve the problems on multiple random variables, joint distribution and statistical independence, (L1)
- understand the classifications of random processes and concepts such as strict stationarity, wide-sense stationarity (L2)
- apply the concept on time averages and ergodicity (L3)

Unit-2: Correlation and Covariance functions: (5 hours)

Auto correlation, Cross correlation, Properties. Covariance functions. Gaussian random processes, Poisson random processes:

Learning Outcomes:

At the end of this unit, the student will be able to:

- know the definition of auto correlation and its application(L1)
- to understand about the correlation functions(L2)
- demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models (L2)

Unit-3: Density functions : (5 hours)

Probability density and joint probability density functions, Properties.

Learning Outcomes:

At the end of this unit, the student will be able to:

- know about joint probability density functions and its applications (L1)
- apply concept of joint density functions in random process (L3)
- apply the probability models and function of random variables based on single & multiple random variables (L3)

Unit-4:Spectral densities functions - I : (5 hours)

Spectral characteristics, the power density spectrum: Properties, relationship between power density spectrum and autocorrelation function

Learning Outcomes:

At the end of this unit, the student will be able to:

- understand the concept of power density functions (L2)
- apply substitution to compute power density function properties (L3)
- apply the concepts of power density functions and auto correlation (L3)

Unit-5 Spectral densities functions-II : (5 hours)

Cross-power density spectrum, Properties, relationship between cross power spectrum and cross-correlation function.

Learning Outcomes:

At the end of this unit, the student will be able to:

- develop an appreciation of the role of random processes in system modelling (L1)
- apply the concepts of filtering and prediction of a random process (L3)
- apply the specialised knowledge in random processes to solve practical engineering problems. (L3)

Course Outcomes:

At the end of the course, the student will be able to:

- solve the problems on multiple random variables, joint distribution and independence
- solve the problems Gaussian and Poisson processes
- understand the concept of random processes and determine covariance and spectral density of stationary random processes
- characterize the random signals in communication systems with their autocorrelation and power spectral density functions

Textbook (s)

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.

References

1. Athanasios Papoulis, S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.
2. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
3. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

OPTIMIZATION METHODS

L	T	P	C
2	0	0	2

Preamble:

Optimization is the art of finding the best result under given conditions. In this fast-expanding world, an engineer has to use many Optimization methods, as it is the most significant in decision-making, design, manufacturing, maintenance, planning, and scheduling.

Course Objectives: This course is designed to:

- introduce various optimization methods for solving real-world problems
- find optimal solutions to transportation, assignment, and sequencing problems
- know project planning and scheduling
- study the network analysis techniques through CPM and PERT

Unit – I **6 hours**

Transportation Problem: Introduction and LP formulation of Transportation Problem, feasible solution, basic feasible solution, finding Initial basic feasible solutions by North West corner rule, Least-cost entry method, Vogel's approximation method, Transportation Algorithm (MODI Method) to find an optimal solution.

Learning Outcomes:

After completion of this unit, the student will be able to:

- understand the problem of transportation problem (L2)
- find initial BFS by various methods (L3)
- apply MODI method for finding optimal transportation cost (L3)

Unit – II **5 hours**

Assignment Problems: Introduction to Assignment Problem, Mathematical formulation, Hungarian Method for finding optimal solution, unbalanced assignment problem, Travelling Salesman Problem.

After completion of this unit, the student will be able to:

- understand the problem of assignment problem(L2)
- apply the technique of solving the assignment problem using the Hungarian Method (L3)
- find an optimal solution to unbalanced assignment problem (L3)
- find the optimal route for the salesman (L3)

Unit – III **4 hours**

Sequencing Problem: Introduction, Basic terminology, Algorithms to obtain optimal solutions for sequencing problems with n jobs and two machines and n jobs and k machines.

Learning Outcomes:

After completion of this unit, the student will be able to:

- find optimal job sequencing (L3)
- find the optimal sequence for processing n jobs through two machines (L3)
- convert k machine problem into two machine problem (L4)
- find the optimal sequence for processing n jobs through k machines (L3)

Unit – IV **4 hours**

Network Analysis in Project planning: Project, Project Planning, Project Scheduling, Project Controlling, Work breakdown structure, Network Techniques, terms used in network-activity, event, path, network, dummy activity, looping, Fulkerson's rule, network diagram, and activity on node diagram.

Learning Outcomes :

By the end of this unit, the student will be able to:

- understand the problem of network models (L2)
- know the terms activity, node, labeling (L3)
- know the rules to draw the network diagram (L3)
- construct network diagram (L2)

Unit – V **7 hours**

PERT and CPM: Critical path method (CPM), Measure of activity, Critical path analysis, the four floats, subcritical and supercritical activities, slack, Programme evaluation and review technique (PERT), time estimates, frequency distribution curve for PERT

Learning Outcomes:

After completion of this unit, the student will be able to:

- know the technique of Critical Path Method (CPM) (L3)
- know the technique of PERT (L3)
- find time estimates (L3)
- estimate the probability of completing the project (L2)

Course outcomes:

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

- apply MODI method for finding optimal transportation cost
- apply Hungarian Method for solving assignment problems and finding an optimal route to the salesman
- understand the process of finding optimal sequencing for processing jobs on machines
- understand the network terminology and construction
- apply CPM and PERT techniques for project management

Text Books:

1. Operations Research by S.D.Sarma, Kedarnath, Ramnath and company, 15th edition, 2008.
2. Operations Research An Introduction by Hamdy A. Taha, 8th edition, Pearson, 2007.

Reference Books:

1. Linear Programming by R K Gupta, Krishna Prakashan Mandir, 13th edition 2014.
2. Operations Research Theory and Applications by J K Sharma, 4th edition, Macmillan Publishers India Ltd, 2009.

COMPUTATIONAL METHODS

L T P C
3 0 0 3

Preamble:
It is designed for the students for the basic understanding of techniques for numerical solution of algebraic equations, differentiation, integration used to solve engineering application problems.

Course Objectives:

- Develop the mathematical skills in the areas of numerical methods.
- Focus on the theory and applications of numerical methods in many engineering subjects which require solutions of linear systems, finding eigenvalues, eigenvectors, interpolation, and applications, solving ODEs, PDEs.
- Help in the foundation of computational mathematics for postgraduate courses, specialized studies, and research.
- Train in developing the codes for implementing the numerical methods using any programming languages.
- Formulate a mathematical model for a given engineering problem

UNIT I 9 hours

Mathematical Modeling of Engineering Problems:
Approximations: Accuracy and precision, round-off and truncation errors, error problem with example problems. **Roots of Equations:** Formulations of linear and non-linear algebraic equations, solution with bisection, Newton-Raphson and Secant methods. Application to practical problems. **Algebraic Equations**: Formulation of linear algebraic equations from engineering problems, solution of these problems by Gauss elimination method, pitfalls of elimination and techniques for improving the solutions, Gauss Seidel iteration for solving sparse equations by avoiding storage of zero coefficients in matrix, convergence of iteration methods. LU decomposition methods for symmetric (Chelosky) matrices.

Learning Outcomes:

After completion of this unit the student will be able to

- Find the root for linear and non-linear algebraic equations by using iterative methods. (l1)
- Estimate the true error and approximate error between the iterations of the mathematical procedure. (l5)
- Formulate system of linear equations from engineering problem and solve using any of the numerical procedure(l6)

UNIT II 9 hours

Eigenvalues and Eigenvectors Problems: Formulation of equations to column, truss, spring-mass and friction problems. Solutions for the largest and smallest eigenvalues and corresponding eigenvectors. **Interpolation Methods:** Polynomial interpolation, Lagrange

interpolation polynomials with equi- spaced data. **Regression or Curve Fitting:** Linear regression by least squares method.

Learning Outcomes:

After completion of this unit the student will be able to

- Interpolate a polynomial with any given data(L4)
- Fit a curve using linear regression(L3)
- Calculate Eigenvalues and corresponding Eigenvectors for a given system of equations.(L3)

UNIT III **8 hours**

Initial Value Problems: Ordinary differential equations, Euler, Heun's and Ralston methods. Runge- Kutta method of 2nd and 4th order, application to vibration and heat transfer problems. **Boundary Value Problems:** Linear and nonlinear ordinary differential equations, boundary value problems over semi-infinite domain, solution of nonlinear equations by finite difference method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve ODE's with R-K 2^{nd} and 4^{th} order methods. (L3)
- Interpret the boundary conditions for initial value and boundary value problems. (L2)
- Appreciate the merits of various numerical methods for solving ODE's.(L5)

UNIT IV **8 hours**

Laplace Equations: Finite difference discretization of computational domain, different types of boundary conditions, solution to elliptic equations. **Parabolic Transient Diffusion Equations:** Explicit and implicit formulation, Crank Nicolson Method.

Learning Outcomes:

After completion of this unit the student will be able to

- Classify the given partial differential equation.(l2)
- Discretize the given domain by finite difference method for both elliptic and parabolic pde's. (l3)
- Apply the boundary conditions for any given problem satisfying the physics of the problem.(l2)

UNIT V **8 hours**

Numerical Integration: Trapezoidal, Simpson's 1/3 and 3/8 rule and Gauss quadrature method.

Learning Outcomes:

After completion of this unit the student will be able to

- Solve the integration problem by using numerical methods. (l3)
- Understand the application of simpson's $1/3^{rd}$ and $3/8^{th}$ methods.(l2)

List of Computational Exercises:

1. Determine the real root for a given polynomial equation by (i) Bisection, (ii) Newton-Raphson until the approximate error falls below 0.5%.
2. Solve the system of simultaneous linear equations by

(i) Naïve -Gauss elimination
(ii) Gaussian elimination with partial pivoting
(iii) Gauss -Seidal method.
(iv) LU decomposition

3. Implement power method to find Eigenvalues and Eigenvectors for Spring mass system
4. Solve the parabolic partial differential equations by using explicit, implicit and semi-implicit methods
5. Solve the elliptic partial differential equations by finite difference techniques.
6. Finding the integral for a second-order polynomial using Gauss quadrature formula.
7. Solve numerical differentiation problems using Runge-Kutta 2^{nd} and 4^{th} order methods.
8. Find the integral by numerical methods such as Trapezoidal and Simpson's rule.

Course Outcomes:

At the end of the course, the student will be able to:

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.
- Implement numerical methods using any programming language (matlab, scilab, python…)
- Write efficient, well-documented code and present numerical results in an informative way.

Text Book(s)

1. S.P. Venkateshan, P. Swaminathan, Computational Methods in Engineering, 1/e, Ane Publisher, 2014.
2. S.C. Chapra, R.P. Canale, Numerical Methods for Engineers, 6/e, Tata McGraw-Hill, 2012.

Reference

1. S.K. Gupta, Numerical Methods for Engineers, 1/e, New Age International, 2005.

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

At the end of this unit, the student will be able to

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

MECH1011: ENGINEERING VISUALIZATION AND PRODUCT REALIZATION

L	T	P	C
0	0	4	2

The course enables the students to convey the ideas and information graphically that come across in engineering. This course includes projections of lines, planes, solids sectional views, and utility of drafting and modelling packages in orthographic and isometric drawings.

Course Objectives

- Create awareness of the engineering drawing as the language of engineers.
- Familiarize how industry communicates, practices for accuracy in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Train in 2D and 3D modeling softwares.
- Teach assembly of simple components and their animation.
- Teach basic 3D printing software for preparation of simple components

Manual Drawing: (8 P hours)

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions. Dimensioning, sectioning and datum planes

Free hand sketching (4 P hours)

Free hand sketching of isometric & orthographic views and interpretation of drawings.

Computer Aided Drafting (12 P hours)

Introduction to CAD software: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

Assemble drawings (12 P hours)

Constraints and assembly drawings. Engineering animation including motion curves, coordinating multiple moving parts under joint-constraints and the notion and impact of lighting and camera.

3D printing (8 P hours)

introduction to 3D printing software. slicing, grading and rendering of simple geometries using software

Project by group of students in the following themes (12 P hours)

IC engine model and 3D printed mini model
Belt drive for a bike
Four-wheel drivable ATV robot
Toy making - Carrom board, chess board & pieces model toy train, avengers
Buildings, bridges dams etc.
Wind turbine model
Design of Programmable Intelligent Controllers – PIC
Design of Printed Circuit Boards
Arduino Board Design and 3D Printing of Enclosures for Arduino Boards
Design of Radar and 3D Printing of Radar Models
Design of Mini Motherboards

Course Outcomes

After completing the course, the student will be able to

- utilize Engineering visualization as Language of Engineers. (L3)
- prepare drawings as per international standards. (L3)
- create 2D and 3D models using CAD packages. (L3)
- use 3D printing software and create model for printing of simple objects

MECH1021: WORKSHOP

L	T	P	C
0	0	4	2

This course enables the students to familiarize with the basic fabrication practices and to explore the various devices, tools and equipment used. Hands-on exercise is provided in various trade sections. Essentially student should understand the labor involved, machinery or equipment necessary, time required to fabricate and should be able to estimate the cost of the product or job work which are fundamental tasks for engineering plans.

Course Objectives

- Explain tools used in carpentry, fitting and sheet metal and practice procedure of doing experiments.
- Make the students to learn types of basic electric circuit connections and PCBs.
- Provide training to prepare FRP composites.
- Train the students on preparing 3D plastics using injection molding.
- Demonstrate on utilizing 3D printer for printing 3D objects

List of Jobs

1. Wood Working - Cross halving Joint/Dove Tail Joint/End Bridle Joint (Any two)
2. Sheet Metal working - Taper tray/conical funnel/Elbow pipe (Any Two) (including soldering).
3. Fitting- V fit/Dove Tail fit/ Semicircular fit (Any Two)
4. Electrical Wiring -Parallel and series connection
5. Electrical Wiring -Two-way switch connection
6. Electrical Wiring- Wiring of lighting systems
7. Injection molding-Make any two plastic components using injection molding machine.
8. 3D printing Demonstartion

Text Books

1. P. Kannaiah, K. L. Narayana, 'Workshop Manual', 2/e, Scitech Publications, India, 2007.
2. B. L Juneja , 'Workshop Practice ', 1/e, Cengage Learning ,Delhi, 2015

Additional Reading

1. K Mallick, 'Fiber-Reinforced Composites: Materials, Manufacturing, and Design', 3/e, CBC Press, New York, 2007.

Course Outcomes:

After completion of this lab the student will be able to

- Summarize application of different power tools (L1)
- Develop different parts with metal sheet/wood working/fits in real time applications. (L3)
- Demonstrate electrical circuits in various applications. (L2)
- Prepare models using injection molding m/c . (L3)
- Familiarize with 3D printer operations (L1)

MECH1031: DESIGN THINKING

L	T	P	J	S	C
0	0	2	0	0	1.0

Course Pre-requisite(s):Engineering Visualization and Product Realization

Design is a realization of a concept or idea into a configuration, drawing or product. Design Thinking is the cognitive and practical process by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end-user. This course introduces design thinking in product innovation.

Course Objectives

1. To familiarize the product design process
2. To introduce the basics of design thinking
3. To bring awareness on idea generation
4. To familiarize the role of design thinking in services design

Topic	Type
Each member of the group has to ask (vocally) the group members different questions about a product that they would like to design. Write down the questions and answers and submit as a word or pdf document.	Exercise
Each member of the group must ask (vocally) the group members questions about the product chosen in the previous experiment. This helps to gain indepth insights as well as new findings and information in order to grasp the problem or situation holistically or simply to find relevant questions for an interview. Write down the questions and answers and submit as a word or pdf document	Exercise
Identify relevant factors of influence that constitute the basis for a new or improved product or offer; then analyze it in a targeted manner. ➢ Make sure that you are sufficiently creative in the analysis process, because the focus is on technical “details”. ➢ Boost the efficiency of the analysis process by avoiding empty runs. ➢ Make use of a standardized procedure in order to examine the problem and solution space again with the help of data.	Exercise
➢ Do research, talk with people, and have empathy to formulate profound stories. ➢ Summarize the results from the “understand” and “observe” phases and discuss with the team. ➢ Highlight unexpected results and generate new perspectives. ➢ In general, share insights, ideas, and results (solutions) with others.	Exercise
➢ Explore untapped market opportunities. ➢ Provide differentiated and new offers based on the user needs. ➢ Adapt a strategy to new market needs by understanding the competitive edge. ➢ Establish the right vision for the design challenge or a road map for stepby-step implementation and control mechanisms.	Exercise
➢ Find out at an early stage whether the basic need is satisfied and the product attracts interest on the market. ➢ Find out through iterative testing whether the user need is met with a minimally functional product and how the product should be enhanced. ➢ Find out through user feedback how much demand there is for the product before developing further details and features. ➢ Minimize the risk of investing in a solution for which there is little demand on the market, thus saving time, money, and energy.	Exercise

➢ Perform a true A/B test or several variants of a prototype in the form of a multi-variants test or as split testing. ➢ Do a quantitative evaluation. ➢ Carry out a qualitative survey and evaluate the number and content of feedbacks. ➢ Compare individual variants of a function or a prototype (e.g. buttons, visuals, arrangement).	Exercise
➢ Collect and appraise experiences made in the project in a structured manner. ➢ Learn from experience and make use of it in the next project. ➢ Facilitate a positive attitude toward mistakes and appreciate progress. ➢ Identify and document the findings; make them applicable and usable.	Exercise
Case Studies : Example : Software Prototyping, Additive Manufacturing; Design of Arduino Boards for various applications etc	Exercise

Texbook(s)	**Topics**
1. Pahl, Beitz, Feldhusen, Grote,'Engineering Design: a systematic approach',3rd,Springer Science & Business Media,London,2007,978-1846283185	All Exercises
2. Christoph Meinel,Larry Leifer,Hasso Plattner,'Design Thinking Understand – Improve – Apply',1st,Springer,Berlin, Heidelberg,2011,978-3-642-13756-3	All Exercises

Additional Reading(s)	**Topics**
1. Marc Stickdorn, Jakob Schneider,'This is Service Design Thinking: Basics, Tools, Cases',1st,WILEY,United States,2012,978-1-118-15630-8	All Exercises

Journal(s)	**Topics**

Website(s)	**Topics**

Course Outcomes(COs)

1 Innovate new methods in product development
2 2 Apply Design Thinking in developing the new designs
3 Select ideas from ideation methods in new product development
4 Use Design Thinking in developing software products
5 Apply principles of Design Thinking in service design

CSEN1011 - PROBLEM SOLVING AND PROGRAMMING WITH C

L	T	P	C
0	0	6	3

The course is designed to enable the student to write programs for problem solving. After an introduction to program logic design using algorithms and flowcharts, converting the logic into programs is taught. The features of structured programming are explained with the C programming language as an example. This course lays the foundation both for developing program logic and for writing programs in C according to the developed logic.

Course Objectives:

1. Familiarize the student with the steps involved in writing and running a compiled program.
2. Enable the student to build program logic with algorithms and flowcharts.
3. Explain with the features and constructs of C programming such as data types, expressions, loops, functions, arrays, pointers, and files.
4. Demonstrate the handling of variables and input-output operations in C.
5. Train the student to convert program logic into C language code using a top-down approach.

Module I: Introduction to Computer Problem-Solving 12 P

Introduction, the Problem-Solving Aspect, Top-Down Design, Introduction to the idea of an algorithm, Introduction to Flowchart using Raptor tool.

Introduction to C Language – Structure of a C Program, Keywords, Identifiers, Data Types (int, float, char, unsigned int) and Variable declaration, Constants, Input / Output function. Operators, Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.

Exercises: Construct a flowchart and write a program to

- Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
- Calculate simple and compound interest for various parameters specified by the user
- To enter marks of five subjects and calculate total, average and percentage.
- Calculate net salary of employee given basic,da,hra,pf and lic
- retrieve remainder after division of two numbers without using mod operator
- Convert an upper-case character to a lower-case character.
- Swap two numbers
- Enter two angles of a triangle and find the third angle.
- Check Least Significant Bit (LSB) of a number
- Input any number from user and check whether nth bit of the given number is set (1) or not (0)(hint: Use bitwise operators)

Learning Outcomes

After completion of this unit the student will be able to

- Develop algorithms and basic flowcharts for performing Input, Output and Computations (L3)
- Interpret the structure of C program and various key features of C (L2)
- Translate mathematical expressions to C notation using operators (L2).

Module II: Control Structures 15 P

- **Control Structures:** Selection Statements (making decisions) – if, if-else, nested if, else if ladder and switch statements. Repetition statements (loops)-while, for, do-while statements, Nested Loops.
- Unconditional statements-break, continue, goto.
- Pointers – Pointer variable, pointer declaration, Initialization of pointer, accessing variables through pointers, pointers to pointers, pointers to void.

Exercises: Construct a Flowchart and Write a Program to

- Check whether the triangle is equilateral, isosceles, or scalene triangle.
- Check whether entered year is a leap year or not
- Find minimum among three numbers.
- Check whether a number is divisible by 5 and 11 or not.
- Check whether a number is positive, negative or zero using switch case.
- Design a calculator that performs arithmetic operations on two numbers using switch case
- Find Roots of a Quadratic Equation
- Find factorial of a number
- Check whether number is a palindrome or not
- Check whether number is perfect or not
- Convert a decimal number to binary number
- To find the sum of the series [1-X^2/2!+X^4/4!- .....].
- Print following patterns

```
*
*
* *
* * *
* * * *
```

```
A
B B
C CC
D D D D
E E E EE
```

```
1
2 3
4 5 6
7 8 9 10
```

- Calculate the greatest common divisor of two numbers
- Generate first n numbers in the Fibonacci series
- Generate n prime numbers
- Swap two numbers using pointers.
- Performs all the five arithmetic operations using Pointers.

Learning Outcomes:

After completion of this unit the student will be able to

- Construct C programs using various conditional statements (L3).

- Develop C programs using loops and nested loops (L6).
- Demonstrate the usage of pointers (L3).

Module III: Functions 15 P

Functions-Designing Structured Programs, user defined function- function definition, function prototype, function call, Types of functions. Parameter Passing by value, parameter passing by address, Recursive functions. Dynamic Memory allocation Functions, pointers to functions. Storage classes-auto, register, static, extern.

Exercises: Write a program using functions to

- Print even and odd numbers in a given range
- Find power of a number
- Return maximum of given two numbers
- To print all strong numbers between given interval using functions.
- Check whether a number is prime, Armstrong or perfect number using functions.
- Demonstrate call by value and call by reference mechanisms.
- Find power of any number using recursion.
- Generate Fibonacci series using recursion
- Find product of two numbers using recursion
- Find the sum of digits of a number. Number must be passed to a function using pointers.
- Find GCD (HCF) of two numbers using recursion.
- Find LCM of two numbers using recursion.

Learning Outcomes:

After completion of this unit the student will be able to

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- infer the effect of storage classes on variables (L2).

Module IV: Arrays and Strings 15 P

Arrays – Declaration and Definition of Array, accessing elements in array, Storing values in array, linear search, binary search, bubble sort, Two – dimensional arrays, multidimensional arrays. Arrays and Pointers, Pointer Arithmetic and arrays, array of pointers, Passing array to function. Strings – Declaration and Definition of String, String Initialization, unformatted I/O functions, arrays of strings, string manipulation functions, string and pointers.

Exercises: Write a program to

- Find minimum and maximum element in an array
- Implement linear search.
- Sort an array in descending order.
- Given a two-dimensional array of integers and a row index, return the largest element in that row.
- Find transpose of a matrix.
- Perform multiplication of two matrices
- Count total number of vowels and consonants in a string.
- Reverse the given string without using String handling functions.
- Sort strings in dictionary order

- To perform addition of two matrices.
- Read an array of elements of size ‘n’ and find the largest and smallest number using functions
- find total number of alphabets, digits or special character in a string using function

Learning Outcomes:

After completion of this unit the student will be able to

- develop programs for storing and managing collections of items using arrays (L3).
- make use of the in-built functions to manipulate strings (L3).
- solve problems related to arrays and strings (L3).

Module V: Structures and Files 15 P

Structures–Declaration, initialization, accessing structures, operations on structures, structures containing arrays, structures containing pointers, nested structures, self-referential structures, arrays of structures, structures and functions, structures and pointers, unions.

Files – Concept of a file, Opening and Closing files, file input / output functions (standard library input / output functions for text files)

Exercises: Write a program to

- Store information of a student using structure
- Add two complex numbers by passing structures to a function
- Store information of 10 students using structures
- Store Employee information using nested structure
- Read file contents and display on console.
- Read numbers from a file and write even and odd numbers to separate file.
- Count characters, words and lines in a text file.

Learning Outcomes:

After completion of this unit, the student will be able to:

- develop programs using structures and unions for storing dissimilar data items (L6).
- compare the utilization of memory by structures and unions (L5).
- make use of files and file operations to store and retrieve data (L3).

Text Books(s)

1. B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning

Reference Book(s)

1. Jeri R Hanly, Elliot B Koffman, Problem Solving and Program Design in C, 7/e, Pearson Education, 2012.
2. B.W. Kernighan and Dennis M. Ritchie, The C Programming Language, 2/E, Pearson education, 2015.
3. B. Gottfried, Programming with C, 3/e, Schaum’s outlines, McGraw Hill (India), 2017.
4. P. Dey and M Ghosh, Programming in C, 2/e, Oxford University Press, 2011.

Course Outcomes:

After completion of this course the student will be able to

- Build logic for solving a problem and translate it into a program. (L3).
- Define variables and construct expressions using C language (L1).
- Utilize arrays, structures and unions for storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

Additional Exercises:

- Given numbers x, y, and target, return whichever of x and y is closer to the target. If they have the same distance, return the smaller of the two
- There are three friends Ram, Raheem and Robert. Ram's age is 20, Raheem is aged three times more than his friend Ram. After 8 years, he would be two and a half times of Ram's age. After further 8 years, how many times would he be of Rams age? Robert's age is 25 now. Now program your computer to determine the final ages of all the three people after 16 years and also show who is elder.
- Given an actual time and an alarm clock time, both in "military" format (such as 0730 for 7:30am), print how many more minutes before the alarm rings. But if the time is after the alarm, print "Alarm already went off".
- Let there be a scenario where you and your friend are going to a restaurant. You have lunch there every fourth day, and he has his lunch there every sixth day. How many days before you meet again for lunch at the same restaurant?
- Two friends Suresh and Ramesh have **m** red candies and **n** green candies respectively. They want to arrange the candies in such a way that each row contains equal number of candies and also each row should have only red candies or green candies. Help them to arrange the candies in such a way that there are maximum number of candies in each row.
- On a chessboard, positions are marked with a letter between a and h for the column and a number between 1 and 8 for the row. Given two position strings, return true if they have the same colour.
- Given two strings s0 and s1, return whether they are anagrams of each other.
- Write a program to encrypt and decrypt a password which is alphanumeric
- Given a string, return the string with the first and second half swapped. If the string has odd length, leave the middle character in place.
- Given an array of integers, return the second-largest element.
- Given lists of integers people, jobs, profits. Each person i in people have people[i] amount of strength, and performing job j requires jobs[j] amount of strength and nets profits[j] amount of profit. Given that each person can perform at most one job, although a job can be assigned to more than one person, return the maximum amount of profit that can be attained.
- Mr. Roxy has arranged a party at his house on the New Year's Eve. He has invited all his friends - both men and women (men in more number). Your task is to generate the number of ways in which the invitees stand in a line so that no two women stand next to each other. Note that the number of men is more than the number of women and Roxy doesn't invite more than 20 guests. If there are more than 20 guests or an arrangement as per the given constraints is not possible, print 'invalid'.
- Two friends have entered their date of birth and they want to know who is elder among them. Make a structure named Date to store the elements day, month and year to store the dates.

Case Study:

- Create a structure containing book information like accession number, name of author, book title and flag to know whether book is issued or not. Create a menu in which the following functions can be done: Display book information, Add a new book, Display all the books in the library of a particular author, Display the number of books of a particular title, Display the total number of books in the library, Issue a book (If we issue a book, then its number gets decreased by 1 and if we add a book, its number gets increased by 1)
- Ranjan is maintaining a store. Whenever a customer purchases from the store, a bill is generated. Record the customer name, amount due, the amount paid, mobile number with purchased items in file. At the end of day print the total income generated by store.
- Contact Management System- Create structure to store Contact information like name,gender,mail,phone number and address. Users can add new contact and can also edit and delete existing contact. (Hint: Use Files to store data)

CSEN1021 - PROGRAMMING WITH PYTHON

L	T	P	C
0	0	6	3

Course Objectives:

- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Python solution patterns

Module I: Introduction to Python 12 H

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/output statements, Conditional If, while and for loops.

Exercises:

- Accept input from user and store it in variable and print the value.
- Use of print statements and use of (.format)for printing different data types.
- Take 2 numbers as user input and add, multiply, divide, subtract, remainder and print the output (Same operations on floating point input as well)
- Conversion of one unit to another (such as hours to minutes, miles to km and etc)
- Usage of mathematical functions in python like math.ceil, floor, fabs, fmod, trunc, pow, sqrt etc.
- Building a mathematical calculator that can perform operations according to user input. Use decision making statement.
- Accepting 5 different subject marks from user and displaying the grade of the student.
- Printing all even numbers, odd numbers, count of even numbers, count of odd numbers within a given range.
    - Compute the factorial of a given number. b) Compute GCD of two given numbers. c) Generate Fibonacci series up to N numbers.
- Check whether the given input is a) palindrome b) strong c) perfect
- Compute compound interest using loop for a certain principal and interest amount

Learning Outcomes:

After completion of this unit the student will be able to

- solve simple problems using control structures, input and output statements. (L3)
- develop user defined functions (recursive and non-recursive). (L3)

Module II: Functions **15H**

User defined Functions, parameters to functions, recursive functions. Lists, Tuples, Dictionaries, Strings.

Exercises:

- Create a function which accepts two inputs from the user and compute ${}^{n}C_{r}$
- Recursive function to compute GCD of 2 numbers
- Recursive function to find product of two numbers
- Recursive function to generate Fibonacci series
- Program to print a specified list after removing the 0th, 4th and 5th elements. Sample List : ['Red', 'Green', 'White', 'Black', 'Pink', 'Yellow'] Expected Output : ['Green', 'White', 'Black']
- Program to get the difference between the two lists.
- Program to find the second smallest number and second largest number in a list.
- Given a list of numbers of list, write a Python program to create a list of tuples having first element as the number and second element as the square of the number.
- Given list of tuples, remove all the tuples with length K.
  Input : test_list = [(4, 5), (4,), (8, 6, 7), (1,), (3, 4, 6, 7)], K = 2
  Output : [(4,), (8, 6, 7), (1,), (3, 4, 6, 7)]
  Explanation : (4, 5) of len = 2 is removed.
- Program to generate and print a dictionary that contains a number (between 1 and n) in the form (x, x*x).
  Sample Input: (n=5) :
  Expected Output : {1: 1, 2: 4, 3: 9, 4: 16, 5: 25}
- Program to remove a key from a dictionary
- Program to get the maximum and minimum value in a dictionary.
- Program to perform operations on string using unicodes ,splitting of string,accessing elements of string using locations
- Program for Counting occurrence of a certain element in a string, getting indexes that have matching elements.For ex -.In Rabbit count how many times b has occurred . Example-I have to go to a doctor and get myself checked. Count the number of occurrences of ‘to’.
- Program for replacing one substring by another For example - Rabbit - Replace ‘bb’ by ‘cc’
- Program to Acronym generator for any user input (ex-input is Random memory access then output should be RMA).Example - Random number (RN)
- Python function that accepts a string and calculates the number of uppercase letters and lowercase letters.
- Program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings
- Sample List : ['abc', 'xyz', 'aba', '1221'] Expected Result : 2

Learning Outcomes:
After completion of this unit the student will be able to

- understand the concept of subprograms and recursion (L2).
- apply the in-built functions to develop custom functions for solving problems (L3).
- make use of parameter passing mechanisms (L3).
- develop user defined functions (recursive and non-recursive). (L3)
- summarize the features of lists, tuples, dictionaries, strings and files. (L2)

Module III: Files and Packages **15 H**

Files—Python Read Files, Python Write/create Files, Python Delete Files.
Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions.
Exercises

- read an entire text file.
- read the first n lines of a file.
- append text to a file and display the text.
- Read numbers from a file and write even and odd numbers to separate files.
- Count characters, words and lines in a text file.
- To write a list to a file.
- Given a CSV file or excel file to read it into a dataframe and display it.
- Given a dataframe, select rows based on a condition.
- Given is a dataframe showing the name, occupation, salary of people. Find the average salary per occupation.
- To convert Python objects into JSON strings. Print all the values.
- Write a Pandas program to read specific columns from a given excel file.

Learning Outcomes:
After completion of this unit the student will be able to

- read data from files of different formats and perform operations like slicing, insert, delete, update(L3).
- Ability to define and use of Packages(L2).

Module IV: Operations in database with suitable libraries **15 H**

SQLite3: CRUD operations (Create, Read, Update, and Delete) to manage data stored in a database. Matplotlib -- Visualizing data with different plots, use of subplots. User defined packages, define test cases.
Exercises
Special commands to sqlite3 (dot-commands)
Rules for "dot-commands"
Changing Output Formats
Querying the database schema
Redirecting I/O
Writing results to a file
Reading SQL from a file
File I/O Functions
The edit() SQL function
Importing CSV files
Export to CSV

Export to Excel
Reference - https://www.sqlite.org/cli.html
Matplotlib can be practiced by considering a dataset and visualizing it.
It is left to the instructor to choose appropriate dataset.

Learning Outcomes:
After completion of this unit the student will be able to
- visualize the data (L4).
- Understanding the various operations performed with SQLite3. (L2)
- make use of SQLite3 operations to store and retrieve data (L3).

Module V: Regular Expressions **15 H**

Regular expression: meta character, regEx functions, special sequences, Web scrapping, Extracting data.

Exercises

Write a Python program to check that a string contains only a certain set of characters (in this case a-z, A-Z and 0-9).
Write a Python program that matches a string that has an a followed by zero or more b's
Write a Python program that matches a string that has an a followed by one or more b's
Write a Python program that matches a string that has an a followed by zero or one 'b'
Write a Python program that matches a string that has an a followed by three 'b'
Write a Python program to find sequences of lowercase letters joined with an underscore
Write a Python program to test if a given page is found or not on the server.
Write a Python program to download and display the content of robot.txt for en.wikipedia.org.
Write a Python program to get the number of datasets currently listed on data.gov
Write a Python program to extract and display all the header tags from en.wikipedia.org/wiki/Main_Page

Learning Outcomes:
After completion of this unit, the student will be able to:
- make use of Web scrapping operations (L3).
- Use regular expressions to extract data from strings.(L3)

Text Books(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press

Reference Book(s)
1. Programming with python, T R Padmanabhan, Springer
2. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
3. Python for Data Analysis, Wes McKinney, O.Reeilly

Course Outcomes:
- After completion of this course the student will be able to
- Define variables and construct expressions (L1).
- Utilize arrays, storing and manipulating data (L3).
- Develop efficient, modular programs using functions (L3).
- Write programs to store and retrieve data using files (L3).

APPLICATIONS OF ARTIFICIAL INTELLIGENCE

L T P C
0 0 2 1

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Objectives:

- Provide introduction to basic concepts of artificial intelligence.
- Explore applications of AI
- Explore the scope, advantages of intelligent systems
- Experiment with different machine learning concept
- Exposure to AI-intensive computing and information system framework

Week-1: 2 L

Introduction to Artificial intelligence: Basics of AL Agents and Environment, The Nature of Environment.

List of Experiment(s):

1. Implementation of toy Problems (8-Puzzle,Wumpus World, Vacuum-clean Example, etc)

Week-2: 2 P

Applications of AI: Game Playing, [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo]

List of Experiment(s):

1. Implementation of (Sudoku, Crossword Puzzle, or WumpusWorld, etc)

Learning Outcomes:

The student will be able to:

- Understand the basics in AI.
- Recognize various domains in AI.

Week-3: 2 P

Conceptual introduction to Machine Learning: Supervised, Unsupervised, and Semi-Supervised Learning.

List of Experiment(s):

1. Supervise - Perform Data Labelling for various images using object recognition

Week-4: 2 P

Reinforcement Learning, Introduction to Neural Networks, Deep Learning.

List of Experiment(s):

1. Explore the effect of different hyperparameters while implementing a Simple Fully Connected Neural Network. (https://playground.tensorflow.org)

Learning Outcomes:
The student will be able to:

- Define machine learning and forms of learning
- Identify types of Neural Networks

Week-5: 2 P
Image Processing & Computer Vision: Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Edge Detection.
List of Experiment(s):

1. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons

Week-6: 2 P
Segmentation. Feature Detection & Recognition. Classification of images. Face recognition, Deep Learning algorithms for Object detection & Recognition.
List of Experiment(s):

1. Teachable Machine Brain.JS In Browser Object Recognition through
2. Haar Cascade Object detection for Eye and Face in Python using Open CV

Learning Outcomes:
The student will be able to:

- Identify the concepts of image processing
- Implement the methods in computer vision

Week-7: 2 P
Conceptual introduction to Natural Language Processing: Speech Recognition & Synthesis: Speech Fundamentals, Speech Analysis, Speech Modelling.
List of Experiment(s):

1. Sentiment Analysis and Polarity detection

Week-8: 2 P
Speech Recognition, Speech Synthesis, Text-to-Speech, Sentiment Analysis, Segmentation and recognition.
List of Experiment(s):

1. Text to Speech recognition and Synthesis through APIs

Learning Outcomes:
The student will be able to:

- Understand the basics of Speech Processing
- Describe natural language processing and concepts for converting speech to different forms

Week-9: 2 P
Introduction to o Chatbot, Architecture of a Chatbot. NLP in the cloud, NL Interface, How to Build a Chatbot, Transformative user experience of chatbots, DesigningElements of a chatbot, Best practices for chatbot development. NLP components. NLP wrapper to chatbots. Audiobots and Musicbots.
List of Experiment(s):

1. Building a Chatbot using IBM Watson visual studio
2. Building a Chatbot using Pandora bots
3. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python

Learning Outcomes:
The student will be able to:

- Understand basic architecture of chatbots.
- Implement chatbots for various applications.

Week-10: 2 P

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation andAutonomous Vehicles, Smart Homes, Smart Cities

List of Experiment(s):

1. Build a smart application specific to the domain of the student.

Learning Outcomes:

The student will be able to:

- Understand the application of intelligence in various domains
- Correlate Artificial Intelligence to advanced applications

Text Books(s)

1. Tom Markiewicz& Josh Zheng, Getting started with Artificial intelligence, Published by O'Reilly Media,20l7
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach.

Reference Book(s)

1. Aurtlien Giron. Hands on Machine Learning with Scikit-Learn and TensorFlow concepts,Tools, and Techniques to Build intelligent Systems , Published by O'Reilly Mcdia,20l 7
2. Build an AI Assistant with wolfram alpha and Wikipedia in python.https://medium .com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe.
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv Computer Vision Projects withPython-Publishing (201 6).
4. Curated datasets on kaggle https://www.kaggle.com/datasets.

Course Outcomes:

- Able to grasp the concepts of artificial intelligence, machine learning, natural language processing, image processing
- Recognize various domains in which Al can be applied
- Implement the methods in processing an image:
- Implement simple of chatbots
- identify smart applications:

PROBABILITY AND STATISTICS

L	T	P	C
3	0	0	3

Course Objectives:

- To familiarize the students with the foundations of probability and statistical methods
- To impart concepts in probability and statistical methods in engineering applications.

Unit I: Data Science and Probability **10 hrs**

Data Science: Statistics introduction, Population vs Sample, collection of data, primary and secondary data, types of variable: dependent and independent Categorical and Continuous variables, data visualization, Measures of central tendency, Measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:

At the end of this unit, the student will be able to

- summarize the basic concepts of data science and its importance in engineering (L3)
- analyze the data quantitatively or categorically , measure of averages, variability (L4)
- define the terms trial, events, sample space, probability, and laws of probability (L3)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to real time problems (L3)

Unit II: Random Variable and Probability Distributions **8 hrs**

Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the notion of random variable, distribution functions and expected value(L3)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

Unit III: Correlation, Regression and Estimation **8 hrs**

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves). **Estimation:** Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

At the end of this unit, the student will be able to

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and its interval (L3)

Unit IV: Testing of Hypothesis and Large Sample Tests **8 hrs**

Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance, and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

Learning Outcomes:

At the end of this unit, the student will be able to

- identify the difference between one- and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

Unit V: Small Sample Tests **6 hrs**

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

At the end of this unit, the student will be able to

- analyze the testing of hypothesis for small samples (L4)
- test for the Chi-square goodness of fit and independence of attributes (L4)

Text Books:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson Education India, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

Upon successful completion of this course, the student should be able to

- classify the concepts of data science and its importance (L3)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)
- infer the statistical inferential methods based on small and large sampling tests (L4)

EECE1001: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

L	T	P	C
2	1	2	4

This course introduces the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems, and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Objectives:

- To impart the analysis and design aspects of DC networks in electrical and electronic circuits
- To explain the basic concepts of AC networks used in electrical and electronic circuits.
- To demonstrate the importance and operating principles of electrical machines (transformers, motors and generators)
- To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, Metal Oxide Semiconductor Field Effect Transistors (MOSFETs).
- To expose basic concepts and applications of Operational Amplifier and configurations.

Unit I: 7L

DC Circuits: Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Superposition, Thevenin's and maximum power transfer theorem.

Learning Outcomes

After completion of this unit the student will be able to

- state Ohms law and Kirchhoff's Laws (L1).
- calculate equivalent resistance of series and parallel connections in a circuit (L1).
- able to calculate voltage and current using voltage and current division methods (L2).
- determine the current, voltage and power in the given electrical circuit (L4).
- apply various theorems to analyze an electric circuit (L3).

Unit II: 8L

AC Circuits: Alternating voltages and currents, AC values, single phase RL, RC, RLC series circuits, power in AC circuits, Power Factor, three phase systems-Star and Delta Connection-Three phase power measurement.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe AC voltages and currents (L1).
- analyse Series RL, RC and RLC circuits (L4).
- Learn calculations of power factor and power measurement (L2)
- Understand star and delta connections in three phase systems (L3).

Unit III: 9L

Electrical Machines: Construction, working principle and application of DC machines, Transformers, single phase and three phase Induction motors, special machines-Stepper motor, Servo motor and BLDC motor.

Learning Outcomes:

After completion of this unit, the student will be able to

- Understand working principle of dc machines (L1).
- demonstrate principle operation of transformer (L3).
- discuss about open and short- circuit tests of transformer (L2).
- explain the working principle of three phase induction motor (L5).
- gain knowledge on applications as special machines, stepper motor (L1).
- Identify and choose servo motor and BLDC motor applications (L2).

Unit IV: **8L**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the device structure and physical operation of a diode (L1).
- discuss V-I characteristics of diodes (L2).
- explain the use of diode as switch and in electronic circuits (L2).
- describe the construction and operation of n-channel and p-channel MOSFETs (L1).
- explain the use of MOSFET as an amplifier and bidirectional switch(L2).

Unit V: **8L**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non-Inverting Configuration, Difference amplifiers, A Single Op-amp difference amplifier. Adders, subtractors, integrators, differentiators, filter circuits using Opamps,

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of an ideal Op Amp (L1).
- design the Inverting and Noninverting configurations of Op-Amp(L2).
- construct a single Op-amp difference amplifier (L3).
- List several applications of opamps

Basic Electrical and Electronics Engineering Laboratory

List of Experiments:

1. Verification of Kirchhoff's Laws.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Maximum power transfer Theorem.
5. Load test on DC generator.
6. Load test on single phase transformer.
7. Measurement of voltage, current and power factor of single phase RL, RC series circuits.
8. Measurement of voltage, current and power factor of single phase RLC series circuit.
9. Measurement of power in a three phase circuit.
10. Current Voltage Characteristics of a p-n Junction Diode/LED.
11. Diode Rectifier Circuits.

12. Voltage Regulation with Zener Diodes.
13. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
14. Inverting and Non-inverting Amplifier Design with Op-amps.
15. Simulation experiments using PSPICE

(a) Diode and Transistor Circuit Analysis.
(b) MOSFET Amplifier design.
(c) Inverting and Noninverting Amplifier Design with Op-amps.

Text Book(s):

1. D. P. Kothari, I. J. Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B. L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R. K. Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

After completion of this course, the student will be able to

- predict and analyse the behaviour of an electrical circuit (L3).
- analyse the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
- explain the use of transformers in transmission and distribution of electric power and other applications (L2).
- demonstrate the operation and applications of various electronic devices (L2).
- construct Inverting and Noninverting configurations of Op-amp (L3).

INTERNSHIP I

L T P C J
0 0 0 1 1

Prerequisite: Completion of minimum of four semesters

Course Objectives:
The course is designed to expose the students to expected industry skills and industry environment and to take up onsite assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. identify skill set required to participate activity in real-time projects relevant to the industry
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. formulate technical background required to participate in Internship 2

Contents: 1 **Week**

One week of work at industry site. Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

INTERNSHIP II

L T P C J
0 0 0 0 13

Prerequisite: Completion of minimum of six semesters

Course Objectives:
The course is designed to expose the students to industry environment and to take up onsite assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents: 1 **Week**

Four weeks of work at industry site. Supervised by an expert at the industry

Mode of Evaluation: Internship Report, Presentation and Project Review

COMPREHENSIVE EXAMINATION

L T P J C
1 0 0 0 1

Prerequisite: Completion of minimum of six semesters

Course Objectives:
1. Designed to test the students on the electronics and communication engineering concepts, and tools, and the process of identifying and solving engineering problems.

Course Outcomes
The students will be able to
1. Apply knowledge of mathematics, science, and engineering
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care and safety, manufacturability, and sustainability

Module:1 Networks, Signals and Systems
Network solution methods: nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton‟s maximum power transfer; ye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks and Network Synthesis (RL,RC,LC and RLC Synthesis): Positive real functions, hurwitz polynomial, foster and cauer forms. Continuous-time signals: LTI System & Properties,Fourier series and Fourier transform representations, sampling and aliasing concepts and applications; Discrete-time signals: discrete time Fourier transform (DTFT), DFT, FFT, Z-transform. Interconnection of systems; Filter design concepts, phase and group delay concepts

Module:2 Electronic Devices and Circuits
Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, LED, photo diode and solar cell; MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, ideal I-V characteristics, MOS capacitor, C-V characteristics, DC transfer Characteristics of CMOS inverter.

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Special diodes, Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, tuned amplifiers, power and operational; Simple opamp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, 555 timers, open and closed loop applications of Comparators, Voltage Regulators, regulator protection methods, noise analysis of electronic circuits, PLLs and Data converters

Module 3: Digital Circuits
Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift- registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microcontroller (8051): architecture, programming, memory and I/O interfacing.

Module:4 Electromagnetics
Electrostatics; Maxwell‟s equations: differential and integral forms and their interpretation boundary conditions, wave equation, Poynting vector; Plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission lines: equations, characteristic impedance, impedance matching, S-parameters, Smith chart; Waveguides: modes, boundary conditions, cut-off frequencies, Rader range equvation, Friss formula; Antennas: antenna types, radiation pattern, gain and directivity, return loss, antenna arrays; Wave Propagation, Antenna design considerations - Microstrip and Horn antennas. Basics of radar; Properties and characteristics of light sources (Laser and LED) and detectors; Light propagation in optical fibers.

Module 5: Control Systems
Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Closed loop control system design by Nichols plot , PID controller design, Lag, lead and lag-lead compensation, States space models, states space equations and solutions, states space methods for controller designs and non-linear control systems and its applications.

Module 6: Communications
Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem. Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; inter-symbol interference and its mitigation; Wireless Communication: Structure of a Wireless Communication Link, Modulation Techniques: QPSK, MSK, GMSK. Basics of TDMA, FDMA and CDMA.

Mode of Evaluation: 12 Quizzes with Multiple Choice Questions. Best 10 quizzes are considered for computing 100M. Student shall score atleast 80% in atleast 8 quizzes to be considered for grading

CAPSTONE PROJECT – INTRODUCTION

L	T	P	S	J	C
0	0	0	0	2	2

Course Objectives:

To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Course Outcome:

At the end of the course the student will be able to

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesis the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Course Logistics

Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

1. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
2. Can be individual work or a group project, with a maximum of 3 students.
3. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
4. Carried out inside or outside the university, in any relevant industry or research institution.
5. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

HSMCH102 - UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

L T P C
2 1 0 3

Human Values Courses: During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

OBJECTIVE: The objective of the course is four fold:

1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

COURSE TOPICS: The course has 28 lectures and 14 practice sessions in 5 modules:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.

6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
   a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
   b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

READINGS: Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor

encourages the student to connect with one's own self and do self- observation, self-reflection and self-exploration.

Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations.

Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials)would also provide support to a student in performing actions commensurate to his/her beliefs. It is
intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty.

Teacher preparation with a minimum exposure to at least one 8- day FDP on Universal Human Values is deemed essential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:
Assessment by faculty mentor: 10 marks
Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

OUTCOME OF THE COURSE: By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-to- day settings in real life, at least a beginning would be made in this direction.

This is only an introductory foundational input. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

PROJECT EXHIBITION I

L	T	P	S	J	C
0	0	0	0	1	1

Course Objectives:

To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

PROJECT EXHIBITION II

L	T	P	S	J	C
0	0	0	0	1	1

Course Objectives:

To provide platform for the student to exhibit their project work to

a) Excite interested students in continuing/initiating in the work of interest
b) Attract startups/industry to commercialize the project work
c) acquire comments on improving the quality of the work from other students/academicians/industry

Mode of Evaluation: Poster submission, Viva-Voce Examination

Course Code	Course Title	L	T	P	C
PC0	19EEE122:Electrical Workshop	0	0	2	1
School	SOE	Syllabus version			

Pre-requisities	Simple mathematics and physics, circuit
Alternate Exposure	Basic circuits
Co-requisities	intrest to learn and understand circuits
Course Description	

th commonly used components, accessories and measuring equipment in Electrical installations. The course also provides hands on experience in setting up of simple

Course Objectives	
1	Explain different tools and symbols used in electrical wiring
2	Impart the skills to do few varieties of electric wiring
3	Demonstrate different electrical machines and their wiring arrangement
4	Train to operate various electrical machines
5	
6	

Course Outcomes	
1	summarize supply arrangements and their limitations, knowledge of standard voltages and their tolerances, safety aspects of electrical systems and importance of protective measures in wiring systems (L2).
2	explain types of wires, cables and other accessories used in wiring. Creating awareness of energy conservation in electrical systems (L1).
3	Demonstrate simple lighting circuits for domestic buildings, distinguish between light and power circuits (L3).
4	derive electrical circuit parameters and current, voltage and power in a circuit (L2).
5	explain with backup power supply in domestic installation (L1).
6	

Specific Instructional Objectives	
1	anlysis of various circuits in laboratory
2	Hands on experience with basic circuit connections
3	Measurement and calculation of voltage and current from circuits

S.No	List of Topic	Type
1	Study of various electrical tools and symbols	Exercise
2	Identify different types of cables/wires and switches, fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage	Project
3	Wiring of light/fan circuit using two way/three way control (Staircase wiring)	Exercise
4	Go-down wiring / Tunnel wiring	Experiment
5	Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, Main switch and Energy meter	Experiment
6	Measurement of voltage, current, resistance in DC circuit.	Experiment
7	ment of voltage, current and power in single phase circuit using voltmeter, ammeter and wattmeter. Calculate the power factor of t	Experiment
8	Wiring of backup power supply including inverter, battery and load for domestic installations.	Experiment
9	Starting of DC shunt motor using three point starter.	Experiment
10	Starting of DC series motor using two point starter	Experiment
11	Starting of single phase induction motor.	Experiment
12	Starting of three phase induction motor.	Experiment
13		
14		
15		

Peadagogy Tools	identifying instruments	drawing diagrams	recollecting	hands on experimentin	learning safety rules	recording data	analyse data
	PPT	Chalk and Talk	assignments	calculations	draw a graph		

Total Number of Contact Hours	40 Hours

Text Books	
1	Sudhakar and Shyam Mohan ,Network Theory, 2/e, TMH,2012.
2	Schaum's outline series, Basic circuit analysis, McGraw-Hill Professional,2012
3	A.Chakrabarti, Circuit Theory Analysis & Synthesis, 6/e, DhanpatRai and Company,2014.
4	Robert L Boylestad, Introductory Circuit Analysis,12/e, Pearson Publications,2013.

Reference Books	Topic

1	William H. Hayt Jr., Jack E. Kemmerly, Engineering Circuit Analysis, 8/e, McGrawHill,2013	
2		
3		
4		

Online Resources	
1	PHET simulation from University of Colorado
2	from MHRD govt of India
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12	Exp13	Exp14
	Exp15													

Evaluation Procedure														
Continuous Evaluation	Total 100 Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			
Term End Examination														

Course Outcome - Program Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	5	1		2			1					2		
2	3	5	1		2			2					2		
3	3	4	1		2			2		1			1		
4	3	5	2		2			1		2		2	2		
5	3	5	3		4			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC2	Electrical Circuit Analysis	3	1	2	4
School	SOE	Syllabus version			

Pre-requisities	EECE101-BASIC ELECTICAL AND ELECTRONICS ENGINEERING
Alternate Exposure	Basics of electricity
Co-requisities	
DC Machines and Transformers, AC Machines, Electric power transmission and didtribution	
Course Description	

This course is aimed to introduce the basic concepts of electric circuits which are needed for the circuit analysis and has potential applications in various subjects that include design and development. This is base course for subjects like electrical machines, power systems and power electronics. The students are provided with hands on experience in verification of various network theorems and evaluation of network parameters

Course Objectives	
1	To familiarize various circuit elements, basic laws and theorems.
2	To appraise the behavior of RLC networks for DC excitation.
3	To teach the concepts of sinusoidal steady state analysis and resonance.
4	To familiarize concepts of magnetic coupling in coupled circuits.
5	To acquire two-port network parameters and the relations between them.
6	To solve three phase balanced and Unbalanced circuits.

Course Outcomes	
1	solve various electric circuits using basic laws and thermos(L3).
2	examine the behavior of RC and RL networks for DC excitation(L4).
3	calculate voltage, current, real power, reactive power and power factor in electric circuits with sinusoidal excitation(L3).
4	apply concepts of coupled circuits, resonance and two port networks(L5).
5	determine voltages, currents and their phase relation in balanced and unbalanced 3--phase circuits (L3).
6	

Specific Instructional Objectives	
1	anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

S.No	List of Topic	Type
1	Verification of Thevenin's and Norton's theorems	Experiment
2	Verification of superposition theorem and maximum power transfer theorem	Experiment
3	Verification of reciprocity, Milliman's theorems	Experiment
4	Locus diagrams of RL and RC series circuits	Experiment
5	Series and parallel resonance	Experiment
6	Determination of self, mutual inductances and coefficient of coupling	Experiment
7	Determination of Z and Y parameters	Experiment
8	Determination of transmission and hybrid parameters	Experiment
9	Measurement of reactive power for star and delta connected balanced loads	Experiment
10	Determination of time response of RL & RC network	Exercise
11	Determination of form factor of non sinusoidal waveform	Exercise

Peadagogy Tools	MATLAB	CIRCUITLAB	VA CIRCUIT SIMULATO	PSPICE			
	HANDOUTS						

Total Number of Contact Hours	30 Hours

Text Books	
1	William H. Hayt Jr., Jack E. Kemmerly, Engineering Circuit Analysis, 8/e, McGrawHill,2013
2	Van ValkenburgM.E, NetworkAnalysis, 3/e, P49renticeHallIndia, 2014
3	
4	

Reference Books		Topic
1	Sudhakar and Shyam Mohan ,Network Theory, 2/e, TMH,2012.	
2	Schaum's outline series, Basic circuit analysis, McGraw-Hill Professional,2012	
3	A.Chakrabarti, Circuit Theory Analysis & Synthesis, 6/e, DhanpatRai and Company,2014.	
4	Robert L Boylestad, Introductory Circuit Analysis,12/e, Pearson Publications,2013.	

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12	Exp13	Exp14
	TB1	RB1	OR1	TB2	RB2	OR2	TB3	RB3	OR3	TB4	RB4	OR4	TB5	RB5
	Exp15													
	OR5													

Evaluation Procedure	

Continuous Evaluation	Total 100 Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Term End Examination	Total XX Marks

Course Outcome - Program Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1					2		
3	3	3	1		2			1		1			2		
4	3	3	2		2			1		2			2		
5	3	3	2		2			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC2	Electrical Circuit Analysis	2	1	2	4
School	SOE	Syllabus version			

Pre-requisties	EECE101-BASIC ELECTICAL AND ELECTRONICS ENGINEERING
Alternate Exposure	Basics of electricity
Co-requisties	DC Machines and Transformers, AC Machines, Electric power transmission and didtribution

Course Description

This course is aimed to introduce the basic concepts of electric circuits which are needed for the circuit analysis and has potential applications in various subjects that include design and development. This is base course for subjects like electrical machines, power systems and power electronics. The students are provided with hands on experience in verification of various network theorems and evaluation of network parameters

Course Objectives

1	To familiarize various circuit elements, basic laws and theorems.
2	To appraise the behavior of RLC networks for DC excitation.
3	To teach the concepts of sinusoidal steady state analysis and resonance.
4	To familiarize concepts of magnetic coupling in coupled circuits.
5	To acquire two-port network parameters and the relations between them.
6	To solve three phase balanced and Unbalanced circuits.

Course Outcomes	After the completion of this course, the students will be able to
1	solve various electric circuits using basic laws and thermos(L3).
2	examine the behavior of RC and RL networks for DC excitation(L4).
3	calculate voltage, current, real power, reactive power and power factor in electric circuits with sinusoidal excitation(L3).
4	apply concepts of coupled circuits, resonance and two port networks(L5).
5	determine voltages, currents and their phase relation in balanced and unbalanced 3--phase circuits (L3).
6	

Specific Instructional	
1	anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

Unit I	Introduction	8

Ohms law, Kirchhoff's laws, series and parallel circuits, source transformations, delta–wye conversion, linearity and superposition theorem with simple examples, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples, compensation theorem, reciprocity theorem, Milliman's theorem, mesh analysis and nodal analysis with simple examples, concepts of super node and super mesh.

Pedagogy Tools							
	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit II	DC Transients	6

source free response of RL, RC and RLC circuits, forced response of RL, RC and RLC for DC excitation.

Pedagogy Tools							
	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit III	Sinusoidal steady-state analysis	8

sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, concept of phasors, phasor relationships for RL, RC and RLC circuits and steady-state analysis of RL, RC and RLC circuits.

Pedagogy Tools							
	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit IV	Coupled circuits, Resonance and Two-port Networks	8

magnetically coupled circuits, mutual inductance, coupling coefficient, parallel resonance, series resonance, bandwidth, quality factor, two port networks, impedance parameters, admittance parameters, hybrid parameters and transmission parameters, relationships between parameters.

Pedagogy Tools							
	text book	coursera	nptel	ava circuit simulato	matlab		

Pedagogy Tools	ppts	circuitlab					

Unit V	Three phase circuits	6

voltage, current and power in star connected and delta connected 3-phase circuits (for balanced and unbalanced loads).

Pedagogy Tools	text book	coursera	nptel	va circuit simulat	matlab		
	ppts	circuitlab					

Total Number of Contact Hours	L	36	T	0	P	150

Text Books	
1	William H. Hayt Jr., Jack E. Kemmerly, Engineering Circuit Analysis, 8/e, McGrawHill,2013
2	Van ValkenburgM.E, NetworkAnalysis, 3/e, P49renticeHallIndia, 2014
3	
4	

Reference Books	
1	Sudhakar and Shyam Mohan ,Network Theory, 2/e, TMH,2012.
2	Schaum's outline series, Basic circuit analysis, McGraw-Hill Professional,2012
3	A.Chakrabarti, Circuit Theory Analysis & Synthesis, 6/e, DhanpatRai and Company,2014.
4	Robert L Boylestad, Introductory Circuit Analysis,12/e, Pearson Publications,2013.

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1		2			1					2		
2	3	1		2			1					2		
3	3	1		2			1		1			2		
4	3	3		2			1		2			2		
5	3	3		4			2		1	1	1	2		
6														

Date of Approval	21.05.2021

Course Code	Course Title				L	T	P	C
PC4	ELECTRO MAGNETIC FIELDS				3	0	0	3
School	SOE				Syllabus version			

Pre-requisties	19EPH131: ENGINEERING PHYSICS
Alternate Exposure	
Co-requisties	

Electrical circuits, Electrical Machines and Power systems.

Course Description

This course provides scientific, mathematical and engineering principles that enable the students to understand forces, fields, and waves. The students need to understand the fundamental principles and laws of electromagnetism to develop and implement better analog and digital electronic system that take into account electromagnetic wave propagation and radiation effects. This course is base for other subjects like Electrical circuits, Electrical Machines and Power systems.

Course Objectives

1	To introduce various concepts of vector calculus and coordinate systems.
2	To expose different concepts of electrostatic, magneto static and time varying electromagnetic systems.
3	To familiarize the concepts of conductors, and dielectrics.
4	To impart the concepts of Magnetic materials, magnetic forces and inductance.
5	To expose the students the ideas of electromagnetic waves.

Course Outcomes	After the completion of this course, the students will be able to
1	determine the electric fields for different geometric configurations(L3)
2	calculate capacitance using Poisson's and Laplace equations(L3).
3	determine the magnetic fields for different geometric configurations(L3).
4	determine and solve the Maxwell"s equations(L5).
5	demonstrate wave propagation in different media(L2).
6	

Specific Instructional

1	
2	
3	

Unit I	Review of vector calculus	8

Vector addition, subtraction, components of vectors, scalar and vector multiplications, triple products, Vector differentiation, partial differentiation, integration, vector operator- del, gradient, divergence and curl, integral theorems of vectors, three orthogonal coordinate systems (rectangular, cylindrical and spherical), conversion of a vector from one coordinate system to another.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit II	Conductors, dielectrics and capacitance	8

Behavior of conductors and dielectrics in an uniform electric field, current and current density, Ohm's law in point form, continuity equation, boundary conditions of perfect dielectric materials, permittivity of dielectric materials, capacitance of parallel plate and spherical capacitors, Poisson's and Laplace's equations in electric field and solution of Laplace's equation.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit III	Static Magnetic Fields,Magnetic Forces, Materials and Inductance	8

Static Magnetic Fields: Biot-Savart law, Ampere law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Magnetic Forces, Materials and Inductance: force on a moving charge, force on a differential current element, force between differential current elements, nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, self-inductance of solenoid and toroid,

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit IV	Time Varying Fields and Maxwell's Equations	6

Time Varying Fields and Maxwell's Equations: Faraday's laws of electromagnetic induction, static and motional electromotive forces, displacement current, point and integral forms of Maxwell equations, time varying fields.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit V	Electromagnetic waves	6

Electromagnetic waves: Derivation of wave equation, uniform plane waves, Maxwell's equation in phasor form, wave equation in phasor form, plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect, Poynting theorem

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Total Number of Contact Hours	L	36	T	0	P	0

Text Books

1	A.Pramanik, Electromagnetism-Theory and Applications, PHI Learning Pvt. Ltd,2009.
2	A. Pramanik, Electromagnetism-Problems with Solution, Prentice Hall India,2012.
3	
4	

Reference Books

1	M. N. O. Sadiku, Elements of Electromagnetics, Oxford University Publication,2014.
2	W. Hayt, Engineering Electromagnetics, McGraw Hill Education,2012.
3	Joseph Edminister , Vishnu Priye, Electromagnetics, Schaum's Outline Series,2017.
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2		1	3					2		
2	3	2	1		2		1	1					3		
3	3	1	1		2		1	2		1			2		
4	3	3	3		2		1	1		3			3		
5	3	3	3		4		1	3		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC7	Linear Control Systems Laboratory	3	1	2	4
School	SOE	Syllabus version			

Pre-requisities	19EEE331: LINEAR CONTROL SYSTEMS
Alternate Exposure	Electrical circuit analysis
Co-requisities	Electrical circuit analysis,linear control systems
Course Description	This course is aimed to introduce linear mathematical modeling of different systems and their representation as open loop and closed loop systems. Output Response of developed mathematical models for different single input systems for standard test signals will be studied. Stability of system is assessed in with time-domain and frequency domain plots.

Course Objectives	
1	To familiarize various various concepts of block diagrams reduction techniques.
2	To appraise the mathematical modeling of the system
3	To obtain the response of single input systems for various test signals
4	To analyse stability of the system in time and frequency domains
5	To acquire state variable analysis to multi-input and multi-output systems

Course Outcomes	
1	Solve numerical on block diagrams reduction techniques(L3)
2	Build the mathematical model of a given system(L3)
3	Analyze the response of different order systems for various step inputs(L4)
4	Analyze the stability of the system(L4)
5	Able to comprehend solution of state equation(L5)

Specific Instructional Objectives	
1	anlysis of various circuits using Electronic system Kits
2	
3	

S.No	List of Topic	Type
1	Characteristics of series, parallel magnetic amplifier.	Experiment
2	Design of PID controller for second order systems.	Experiment
3	Time response of first and second order systems.	Experiment
4	Frequency response for a lag compensating network.	Experiment
5	Characteristics and transfer function of DC servo motor	Experiment
6	Characteristics and transfer function of AC servo motor.	Experiment
7	Stepper motor control.	Experiment
8	Frequency response for a lead compensating network	Experiment
9	Characteristics of self-saturated magnetic amplifier.	Experiment
10	D.C Position control system.	Experiment
11	Design of lag-lead compensator	Experiment
12	Step response and frequency response of a given plant	Experiment

Peadagogy Tools							
	MATLAB	CIRCUITLAB	VA CIRCUIT SIMULATO	PSPICE			
	HANDOUTS						

Total Number of Contact Hours	30 Hours

Text Books	
1	Benjamin C.Kuo, Automatic Control Systems ,7/e , Prentice Hall of India, 1997.
2	M.Gopal, Control Systems Engineering , 3/e , Wiley Eastern Ltd., TMH ,2008
3	
4	

Reference Books		Topic
1	Ogata, Modern Control Engineering , 2/e, Prentice Hall of India.,2011	
2	R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998	

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12	Exp13	Exp14
	TB1	RB1	OR1	TB2	RB2	OR2	TB3	RB3	OR3	TB4	RB4	OR4	TB5	RB5
	Exp15													
	OR5													

Evaluation Procedure	

Continuous Evaluation	Total 100 Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Term End Examination	Total XX Marks

Course Outcome - Program Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1					2		
3	3	3	1		2			1		1			2		
4	3	3	2		2			1		2			2		
5	3	3	2		2			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC7	LINEAR CONTROL SYSTEMS	3	0	3	45
School	SOE	Syllabus version			

Pre-requisties	
Alternate Exposure	Basics of modelling of control systems
Co-requisties	

Networks,power system components,modelling of different systems

Course Description

This course is aimed to introduce linear mathematical modeling of different systems and their representation as open loop and closed loop systems. Output Response of developed mathematical models for different single input systems for standard test signals will be studied. Stability of system is assessed in with time-domain and frequency domain plots. Modern state space approach for modeling and analysis of multi-input and multi-output systems are introduced

Course Objectives

1	To familiarize various concepts of block diagrams reduction techniques.
2	To develop the mathematical modeling of the system.
3	To obtain response of single input systems for various test signals.
4	To analyze stability of the system in time and frequency domains.
5	To acquire state variable analysis to multi-input and multi-output systems.

Course Outcomes — After the completion of this course, the students will be able to

1	To Solve numerical on block diagrams reduction techniques(L3)
2	To Build the mathematical model of a given system(L3)
3	To Analyze the response of different order systems for various step inputs(L4)
4	To Analyze the stability of the system(L4)
5	Able to comprehend solution of state equation(L5)

Specific Instructional

1	analysis of various types of control systems using simulation tools like MATLAB, PSPICE
2	
3	

Unit I	Introduction	8

Concepts of control systems. Different examples of control systems, Open loop and closed loop control systems and their differences. Block diagram representation of systems considering electrical systems as examples. Block diagram algebra. Representation by Signal flow graph, reduction using Mason's gain formula, feedback Characteristics, Effects of feedback

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	hear control systems L					

Unit II	Introduction to mathematical modeling of physical systems	6

deling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	hear control systems L					

Unit III	Concept of stability	8

Routh-Hurwitz criterion, construction of Root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	hear control systems L					

Unit IV	Stability of Control Systems	8

Bode plots, Polar plots and Nyquist plots, all pass and minimum phase systems, numerical examples.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	hear control systems L					

Unit V	State variable analysis	6

ble representation. Transfer function form to State variable form (Diagonal form), State variable form to transfer function form, transfe

Pedagogy Tools	text book	coursera	nptel	va circuit simulat	matlab		
	ppts	hear control systems L					

Total Number of Contact Hours	L	36	T	0	P	150

Text Books

1	Benjamin C.Kuo, Automatic Control Systems ,7/e , Prentice Hall of India, 1997
2	M.Gopal, Control Systems Engineering , 3/e , Wiley Eastern Ltd., TMH ,2008

Reference Books

1	Ogata, Modern Control Engineering , 2/e, Prentice Hall of India.,2011
2	R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1		2			1					2		
2	3	1		2			1					2		
3	3	1		2			1		1			2		
4	3	3		2			1		2			2		
5	3	3		4			2		1	1	1	2		
6														

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC8	DC Machnes and Transformers	2	0	2	3
School	SOE	Syllabus version			

Pre-requisities	Basic Electrical and Electronics Engineering
Alternate Exposure	Basics of electricity
Co-requisities	DC Machines and Transformers
Course Description	

This course is aimed to introduce the principles and applications of dc machines and transformers. Construction, working and testing of dc Machines are discussed in detail. The students are provided with hands on experience in testing the performance of various types of DC machines and transformers

Course Objectives	
1	To teach principles and working of dc Machines and transformers.
2	To demonstrate the performance and control of dc machines and transformers.
3	To appraise the testing methods of dc machines and transformers.
4	To focus on the applications of electrical machines in industry.
5	
6	

Course Outcomes	Upon successful completion of this course, the student will be able to
1	summarize principles, laws, and working of dc machines
2	analyze the characteristics and application of various types of dc generators
3	analyze the construction, characteristics and application of various type of dc motors and testing of motors
4	explain the working of 1- phase and 3- phase transformers
5	apply the principles of 3 phase transformer to multi-phase transformer
6	

Specific Instructional Objectives	
1	Anlysis of various circuits using simulation tools like MATLAB, LABVIEW
2	
3	

S.No	List of Topics	Type
1	Open circuit characteristics (OCC) and external characteristics of separately excited dc Generator	Experiment
2	Swinburne's test on a dc shunt motor.	Experiment
3	OC and SC tests on single phase transformer.	Experiment
4	Brake test on dc shunt motor	Experiment
5	Load test on Single phase transformer.	Experiment
6	Scott connection of transformers	Experiment
7	Characteristics of dc series generator.	Experiment
8	Characteristics of dc compound generator.	Experiment
9	Separation of losses in dc shunt machine.	Experiment
10	Speed control methods of dc shunt motor.	Experiment
11	Hopkinson test.	Experiment
12	Separation of losses in single phase transformer	Experiment
13		
14		
15		

Peadagogy Tools	HANDOUTS	MATLAB	LAB VIEW				

Total Number of Contact Hours	36 Hours

Text Books	
1	A.E. Fitzgerald, Charles Kingsley Jr. Stephen D. Umans, Electric Machinery, 7/e, McGraw Hill., 2013
2	I.J. Nagarath and D.P. Kothari, Electric Machines, 4/e, McGraw Hill,2010
3	
4	

Reference Books		Topic
1	A.E. Clayton and N.N.Hancock, Performance and Design of DC Machines, Oxford,1987	

2	Chakrabarthy, Electrical Machines, 1/e, McGraw Hill,2013	
3	S.J. Chapman, Electric Machine Fundamentals, 5/e, McGraw Hill,2011	
4		

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12		
	TB1	TB1	RB1	TB2	TB1	TB2	TB2	RB1	RB1	RB2	TB2	RB2		

Evaluation Procedure	
Continuous Evaluation	Total XX Marks
Term End Examination	Total XX Marks

Continuous Evaluation	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Course Outcome - Program Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2	1		2			1					2		
2	3	2	1		2			1					2		
3	3	2	1		2			1		1			2		
4	3	2	2		2			1		2			2		
5	3	2	2		2			2		1	1	1	2		
6															

Date of Approval	

Course Code	Course Title	L	T	P	C
PC9	ELECTRICAL MEASUREMENTS LABORATORY	2	0	2	3
School	SOE	Syllabus version			

Pre-requisities	EECE1001-BASIC ELECTICAL AND ELECTRONICS ENGINEERING
Alternate Exposure	Basics of electricity
Co-requisities	DC Machines and Transformers, AC Machines, Electric power transmission and didtribution
Course Description	

Course Objectives	
1	Introduce students to various secondary instruments.
2	Train students about various bridges.
3	Acquaint various meters and its construction
4	Classify instrument transformers and its testing
5	Apply knowledge to design and create novel products.
6	

Course Outcomes	
1	Determine dynamo meter type measuring instruments. (L5)
2	Analyze to balance Bridges to find unknown values. (L4)
3	Determine use the potentiometer and skills for electrical projects. (L5)
4	Solve and CT and PT ratios. (L6)
5	Simplify measurement of R, L, C ,Voltage, Current, Power factor , Power, Energy . (L4)
6	

Specific Instructional Objectives	
1	anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

S.No	List of Topic	Type
1	Measurement of very low resistance using Kelvin's double bridge.	Experiment
2	Measurement of medium resistance using Wheatstone's bridge.	Experiment
3	Measurement of self inductance using Maxwell's bridge.	Experiment
4	Measurement of self inductance in terms of capacitance using Anderson's bridge.	Experiment
5	Measurement of capacitance power factor using Schering Bridge.	Experiment
6	Measurement of capacitance using Wien's bridge.	Experiment
7	Calibration of Energy meter by Phantom loading	Experiment
8	Calibration of Wattmeter	Experiment
9	Finding parameters of Choke Coil	Experiment
10	Measurement of mutual inductance	Experiment
11	Measurement of 3-phase power using 2-Wattmeter method	Experiment

Peadagogy Tools							
	MATLAB	CIRCUITLAB	VA CIRCUIT SIMULATO	PSPICE			
	HANDOUTS						

Total Number of Contact Hours	30 Hours

Text Books	
1	A.K. Sawhney, "A Course in Electrical and Electronic Measurement and Instrumentation", 19/e, Dhanpat Rai
2	E.W. Golding and F.C. Widdis, "Electrical Measurements and Measuring Instruments" ,5/e, Wheeler
3	
4	

Reference Books		
1	Rajendra Prasad., "Electronic Measurements and Instrumentation", 4/e, Khanna Publishers, 2012	
2	Harris F.K., "Electrical Measurements", John Wiley Publishers, 1974.	
3	U.A. Bakshi, A.V. Bakshi,"Electrical measurements and instrumentation, Technical publications, 2009.	
4		

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11			
	TB1	RB1	OR1	TB2	RB2	OR2	TB3	RB3	OR3	TB2	RB3			
	Exp15													
	OR5													

Evaluation Procedure	
Continuous Evaluation	Total 100 Marks
Term End Examination	Total XX Marks

Continuous Evaluation	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Course Outcome - Program Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1					2		
3	3	3	1		2			1		1			2		
4	3	3	2		2			1		2			2		
5	3	3	2		2			2		1	1	1	2		
6															

Date of Approval	10.12.2021

Course Code	Course Title				L	T	P	C
PC9	Electrical Measurements				2	0	2	3
School	SOE				Syllabus version			

Pre-requisties	Electrical Circuit analysis
Alternate Exposure	Basics of electricity
Co-requisties	

DC Machines and Transformers, AC Machines, Electric power transmission and didtribution

Course Description

This subject deals with analog and digital measuring instruments. It signifies measurement of resistance, inductance and capacitance by using bridge circuits and calibration of meters. It acts as a base course for Electrical machines, Electrical power systems and power electronics etc...

Course Objectives

1	Introduce students to various secondary instruments.
2	Train students about various bridges.
3	Acquaint various meters and its construction
4	Classify instrument transformers and its testing
5	Apply knowledge to design and create novel products.

Course Outcomes	After the completion of this course, the students will be able to
1	Determine dynamo meter type measuring instruments. (L5)
2	Analyze to balance Bridges to find unknown values. (L4)
3	Determine use the potentiometer and skills for electrical projects. (L5)
4	Solve and CT and PT ratios. (L6)
5	Simplify measurement of R, L, C ,Voltage, Current, Power factor , Power, Energy . (L4)
6	

Specific Instructional	
1	
2	
3	

Unit I	8

Indicating instruments: Principle, different types of control and damping arrangements in indicating instruments, Permanent Magnet Moving Coil (PMMC), Moving Iron (MI), electrostatic and dynamometer type meters, errors in indicating instruments, extension of instrument range for ammeters and voltmeters.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit II	8

Measuring instruments: Dynamometer type wattmeter, errors and compensation, 3-phase power measurement by two wattmeter method, single phase energy meters, single phase induction type energy meter, errors and compensation. Calibration of wattmeter and energy meter. Frequency meters: Mechanical and electrical resonance type. Power factor meters: Dynamometer type, Moving Iron (MI) type.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit III	8

Measurement of resistance using Wheatstone bridge, Kelvin double bridge and megger. LCR meter Measurement of inductance using Maxwell's bridge, Hay's bridge and Anderson's bridge. Measurement of capacitance using Schering bridge.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	circuitlab					

Unit IV	8

Potentiometers: General principle, Vernier dial, principle of standardization. AC potentiometers coordinate type and polar type, application of DC and AC potentiometers. Display devices: CRT display, DSO, Digital multimeter..

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		

Pedagogy Tools	ppts	circuitlab					

Unit V		8

Instrument transformers: Components and working of Current Transformer (C.T.), phasor diagram, ratio error and phase angle error, testing. Components and working of Potential Transformer (P.T.), phasor diagram, ratio error and phase angle error, testing.

Pedagogy Tools	text book	coursera	nptel	va circuit simulat	matlab		
	ppts	circuitlab					

Total Number of Contact Hours	L	40	T	0	P	150

Text Books	
1	A.K. Sawhney, “A Course in Electrical and Electronic Measurement and Instrumentation”, 19/e, Dhanpat Rai
2	E.W. Golding and F.C. Widdis, “Electrical Measurements and Measuring Instruments” ,5/e, Wheeler
3	
4	

Reference Books	
1	Rajendra Prasad., “Electronic Measurements and Instrumentation”, 4/e, Khanna Publishers, 2012
2	Harris F.K., “Electrical Measurements”, John Wiley Publishers, 1974.
3	U.A. Bakshi, A.V. Bakshi,”Electrical measurements and instrumentation, Technical publications, 2009.
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1		2			1					2		
2	3	1		2			1					2		
3	3	1		2			1		1			2		
4	3	3		2			1		2			2		
5	3	3		4			2		1	1	1	2		
6														

Date of Approval	10.12.2021

Course Code	Course Title				L	T	P	C
PC10	AC Machines				3	0	2	4
School	SOE				Syllabus version			

Pre-requisties	Electrical Circuit Analysis
Alternate Exposure	AC circuits
Co-requisties	Basics of Electrical and Electronics Engineering, DC Machines and Transformers

Course Description

This course is aimed to introduce to students the principles and applications of electrical alternating machines which are gaining importance in industries. Induction motors are used to meet the demand of the several industrial and commercial applications. Alternators are very widely used machine for generating bulk of electricity worldwide. Synchronous motors are used in all industrial applications where constant speed is necessary. This course is base to power electronic drives, power system stability and power system operation and control.

Course Objectives

1	To study principles of AC machines and how they work.
2	To familiarize various types of induction motors, synchronous motors.
3	To acquaint the performance and control of AC machines
4	To demonstrate the various types of single phase and special machines
5	To expose the significance of AC machines for industries
6	

Course Outcomes	After the completion of this course, the students will be able to
1	Explain the constructional details, principle of operation of induction motor(L3)
2	Describe different tests for calculating the performance parameters of three phase induction motors (L2)
3	Examine the starting and running performance of single phase induction motor and
4	Analyze the performance of ac machines.(L4)
5	describe the principle of operation of synchronous motor and different applications. (L3)
6	

Specific Instructional Objectives	
1	To model , derive the mathematical equations and conduct testing methods on AC Machines by using MATLAB
2	
3	

Unit I	Induction Motors	No of Hours required

Types and constructional features of poly phase induction motors, principle of operation, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field phasor diagram, slip, torque equation, torque characteristics, equivalent circuit, power stages, Methods of starting and speed control for induction motors.

Pedagogy Tools							
	text	coursera	NPTEL	MATLAB			
	ppts						

Unit II	Testing of Induction motors and Single phase induction motors	No of Hours required

No load and Rotor blocked tests, circle diagram. Cogging, crawling. Double cage rotor. Double revolving field theory, starting methods -Split phase type, capacitor start and capacitor run, shaded pole types, equivalent circuit based on double revolving field theory, universal motor, stepper motor, reluctance motor.

Pedagogy Tools							
	text	coursera	NPTEL	MATLAB			
	ppts						

Unit III	Alternators	No of Hours required

Types and constructional features. Air-gap MMF distribution with fixed current through winding-concentrated and distributed. emf Equation, distribution factor, pitch factor. Effect of harmonics on EMF equation. Regulation of alternators on load. Parallel operation of alternators.

Pedagogy Tools							
	text	coursera	NPTEL	MATLAB			
	ppts						

Unit IV	Determination of regulation characteristics and Salient Pole Alternators	No of Hours required

Synchronous impedance method, MMF method, Zero power factor method (ZPF Method). Basic ideas of two reaction theory. Direct and quadrature axis reactance and their determination. Phasor diagram and regulation of salient pole alternators. Expression for power developed as a function of torque angle.

Pedagogy Tools							
	text	coursera	NPTEL	MATLAB			

Pedagogy Tools	ppts						

Unit V	Synchronous Motors	No of Hours required

Constructional features and working of synchronous motors, synchronous machines on infinite bus bars. Phasor diagram. Starting methods. Synchronization, V and inverted V curves. Current and Power circle diagrams. Hunting and its suppression. Synchronous condenser.

Pedagogy Tools	text	coursera	NPTEL	MATLAB		
	ppts					

Total Number of Contact Hours	L	45	T	0	P	150

Text Books		
1		M.G.Say, “Performance and design of AC Machines”, 3/e, ELBS, 2002.
2		I.J.Nagarath and D.P.Kothari, “Electrical Machines”, 4/e, McGraw Hill, 2010.
3		
4		

Reference Books	
1	Atkins; Chapman, “General Theory of Electrical Machines”, 8/e, McGraw Hill, 1979.
2	Fitzgerald A.E. & Kingsley, “Electrical Machinery”, 7/e, McGraw Hill, 2013.
3	George McPherson, Robert D. Laramore, “An Introduction to Electrical Machines and Transformers”, 2/e, Wiley, 2014
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping															
Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3				1			1		1	2	1	3		1
2	1	2	3	1	2		1	1		1	2	1			
3	2	1						1		1			3		
4	3	2	2		1		1	1		1			1	1	1
5	3	2	1		1		1	1		1	2	1	1	1	1
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
	AC Machines Laboratory	3	0	2	4
School	SOE	Syllabus version			

Pre-requisities	Electrical Circuit Analysis
Alternate Exposure	Details on AC Machines
Co-requisities	Basics of Electrical and Electronics Engineering, DC Machines and Transformers

Course Description

This course is aimed to introduce to students the principles and applications of electrical alternating machines which are gaining importance in industries. Induction motors are used to meet the demand of the several industrial and commercial applications. Alternators are very widely used machine for generating bulk of electricity worldwide. Synchronous motors are used in all industrial applications where constant speed is necessary. This course is base to power electronic drives, power system stability and power system operation and control.

Course Objectives	
1	To study principles of AC machines and how they work.
2	To familiarize various types of induction motors, synchronous motors
3	To acquaint the performance and control of AC machines
4	To demonstrate the various types of single phase and special machines
5	To expose the significance of AC machines for industries
6	

Course Outcomes	After the completion of this course, the students will be able to
1	Explain the constructional details, principle of operation of induction motor(L3)
2	Describe different tests for calculating the performance parameters of three phase induction motors (L2)
3	Examine the starting and running performance of single phase induction motor and
4	Analyze the performance of ac machines.(L4)
5	describe the principle of operation of synchronous motor and different applications. (L3)
6	

Specific Instructional Objectives	
1	
2	
3	

S.No	List of Topic	Type
1	No load and blocked rotor test on three phase Slip ring induction motor.	Experiment
2	No load and blocked rotor test on three phase Squirrel cage induction motor.	Experiment
3	No load and blocked rotor test on Single phase induction motor	Experiment
4	Regulation of alternator by Synchronous impedance method	Experiment
5	V and inverted V curves of Synchronous motor	Experiment
6	Load test on three phase Slip ring induction motor	Experiment
7	Load test on three phase Squirrelp ring induction motor	Experiment
8	Load test on single phase induction motor	Experiment
9	Regulation of alternator by Zero Power Factor(ZPF) method	Experiment
10	Speed control of three phase Squirrel cage induction motor by frequency control(V/f) method	Experiment
11	Speed control of three phase Slip ring induction motor by rotor resistance control method	Experiment
12	Slip test on three phase synchronous machine	Experiment
13		
14		
15		

Peadagogy Tools							
	MATLAB Simulink						
	Handouts						

Total Number of Contact Hours	30 Hours

Text Books

1. M.G.Say, “Performance and design of AC Machines”, 3/e, ELBS, 2002.
2. I.J.Nagarath and D.P.Kothari, “Electrical Machines”, 4/e, McGraw Hill, 2010.
3.
4.

Reference Books		Topic
1	Atkins; Chapman, “General Theory of Electrical Machines”, 8/e, McGraw Hill, 1979.	

2	Fitzgerald A.E. & Kingsley, “Electrical Machinery”, 7/e, McGraw Hill, 2013.
3	George McPherson, Robert D. Laramore, “An Introduction to Electrical Machines and Transformers”, 2/e, Wiley, 2014
4	

Online Resources	
1	To model , derive the mathematical equations and conduct testing methods on AC Machines by using MATLAB
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12		
	TB2	TB2	TB1	RB2	RB1	TB1	TB2	TB2	RB1	TB2	RB2	TB2		

Evaluation Procedure														
Continuous Evaluation	Total XX Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			
Term End Examination	Total 20 Marks													

Course Outcome - Program Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3				1			1		1	2	1	3		1
2	1	2	3	1	2		1	1		1	2	1			
3	2	1						1		1			3		
4	3	2	2		1		1	1		1			1	1	1
5	3	2	1		1		1	1		1	2	1	1	1	1
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC11	Electrical Power System Generation, Transmission and Distribution	3	0	0	3
School	SOE	Syllabus version			

Pre-requisties	
Alternate Exposure	
Co-requisties	
Course Description	

In this course it is aimed to introduce to the students the working principles of various power generating sources and detail analysis of faults occurrences in practical power systems. The basic concepts of solar energy, wind energy, biomass energy, geothermal energy and ocean energy are explained. Transmission line modeling parameters, fault conditions and mechanical conditions of transmission lines are analyzed

Course Objectives	
1	To Study various basic concepts of conventional power sources, power grids and microgrids.
2	To Expose various basic concepts of renewable energy sources
3	To Familiarize various parameters in transmission lines
4	To Interpret the effect of sag and usage of underground cables
5	To Expose various AC and DC distributions systems

Course Outcomes	
1	Upon completion of the course, the students would be able to correlate various conventional power sources, power grids and microgrids.
2	Upon completion of the course, the students would be able to identify various renewable energy sources for power generation
3	Upon completion of the course, the students would be able to estimate the various parameters in transmission lines
4	Upon completion of the course, the students would be able to appraise the effect of sag on transmission lines
5	Upon completion of the course, the students would be able to assess various AC and DC distribution systems for concentrated and uniformly distributed loads

Specific Instructional Objectives	
1	
2	
3	

Unit I	Conventional Power Generation	8

Hydroelectric Power Generation: Plant layout, working of hydroelectric power plant and selection of site.
Thermal Power Generation: Plant layout, working of thermal power plant and selection of site.
Nuclear Power Generation: Plant layout, working of nuclear power plant and selection of site

Pedagogy Tools	coursera	nptel	ppts				

Unit II	Renewable Energy sources	8

Solar Power Generation: Physical principles of conversion of solar radiation into heat, working principle of Flat plate collectors and Photovoltaic Cell.
Wind power generation: Basic components of Wind energy conversion systems, working principle of HAWT and VAWT.
Energy from Biomass: Biomass conversion technologies, working principle of Floating drum and fixed dome plants.
Geothermal energy: Working principle of Vapor and Liquid dominated systems
Energy from Oceans: Working principle of closed cycle OTEC. Basic components of Tidal power plant

Pedagogy Tools	coursera	nptel	ppts				

Unit III	Transmission line Parameters	10

Overhead Transmission Lines: Capacitance and Inductance calculations for single phase two wire line,
three phase lines, proximity effect, skin effect.
Sinusoidal Steady state representation of Lines: Short, medium and long lines, Characteristics of transmission lines. Surge Impedance Loading

Pedagogy Tools	coursera	nptel	ppts	matlab			

Unit IV	Mechanical design of overhead lines	8

Sag and insulators: Line supports, insulators, voltage distribution in suspension-type insulators. Testing of insulators, String efficiency, tension and sag calculation, effects of wind and ice loading.
Underground cables: Comparison with overhead line. Types of cables, Insulation resistance, potential gradient, Capacitance of single core cables.
Corona: Formation of corona. Critical voltages, effect on line performance

Pedagogy Tools	coursera	nptel	ppts				

Unit V	Distribution Systems	8

Overview of Distribution systems, Types of DC & AC Distributors: Radial, and Ring systems. Voltage drop calculation with concentrated loads and uniformly distributed loads.

Pedagogy Tools	coursera	nptel	ppts	matlab		

Total Number of Contact Hours	L	42	T	0	P	0

Text Books

1		S. N. Singh, “Electric Power Generation, Transmission and Distribution”, PHI Learning,2010
2		GD Rai, “Non-conventional Energy sources”,4/e,Khannapublishers,2012
3		J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994
4		

Reference Books

1	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995
2	2.Gerald B Sheble, Bruce F Wollenberg Allen J Wood, “Power Generation, Operation, and Control”, 3/e, Wiley Interscience,2010
3	A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999
4	D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003
5	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2			3	3	2				1			2		
2	1	2		2					1		2	1	1	2	
3	1	2		2	2			1		3				1	
4			1			2		1	2	2		2			2
5		2		1			2				2			2	
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC12	Microprocessors and Microcontrollers Laboratory	3	0	2	4
School	SOE	Syllabus version			

Pre-requisities	19EEC232: DIGITAL LOGIC DESIGN
Alternate Exposure	BASIC ELECTRONICS
Co-requisities	
Course Description	

The use of microcontrollers in various fields such as automobile, aeronautics, space, robotics, electronics, defense application, mobile communications, rail transport, industrial processing, and medical applications is rapidly increasing. This course is intended to cover hardware and software aspects of 8086 microprocessor, 8051 microcontroller and brief introduction of ARM processors. Study of programming trains the student to design and

Course Objectives	
1	To familiarize the concepts and architecture of 16-bit microprocessor 8086.
2	To explain assembly language programming of 8086 microprocessor.
3	To demonstrate the architecture, instruction set and programming of8051
4	To impart C programming to interface various peripherals like data converters, timers, serial pot etc
5	To create microcontroller based embedded system
6	

Course Outcomes	
1	summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor (L2).
2	develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits
3	differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments with
4	interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC
5	identify the architectural highlights of ARM processors (L4).
6	

Specific Instructional Objectives	
1	
2	
3	

S.No	List of Topic	Type
1	Arithmetic operations on 8 bit and 16 bit operands.	Experiment
2	Transfer block of data from one memory location to another memory location.	Experiment
3	Programs using monitor routines.	Experiment
4	Compute maximum, minimum and sorting (ascending and descending)	Experiment
5	Generate Fibonacci series, average of N numbers, factorial of N.	Experiment
6	Arithmetic operations on 8051.	Experiment
7	Transfer given string serially with suitable baud rate.	Experiment
8	Generation of waveforms using timers of 8051.	Experiment
9	Interface DAC with 8051 to generate waveforms.	Experiment
10	Interface ADC with 8051 to read analog data and display read data.	Experiment
11	Interface traffic lights using microcontroller 8051.	Excersise
12	Interface stepper motor using microcontroller 8051.	Excersise
13		
14		
15		

Peadagogy Tools	ALLP	HANDOUTS					

Total Number of Contact Hours	30 Hours

Text Books		
1		AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e,Tata McGraw Hill Publications,
2		Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. McKinlay, The 8051
3		Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, Janice Mazidi, ARM Assembly
4		

Reference Books	
1	Barry B. Brey, The Intel Microprocessors: Architecture, Programming andInterfacing, 8/e,

2	Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning,
3	Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware,2/e, Tata McGraw Hill, 2006.
4	

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12	Exp13	Exp14
	TB1	RB1	OR1	TB2	RB2	OR2	TB3	RB3	OR3	TB4	RB4	OR4	TB5	RB5
	Exp15													
	OR5													

Evaluation Procedure	

Continuous Evaluation	Total 100 Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Term End Examination	

Course Outcome - Program Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1					2		
3	3	3	1		2			1		1			2		
4	3	3	2		2			1		2			2		
5	3	3	2		2			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title				L	T	P	C
PC12	MICROPROCESSORS AND MICROCONTROLLERS				3	0	2	4
School	SOE				Syllabus version			

Pre-requisties	19EEC232: DIGITAL LOGIC DESIGN
Alternate Exposure	Basic Electronical and Electronics engineering
Co-requisties	
Course Description	

The use of microcontrollers in various fields such as automobile, aeronautics, space, robotics, electronics, defense application, mobile communications, rail transport, industrial processing, and medical applications is rapidly increasing. This course is intended to cover hardware and software aspects of 8086 microprocessor, 8051 microcontroller and brief introduction of ARM processors. Study of programming trains the student to design and

Course Objectives	
1	To familiarize the concepts and architecture of 16-bit microprocessor 8086.
2	To explain assembly language programming of 8086 microprocessor.
3	To demonstrate the architecture, instruction set and programming of8051
4	To impart C programming to interface various peripherals like data converters, timers, serial pot etc
5	To create microcontroller based embedded system
6	

Course Outcomes	
1	summarize the concepts of architecture, instruction set and addressing modes of 8086 microprocessor (L2).
2	develop programs of 8086 microprocessor to perform various tasks and verify the programs with 8086 kits
3	differentiate between microprocessor and microcontroller and understand the basics of 8051 microcontroller and perform experiments
4	interpret the interfacing of microcontroller with different peripheral devices such as timers, serial port, ADC
5	identify the architectural highlights of ARM processors (L4).
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	The Processor 8086	8

Register organization of 8086, architecture of 8086, signal description of 8086, physical memory organization, I/O addressing capability

Pedagogy Tools							
	text book	coursera	nptel				
	ppts						

Unit II	Instruction Set and Interrupts	6

Addressing modes of 8086, instruction set of 8086, assembly language programs (example programs), interrupts and interrupt service routines, interrupt cycle of 8086, non-maskable interrupt, maskable interrupt (INTR).

Pedagogy Tools							
	text book	coursera	nptel				
	ppts						

Unit III	An Introduction to microcontroller 8051	8

Intel family of 8 bit microcontrollers, architecture, signal description, register set of 8051, important operational features of 8051- program status word (PSW).

Pedagogy Tools							
	text book	coursera	nptel				
	ppts						

Unit IV	Programming 8051 Timers and Serial port	8

Basic registers of timer, modes of operation, programming timers in C(examples), Basics of serial communication, baud rate in 8051, SBUF, SCON, serial port programming in C(examples)

Pedagogy Tools							
	text book	coursera	nptel				

Pedagogy Tools	ppts						

Unit V	Interfacing of Peripherals to 8051	6

ADC 0808/0809 chip with 8 analog channels, programming ADC 0808/0809 in C, DAC interfacing DAC0808, programming DAC in C.
Introduction to ARM processor:The ARM Family History, ARM family variations.

Pedagogy Tools	text book	coursera	nptel			
	ppts					

Total Number of Contact Hours	L	45	T	0	P	150

Text Books		
1		AK Ray, KM Bhurchandi, Advanced Microprocessors and Peripherals, 2/e,Tata McGraw Hill Publications,
2		Muhammad Ali Mazidi, Janice Gillispie, Mazidi, Rolin D. McKinlay, The 8051
3		Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, Janice Mazidi, ARM Assembly
4		

Reference Books	
1	Barry B. Brey, The Intel Microprocessors: Architecture, Programming andInterfacing, 8/e,
2	Kenneth J. Ayala, 8086 Micro Processor: Programming and Interfacing the PC, 1/e, Delmar Cengage Learning,
3	Douglas V Hall, Microprocessors and Interfacing: Programming and Hardware,2/e, Tata McGraw Hill, 2006.
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	5	1		2			1					2		
2	3	5	1		2			1					2		
3	3	5	1		2			1		1			2		
4	3	5	3		2			1		2			2		
5	3	5	3		4			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC13	Power System Analysis	2	1	0	3
School	SOE	Syllabus version			

Pre-requisties	Electrical Power Generation, Transmission and Distribution
Alternate Exposure	Basics of Power Systems
Co-requisties	Modelling of Power system components

Course Description

After completing this course the student will be acquainted with problems faced in power system like fault analysis, load flows, stability etc., and solution methods that are traditionally used to solve power system problems. The course equips the student with the control methods of frequency and voltage in power systems. Also the course introduces the advanced topics like SCADA, basic pricing principle of electricity market and demand side management.

Course Objectives

1	To introduce various short circuit faults that occur in power systems.
2	To acquaint the power system network using load flows and symmetric faults.
3	To stydy the mathematical solution methods to power system problems.
4	To familiarize the concept of control of frequency and voltage.
5	To import monitoring and economic management methods.

Course Outcomes — After the completion of this course, the students will be able to

1	Acquired the knowledge of various short circuit faults in power systems.
2	Enabled to do load flow studies using different numerical methods.
3	Familiar with swing equation and its solution methods.
4	Operate and Control techniques and compensation required in power system.
5	Create awareness of automation and deregulation of power systems.
6	

Specific Instructional

1	anlysis of various power system circuits using simulation tools like MATLAB.
2	
3	

Unit I	Fault Analysis	10

alternator. Symmetrical short circuit currents.
Unsymmetrical Faults: symmetrical components theory. Line to ground, line to line and line to line to ground faults. Problem solving. Fault calculations using Z-bus matrix.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit II	Power Flow Solutions	8

Bus admittance matrix. Load flow studies, Gauss-Seidel Newton-Raphson, Decoupled and Fast decoupled methods of load flow analysis. Comparison of load flow methods.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit III	Stability of Synchronous Grid	10

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault. Analysis using Equal Area Criterion and numerical methods (Euler and Runge-Kutta 4th order).Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit IV	Control of frequency and Voltage	8

Turbines and Speed-Governors. Frequency dependence of loads. Droop Control and Power Sharing. Automatic Generation Control.Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulator. Shunt Compensators, Static VAR compensators and STATCOM. Tap-Changing Transformer.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Unit V	Monitoring, Economics and Management	8

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						

Total Number of Contact Hours	L	30	T	15	P	0

Text Books	
1	J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.
2	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.
3	
4	

Reference Books	
1	O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
2	A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
3	D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education.

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1	1	2			1		1			2		
2	3	1	1	2			1			1		2		
3	3	1	1	2			1	2	1			2		
4	3	3	1	2			1		2			2		
5	3	3	1	4			2		1	1	1	2		

Date of Approval	21.05.2021

Course Code	Course Title			L	T	P	C
PC14	POWER ELECTRONICS			2	0	2	3
School	SOE			Syllabus version			

Pre-requisties	knowledge of circuit theory, signals, and basic electrical aand ectronics engineering
Alternate Exposure	Basics of electronics
Co-requisties	
Course Description	

Power Electronics deals with power conversion from mW to MW using Semiconductor devices (Diode, Thyristor, MOSFET, IGBT etc.). Power Electronics can be used in various fields such as Aerospace, Automotive electrical and electronic systems, industrial, residential, telecommunication, transportation, utility systems, etc. this is base course like Advanced power electronics and Electrical Drives and Control.

Course Objectives	
1	To impart knowledge about various power semiconductor devices
2	To introduce knowledge on the basic theory of power semiconductor devices and their practical
3	To familiarize students to the principle of operation, design and synthesis of different power conversion
4	To expose strong foundation for further study of power electronic circuits and systems
5	To train the students to analyze and design different power converter circuits.
6	

Course Outcomes	
1	Name the various power electronic devices (L1)
2	Classify the controlled rectifiers and explain the operation of each (L 2)
3	Apply Morgan, Jones and Oscillation choppers for DC motor (L3)
4	Examine the analysis of quadrant I chopper (L4)
5	Analyze voltage control in inverters (L4)
6	Conclude the various applications ac-ac converters(L5)

Specific Instructional Objectives	
1	
2	
3	

Unit I	Power semiconductor switches and SCR	9

Power diodes, power transistors, power MOSFET, IGBT,GTO, SCR, Thyristor family, two transistor model of SCR, static and dynamic characteristics, turn-on and turn-off methods, Gate characteristics, series and parallel operation of thyristors, Gate triggering circuits, Thyristor ratings, Protection circuits of SCR.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	PE lab		
	animation	text					

Unit II	Phase controlled rectifiers	8

Single phase and three phases – half wave, semi converter, full wave controlled rectifiers, dual converters, effect of load and source inductances. Natural commutation, forced commutation circuits- Self, impulse, resonant pulse, complimentary and external pulse commutation.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	PE lab		
	animation	text					

Unit III	Choppers	8

Principle of operation, step down choppers, step up choppers, Analysis of first quadrant chopper- Derivation of average load voltage, load current for continuous/discontinuous current operation, Morgan, Jones and Oscillation choppers.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	PE lab		
	animation	text					

Unit IV	Inverters	9

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	PE lab		

Pedagogy Tools	animation	text					

Unit V	AC to AC Converters	9

Principle of operation of cycloconverter, 1-phase to 1-phase cycloconverter, 3-phase to 1-phase cycloconverter, 3-phase to 3-phase cycloconverter, 1- phase and 3- phase voltage controllers using thyristors and triacs, AC choppers.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	PE Lab	
	animation	text				

Total Number of Contact Hours	L	43	T	0	P	150

Text Books		
1		R.Ramshaw, “Power Electronics”, 1/e, John Wiley, 1973.
2		Muhammad H Rashid, “Power Electronics”, 2/e, Pearson Education, 2003.
3		
4		

Reference Books	
1	M D Singh, K B Khanchandani, “Power Electronics”, 3/e, Tata MC Graw Hill, 2008.
2	P.S. Bhimbra, “Power Electronics”, 3/e, Khanna Publishers, 1999
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2	3											3		
2		2	2										3		2
3		2	3										3		2
4		2			2								3		2
5		2	1		2								3		
6	2			3										2	

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PC14	Power Electronics Laboratory	2	0	2	3
School	SOE	Syllabus version			

Pre-requisities	knowledge of circuit theory, signals, and basic electrical aand ectronics engineering
Alternate Exposure	Basics of electronics
Co-requisities	
Course Description	

Power Electronics Lab deals with power conversion from mW to MW using Semiconductor devices (Diode, Thyristor, MOSFET, IGBT etc.). Power Electronics can be used in various fields such as Aerospace, Automotive electrical and electronic systems, industrial, residential, telecommunication, transportation, utility systems, etc. this is base course like Advanced power electronics and Electrical Drives and Control.

Course Objectives	
1	To impart knowledge about various power semiconductor devices
2	To introduce knowledge on the basic theory of power semiconductor devices and their practical applications in power electronics.
3	To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
4	To expose strong foundation for further study of power electronic circuits and systems
5	To train the students to analyze and design different power converter circuits.
6	

Course Outcomes	
1	Name the various power electronic devices (L1)
2	Classify the controlled rectifiers and explain the operation of each (L 2)
3	Apply Morgan, Jones and Oscillation choppers for DC motor (L3)
4	Examine the analysis of quadrant I chopper (L4)
5	Analyze voltage control in inverters (L4)
6	Conclude the various applications ac-ac converters(L5)

Specific Instructional Objectives	
1	anlysis of various converters by experiment and using simulation tools like MATLAB, PSPICE
2	
3	

S.No	List of Topic	Type
1	Static or V-I characteristics of SCR. Find IL and IH	Experiment
2	UJT Relaxation Oscillator	Experiment
3	1-phase half controlled rectifier with R and RL Load	Experiment
4	MOSFET based step up/ step down chopper	Experiment
5	1-phase AC voltage controller using TRIAC	Experiment
6	Voltage commutation	Experiment
7	3-phase Fully controlled Rectifier	Experiment
8	1-phase Dual converter	Experiment
9	3-phase IGBT based PWM Inverter	Experiment
10	3-phase VVVF PWM Inverter	Experiment
11	1-phase Cyclo-converter	Experiment
12	Complementary Commutation	Experiment

Peadagogy Tools							
	experiment modules	power electronics LAB	converter kit	PSPICE			
	MATLAB						

Total Number of Contact Hours	30 Hours

Text Books	
1	R.Ramshaw, “Power Electronics”, 1/e, John Wiley, 1973.
2	Muhammad H Rashid, “Power Electronics”, 2/e, Pearson Education, 2003.
3	
4	

Reference Books		Topic
1	M D Singh, K B Khanchandani, “Power Electronics”, 3/e, Tata MC Graw Hill, 2008.	
2	P.S. Bhimbra, “Power Electronics”, 3/e, Khanna Publishers, 1999	
3		
4		

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12		
	TB1	RB1	TB1	TB2	RB2	TB2	TB1	RB2	RB2	TB1	RB2	RB1		

Evaluation Procedure														
Continuous Evaluation	Total XX Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			

Term End	Total 100 Marks														
Course Outcome -															
Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1		1			2		
3	3	3	2		2			1		2			2		
4	3	3	2		2			2		1	1	1	2		
5															
6															
Date of Approval												21.05.2021			

Course Code	Course Title	L	T	P	C
PC15	POWER SYSTEM PROTECTION Laboratory	2	0	2	3
School	SOE	Syllabus version			

Pre-requisities	knowledge of power systems,circuit theory, signals and systems
Alternate Exposure	Basics of power systems
Co-requisities	
Course Description	

This Laboratory course is aimed to introduce the students the principle of protection and describes the protection of electrical power system components from faults through the disconnection of faulted parts from the rest of the electrical network. Protection scheme is to keep the power system stable by isolating only the components that are under fault. Thus, protection schemes are applicable for very pragmatic and pessimistic approach to clearing the system faults. This is a basic course for power system stability, power system operation and control and Advanced power system protection courses.

Course Objectives	
1	To expose basic concepts of circuit breakers and different circuit breakers.
2	To impart basic idea of protective relay and different types of relays.
3	To acquaint various static relays used in protection
4	To enable the various Computer-aided protection schemes.electronic circuits and systems
5	To accustom different system protection schemes. power converter circuits.
6	

Course Outcomes	
1	Explain the field of power system protection and discuss about basic operation of C.B's.(L1)
2	Demonstrate the working mechanism of circuit breakers and their selection for each of protection scheme design. (L2)
3	Compare the concept of different types of relays, including differential relay, distance relay, etc. and their selection for each protection scheme design. (L
4	Compare the types of static relays. (L4)
5	Develop the Digital Protection algorithms. (L6)
6	Estimate the Effect of Power Swings on Distance Relaying. (L5)

Specific Instructional Objectives	
1	anlysis of various protection devices by experiment and using simulation tools like MATLAB, PSPICE
2	
3	

S.No	List of Topic	Type
1	Study of different types of insulators.	Experiment
2	Study of different types of relays.	Experiment
3	Time-current characteristics of fuse.	Experiment
4	Static over voltage relay.	Experiment
5	Static under voltage relay.	Experiment
6	Time-current characteristics of over current relay.	Experiment
7	Operating characteristics of biased differential relay.	Experiment
8	Earth resistance measurement.	Experiment
9	Transmission line parameters.	Experiment
10	Ferranti effect of transmission line.	Experiment
11	Transmission line efficiency for different loads. a) No load with phase shift in injected voltage b) Mid tapped load	Experiment
12	Real and reactive power flow in transmission line	Experiment
13	Transmission line voltage regulation for different loads.	Experiment
14	Transmission line reactive power compensation with load.	Experiment
15	Enhancing the power flow of transmission line series compensation.	Experiment

Peadagogy Tools							
	experiment modules	power systems LAB	coursera				
	MATLAB						

Total Number of Contact Hours	30 Hours

Text Books	
1	Badriramand D.N. Viswakarma, "Power System Protection and Switchgear", 2/e, Tata McGrawHill, 2011.
2	A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.Education, 2003.
3	
4	

Reference Books		Topic

1	J.B. Gupta , “Switchgear and protection”, S.K.Kataria & sons,2009
2	J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, Newyork, 1987.1999
3	Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall,India, 2010.
4	A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008.
5	D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.Measurements and their Applications”, Springer, 2008.

Online Resources	
1	
2	
3	

Mapping	Experiment Related Books													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	Exp11	Exp12	Exp13	
	TB1	RB1	TB1	RB2	RB3	TB2	RB4	RB2	RB2	TB1	RB5	RB1		
	Exp14	Exp15												
	TB2	RB5												

Evaluation Procedure														
Continuous Evaluation	Total XX Marks													
	Exp1	Exp2	Exp3	Exp4	Exp5	Exp6	Exp7	Exp8	Exp9	Exp10	EAT			
	8	8	8	8	8	8	8	8	8	8	20			
Term End Examination	Total 100 Marks													

Course Outcome -

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	1		2			1					2		
2	3	3	1		2			1		1			2		
3	3	3	2		2			1		2			2		
4	3	3	2		2			2		1	1	1	2		
5															
6															

Date of Approval	21.05.2021

Course Code	Course Title				L	T	P	C
PC15	POWER SYSTEM PROTECTION				2	0	2	3
School	SOE				Syllabus version			

Pre-requisties	knowledge of power systems,circuit theory, signals and systems

Alternate Exposure	Basics of power systems

Co-requisties	

Course Description	

This course is aimed to introduce the students the principle of protection and describes the protection of electrical power system components from faults through the disconnection of faulted parts from the rest of the electrical network. Protection scheme is to keep the power system stable by isolating only the components that are under fault. Thus, protection schemes are applicable for very pragmatic and pessimistic approach to clearing the system faults. This is a basic course for power system stability, power system operation and control and Advanced power system protection

Course Objectives	
1	To expose basic concepts of circuit breakers and different circuit breakers.
2	To impart basic idea of protective relay and different types of relays.
3	To acquaint various static relays used in protection
4	To enable the various Computer-aided protection schemes.electronic circuits and systems
5	To accustom different system protection schemes. power converter circuits.
6	

Course Outcomes	
1	Explain the field of power system protection and discuss about basic operation of C.B's.(L1)
2	Demonstrate the working mechanism of circuit breakers and their selection for each of protection scheme design. (L2)
3	Compare the concept of different types of relays, including differential relay, distance relay, etc. and their selection for each protection sc
4	Compare the types of static relays. (L4)
5	Develop the Digital Protection algorithms. (L6)
6	Estimate the Effect of Power Swings on Distance Relaying. (L5)

Specific Instructional Objectives	
1	
2	
3	

Unit I	Circuit breakers	10

Methods of arc interruption, Expression for RRRV. Resistance switching. Single frequency transients. Current chopping, interruption of capacitive currents. Classification of circuit breakers, principle of operation and constructional features of oil, air, air-blast, SF6 and vacuum circuit breakers. Ratings of circuit breakers. Testing of circuit breakers. Auto reclosing.

Pedagogy Tools	ppts	chalk board	nptel	PS lab			
	animation	text					

Unit II	Faults and Over-Current Protection	8

Types of electromagnetic relays, application, characteristics and general equation of over current. Earth fault. Differential and distance relays. Directional relays. Protection: Feeder protection, protection of transformers, generators, motors.

Pedagogy Tools	ppts	chalk board	nptel	PS lab			
	animation	text					

Unit III	Static Relays	8

Advantages of static relays. Comparators, amplitude and phase comparators. Duality. Classification of static relays: over current, distance, differential protection relays.

Pedagogy Tools	ppts	chalk board	nptel	PS lab			
	animation	text					

Unit IV	Digital Protection	8

rotection, Fourier analysis for phasor estimation, Discrete Fourier Transform and application to current and voltage phasor estimation. DFT issues like

Pedagogy Tools	ppts	chalk board	MATLAB	nptel	PS lab		

Pedagogy Tools	animation	text					

Unit V	System Protection	8

Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

Pedagogy Tools	ppts	chalk board	MATLAB	nptel	PS Lab	
	animation	text				

Total Number of Contact Hours	L	42	T	0	P	150

Text Books

1		Badriramand D.N. Viswakarma, “Power System Protection and Switchgear”, 2/e, Tata McGrawHill, 2011.
2		A. G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, John Wiley & Sons, 1988.Education, 2003.
3		
4		

Reference Books

1	J.B. Gupta , “Switchgear and protection”, S.K.Kataria & sons,2009
2	J. L. Blackburn, “Protective Relaying: Principles and Applications”, Marcel Dekker, Newyork, 1987.1999
3	Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall,India, 2010.
4	A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer, 2008.
5	eimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.Measurements and their Applications”, Springer, 20

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2	3											3		
2		2	2										3		2
3		2	3										3		2
4		2			2								3		2
5		2	1		2								3		
6	2			3										2	

Date of Approval	21.05.2021

Course Code	Course Title			L	T	P	C
PE!	ELECTRICAL MACHINE DESIGN			3	0	0	3
School	SOE			Syllabus version			

Pre-requisties	Electrical Machines 1, Electrical Machines II, Special electrical machines
Alternate Exposure	
Co-requisties	Electrical Machines
Course Description	

This course is aimed to introduce the students the principles and design concepts of machines. The concepts to design the main dimensions and the operating characteristics of dc machine, transformer, induction motor and synchronous machines are highlighted. Transformers and synchronous machines designs are used during substations and power plants erection worldwide. This course is base to power electronic drives, power system stability.

Course Objectives	
1	To expose the students towards the major consideration in the design of electrical machines.
2	To enable overall designing of transformers and learning the operating characteristics
3	To demonstrate the students the designing of induction motor stator and rotor along with performance analysis
4	To train the size and design of synchronous machine
5	To demonstrate the limitations of traditional designs and emphasizing the concepts of modern machines
6	

Course Outcomes	At the end of this course, students will demonstrate the ability to
1	Understand the basic concepts of machine design parameters
2	Identify the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
3	Understand the design dimensions and characteristics of Transformers
4	choose the design procedures to find the main dimensions of Induction Motor and learns the operating characteristic of Induction machine
5	Designing of salient pole machine, turbo generator
6	Understand the structures of PMSMs, BLDCs, SRM.

Specific Instructional Objectives	
1	
2	
3	

Unit I	General aspects	No of Hours required

General aspects: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, temperature rise, rating of machines.
DC Machine: Main dimensions, output equation.

Pedagogy Tools							
	text book	nptel					
	ppts						

Unit II	Transformers	No of Hours required

Main dimensions, KVA Output for single phase and three phase transformers, window space factor, over all dimensions, temperature rise in transformers, and method of cooling.

Pedagogy Tools							
	text book	nptel					
	ppts						

Unit III	Induction machines	No of Hours required

Main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations ,magnetizing current, short circuit current

Pedagogy Tools							
	text book	nptel					
	ppts						

Unit IV	Synchronous Machines	No of Hours required

Main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of turbo alternators, rotor design.

Pedagogy Tools							
	text book	nptel					

Pedagogy Tools	ppts						

Unit V	Computer aided Design (CAD	No of Hours required

Limitations (assumptions) of traditional designs need for CAD analysis. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs,SRM.

Pedagogy Tools	text book	nptel				
	ppts					

Total Number of Contact Hours	L	45	T	0	P	150

Text Books		
1		clayton and Hancock, “Performance and Design Of DC Machines”, 3/e, CBS, 2001.
2		M. G Say, “Performance and Design of AC Machines, Pitman”, 3/e, ELBS. 1983.
3		
4		

Reference Books	
1	A.K .Sawhney, “A course of Electrical Machine Design”, Dhanpat Rai and Sons, 1970
2	K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping															
Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	4	1		2			1					2		
2	3	4	1		2			1					2		
3	3	4	1		2			1		1			2		
4	3	4	3		2			1		2			2		
5	3	4	3		4			2		1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title					L	T	P	C
PE2	ELECTRICAL DISTRIBUTION SYSTEMS					3	0	0	3
School	SOE					Syllabus version			

Pre-requisties	19EEE431-Power Systems II
Alternate Exposure	Basics of electricity
Co-requisties	

DC Machines and Transformers, AC Machines, Electric power transmission and didtribution

Course Description

The structure and load patterns of a power distribution system are significantly different than transmission system. This course gives insight into various aspects of distribution system such as basic components and factors, distribution feeders, system analysis, compensation, design, operation and coordination. In addition, distribution systems are transitioning from passive to active with the adoption of distributed generation, storage, and smart-grid technologies. Therefore, this course acts as base course for analysis of distribution systems with distributed

Course Objectives

1	To interpret load modeling and analyze the characteristics of loads.
2	To identify the design concepts of primary and secondary systems.
3	To explain substation bus schemes and know the difference between them.
4	To demonstrate the coordination procedure of various protective devices.
5	To determine the optimum capacitor location and can understand the applications of capacitors in distribution systems .
6	To explain the importance of voltage control and list the equipment used for it.

Course Outcomes	After the completion of this course, the students will be able to
1	Demonstrate the effects of load variation , voltage fluctuations and motor starting.(L2)
2	Explain the measures to reduce flickering. (L2)
3	Interpret the need for coordination of protective devices. (L2)
4	Illustrate the general coordination procedure.(L2)

Specific Instructional

1	Anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

Unit I	Introduction to distribution systems	8

Overview of distribution systems. Load modeling and characteristics. Coincidence factor, contribution factor loss factor. Relationship between the load factor and loss factor.Classificationofloads(residential,commercial,agriculturalandindustrial) and their characteristics.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit II	Design considerations of distribution feeder	6

Basic design practice of the secondary distribution system. Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit III	System analysis	8

Voltage drop and power loss calculations: derivation for voltage drop and power loss in line, distribution automation. Energy management, load management. Limitations of distribution systems. Improvement of existing distribution system, fault locations, future orientation of rural system.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit IV	Capacitive compensation for power factor control	8

Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors, effect of series capacitors. Power factor correction, capacitor allocation. Economic justification. Procedure to determine the best capacitor location

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		

Pedagogy Tools	ppts						

Unit V	Design, operation and coordination	6

Load variation, voltage fluctuations, Motor starting, simultaneous operation. Continuous varying loads, measure to reduce flickering. Coordination of protective devices: general coordination procedure.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	45	T	0	P	0	

Text Books

1	TuranGonen, Electric Power Distribution System, Engineering, 4/e, McGrawHill ,1985.
2	A.S.Pabla,ElectricPowerDistribution,4/e,TataMcGrawHill,1997.

Reference Books

1	S.Sivanagaraju, V.Sankar, Electrical Power Distribution and Automation, DhanpatRai and Co,2006.
2	V.Kamaraju, Electrical Power Distribution systems, 3/e, Right publishers, 2009.

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2	2	1	1								2		
2	3		1	1	1								2		
3	3	2	1	1	1					1			2		
4	3	1	1	2						2			2		
5	3		2	2	1					1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title					L	T	P	C
PE3	HIGH VOLTAGE ENGINEERING					3	0	0	3
School	SOE					Syllabus version			

Pre-requisties	19EEE431-Power Systems II
Alternate Exposure	Basics of electricity
Co-requisties	

DC Machines and Transformers, AC Machines, Electric power transmission and didtribution

Course Description

In this course it is aimed to introduce the principles of high voltage engineering to the students. Principle causes of over voltages and currents, types and protection against these over voltages and currents are discussed. Mechanism of breakdown in solids, liquids and gases, generation, measurement and testing of the high voltages and currents are enlightened in this subject.

Course Objectives

1	Study the principles of power system protection
2	Familiarize the phenomenon of generation of over voltages and their protection.
3	Expose the mechanisms of electrical breakdown in gases, liquids and solids.
4	Study the methods of generation of high voltages and currents.
5	Impart the methodologies involved in measurement of high voltages and currents.
6	To explain the importance of voltage control and list the equipment used for it.

Course Outcomes	After the completion of this course, the students will be able to
1	Define various testing standards (L1)
2	Explain the testing of insulators, bushings, cables and transformers. (L2)
3	Explain the testing of isolators, circuit breakers, surge diverters (L2)
4	Outline the testing facility requirements and safety precautions.(L2)
5	
6	

Specific Instructional	
1	Anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

Unit I	Over Voltages in Electrical Power Systems	8

Causes of over voltages and their effects on power system , lightning, switching and temporary over voltages, Protection against over voltages , insulation coordination.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit II	Electrical breakdown in gases, solids and liquids	6

Gaseous breakdown in uniform and non-uniform fields , corona discharges. Vacuum breakdown. Conduction and breakdown in pure and commercial liquid. Breakdown mechanisms in solid and composite dielectrics.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit III	Generation of high voltage and currents	8

Generation of high DC voltages, multiplier circuits. Van de Graff generator. High alternating voltage generation using cascade transformers. Production of high frequency AC high voltages. Standard impulse wave shapes. Marx circuit ,generation of switching surges.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit IV	Measurement of high voltages and currents	8

HVDC measurement techniques. Measurement of power frequency A.C voltages. Sphere gap measurement technique, Potential divider for impulse voltage measurements. Measurement of high DC and AC impulse currents.

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		

Pedagogy Tools	ppts						

Unit V	High voltage testing	6

Various standards for HV Testing of electrical apparatus .Tests on insulators. Testing of bushings, Testing of isolators and circuit breakers. Cable testing, testing of transformers. Surge diverter testing. Use of I.S for testing. Testing facility requirements, safety precautions in H. V. Labs.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	45	T	0	P	0

Text Books	
1	M.S Naidu., and Kamaraju, “High Voltage Engineering”, 4/e, Tata McGraw Hill, 2009.
2	E Kuffel and M.Abdullah., “High Voltage Engineering”, 2/e,Pergamon Press, 2000.

Reference Books	
1	C.LWadhwa., “High Voltage Engineering”, 2/e,Wiley Eastern, 2007
2	Dieter Kind, “An Introduction to High Voltage ExperimentalTechnique”, 1/e,WileyEastern,
3	RavindraArora, Wolfgang Mosh, “High Voltage and Electrical Insulation Engineering”,

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1	2	1									2		
2	3		1	2	1								2		
3	3	2		1	2					1			2		
4	3	1	2							2			2		
5	3		2	2	1					1	1	1	2		
6															

Date of Approval	21.05.2021

Course Code	Course Title				L	T	P	C
PE4	Wind and Solar Energy Systems				3	0	0	3
School	SOE				Syllabus version			

Pre-requisties	WIND AND SOLAR ENERGY SYSTEMS
Alternate Exposure	Renewable Energy Systems
Co-requisties	
	Environmental Management , Power sysyems, Hybrid Electic Vehicles
Course Description	

By undergoing this course, the student will acquire the knowledge of renewable energy system particularly wind and solar PV like their historical development, control etc.

Course Objectives	
1	To Identify the control methods used with wind energy system.
2	To Define Stall and aerodynamic control of wind turbine
3	To List different solar receivers
4	To Identify the Power Electronic Converters used with PV system.
5	To Classify the issues while integrating PV and Wind systems to grid

Course Outcomes	After the completion of this course, the students will be able to
1	Understand the history and operating principles of PV and Wind energy conversion.
2	Evaluate the control methods used in PV and Wind energy systems.
3	Understand Solar geometry and solar collectors
4	Identify the Power Electronic Converter and maximum power point tracking methods
5	List the different grid integrating issues like power quality etc.
Specific Instructional	
1	Analyzation of various Renewable Energy System using simulation tools like HOMER, RETScreen etc.,
2	
3	

Unit I	Overview of Wind Energy Conversion Systems:	8

Installed capacity and Growth rate , Small and Large wind turbines,Stand alone and grid connected Applications, On-Land and Offshore Applications, Costs of Wind Energy Conversion Systems. Fundamentals of WECS Control: Wind Turbine Components. Wind Turbine Aerodynamics: Power Characteristic of Wind Turbines, Aerodynamic Power Control: Passive Stall, Active Stall, and Pitch Control, Tip Speed Ratio. Maximum Power Point Tracking Control: MPPT with Turbine Power Profile, with Optimal Tip Speed Ratio and with Optimal Torque Control.

Pedagogy Tools	text book	coursera	nptel	Pvsyst software	matlab		
	ppts	Power system lab					

Unit II	Wind Turbine Technology	6

Horizontal- and Vertical-Axis Wind Turbines, Fixed-and Variable-Speed Turbines, Stall and Pitch Aerodynamic Power Controls. Fixed-Speed WECS without Power Converter Interface, Variable-Speed Systems with Reduced-Capacity Converters, Variable-Speed Systems with Full-Capacity Power Converters.on.

Pedagogy Tools	text book	coursera	nptel	Pvsyst software	matlab		
	ppts	Power system lab					

Unit III	The Solar Resource	8

Introduction,solar radiation spectra, solar geometry,Energy sun angles, Observer sun angles, solar day length, Estimation of solar energy availability.

Pedagogy Tools	text book	coursera	nptel	Pvsyst software	matlab		
	ppts	Power system lab					

Unit IV	Solar photovoltaic	8

Technologies-Amorphous, mono crystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT)algorithm.

Pedagogy Tools	text book	coursera	nptel	Pvsyst software	matlab		
	ppts	Power system lab					

Unit V	Network Integration Issues	6

Overview of grid code technical requirements, fault ride-through for wind farms -real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Pedagogy Tools	text book	coursera	nptel	Pvsyst software	matlab		
	ppts	Power system lab					

Total Number of Contact Hours	L	36	T	0	P	150

Text Books

1		_Navid_Zargari,_Samir_Kour,"Power Conversion and Control of Wind Energy Systems", IEEE Press Series on Power Engineering,
2		2.S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
3		
4		

Reference Books

1	G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
2	T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd.,2005.
3	H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
4	G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2	2		2			2					2	2	
2	3	2	1		2			2	2				3		
3	3	2	1		2			2	2	1			2	1	
4	3	2	3		2			1	2	2		2	2	1	
5	3	2	3		2			2	2	1	1	2	3	2	
6															

Date of Approval	21.05.2021

Course Code	Course Title				L	T	P	C
PE5	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS				3	0	0	3
School	SOE				Syllabus version			
Pre-requisties	ARTIFICIAL INTELLIGENCE APPLICATIONS TO POWER SYSTEMS							
Alternate Exposure	Fuzzy Control Systems Design and Analysis							
Co-requisties								
	Fuzzy Set Theory, Fuzzy Logic and Applications							
Course Description								
This course is aimed to introduce the concepts of rule based expert system,Artificial neural networks, Genetic Algorithm and Hybrid intelligence techniques . This course deals with applications of rule based expert system,Artificial neural networks, Genetic to power systems with the help of simulation studies.AI with the help of sophisticated computer tools is applied to resolve stability, strengthening, reliability, technical advancements, problems for large power systems.								
Course Objectives								
1	Motivation to design fuzzy systems and control.							
2	The study of control-theoretic foundations such as stability and robustness in the frame work of fuzzy control.							
3	Analysis of learning systems in conjunction with feedback control systems.							
4	Exposure to many real world fuzzy control problems.							
Course Outcomes	After the completion of this course, the students will be able to							
1	Provide a strong understanding of Fuzzy Systems theory and design principles(L3).							
2	Provide a good understanding of fuzzy logic controller design(L3).							
3	Provide a good understanding of fuzzy PID controller design(L3).							
4	Provide a good understanding of fuzzy logic based optimization(L3).							
Specific Instructional								
1	Analysis of various soft computing techniques using softwares like C programming, MATLAB etc.,							
2								
3								
Unit I	Expert systems						8	
Major characteristics of expert systems, rule-based expert systems, application to power systems.								
Pedagogy Tools	text book	coursera	nptel	chine Learning Softv	matlab			
	ppts	simulation lab						
Unit II	Fuzzy Logic						6	
Characteristics of fuzzy logic systems, fuzzy logic in power systems.								
Pedagogy Tools	text book	coursera	nptel	chine Learning Softv	matlab			
	ppts	simulation lab						
Unit III	Artificial neural networks						8	
Artificial neural networks, neural network types, neural networks in power systems.								
Pedagogy Tools	text book	coursera	nptel	chine Learning Softv	matlab			
	ppts	simulation lab						
Unit IV	Genetic algorithm:						8	
Characteristics of genetic algorithm, genetic algorithms in power systems.								
Pedagogy Tools	text book	coursera	nptel	chine Learning Softv	matlab			
	ppts	simulation lab						
Unit V	Hybrid systems						6	

Hybrid intelligence techniques, application in power systems.							
Pedagogy Tools	text book	coursera	nptel	hine Learning Soft	matlab		
	ppts	simulation lab					

Total Number of Contact Hours	L	36	T	0	P	150

Text Books

1	D.W.Patterson, "Introduction to Artificial Intelligence and Expert systems", 2/e ,PHI, 2009.

Reference Books

1	Yong-Hua Song, Allan Johns, Raj Aggarwal, "Computational Intelligence Applications to Power Systems" , Science Press , 1/e ,Kluwer Academic Publishers,1997.

Evaluation Procedure					
Continuous Evaluation	Total 70 Marks				
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2		2	2		3	2	3	2	2	2		
2	2	2		2				2	2		2	3	2	
3	2	2						2	2		2	3	2	
4	2	2	2				2		2		2	3	2	
5	3	2	2	3	2		2	2	2		2	3	2	

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PE6	ELECTRIC DRIVES(Elective)	3	0	0	3
School	SOE	Syllabus version			

Pre-requisties	Power Electronics, DC Machines and Transformers, AC Machines
Alternate Exposure	
Co-requisties	Control Systems

Course Description

In this course it is aimed to enable the students on introduction to the operation of electric drives controlled from a power electronic converters and also provides the design concepts of controller. To familiarize students with applications of electric motor drives in industries. This can be a base course for Advanced AC and DC Electrical drives.

Course Objectives	
1	To introduce main principles of drives
2	To familiarize with basic requirements placed by mechanical systems on electric drives.
3	To study the basic concept of electric braking.
4	To enable with phase controlled DC motor drives.
5	To expose to power electronic controlled AC drives.

Course Outcomes	After the completion of this course, the students will be able to
1	What is electric drives(L1)
2	Identify the different types of load torques (L3)
3	Illustrate the operation of electric drive (L2) excitation(L3).
4	Define the dynamics in the motor -load combinations. (L1)
5	Identify the suitable motor for suitable applications. (L3)
6	Develop a suitable braking system to a suitable electric drive (L3)

Specific Instructional	
1	anlysis of various circuits using simulation tools like MATLAB, PSPICE, Caspoc, LabVeiw
2	
3	

Unit I	Introduction	8

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, multi-quadrant operations, Constant torque and constant power operation, Types of load torque: components, nature and classification

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts	lab					

Unit II	Dynamics of Electric Drive	9

Dynamics of motor-load combination Steady state stability of Electric Drive, Transient stability of electric Drive, Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty; Load equalization

Pedagogy Tools	text book	coursera	nptel	circuit simulator	matlab		
	ppts	lab					

Unit III	Electric Braking	8

Purpose and types of electric braking, braking of DC, three phase induction and synchronous motors, Calculation of acceleration time and energy loss during starting of DC shunt and three phase induction motors, Energy relations during braking

Pedagogy Tools	text book	coursera	nptel	circuit simulator	matlab		
	ppts	lab					

Unit IV	Power Electronic Control of DC Drives	8

1- phase and 3- phase controlled converter fed separately excited DC motor drives (continuous conduction only), dual converter fed separately excited DC motor drive, rectifier control of DC series motor, Chopper control of separately excited DC motor and DC series motor.

Pedagogy Tools	text book	coursera	nptel	circuit simulator	matlab		

Pedagogy Tools	ppts	lab					

Unit V	Power Electronic Control of AC Drives	9

3-Phase induction Motor Drive- Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based), static rotor resistance and slip power recovery control schemes. 3-Phase Synchronous motor-staring using SCR's, Self controlled and true synchronous scheme.

Pedagogy Tools	text book	coursera	nptel	circuit simulator	matlab		
	ppts	lab					

Total Number of Contact Hours	L	42	T	0	P	0

Text Books	
1	G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House.
2	S.K. Pillai, "A First Course on Electric Drives", New Age International.
3	B.N. Sarkar, "Fundamental of Industrial Drives", Prentice Hall of India Ltd.
4	

Reference Books	
1	M. Chilkin, "Electric Drives",Mir Publishers, Moscow.
2	Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore.
3	N.K. De and Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd.
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1		2			1					2		
2	3	1		2			1					2		
3	3	1		2			1		1			2		
4	3	3		2			1		2			2		
5	3	3		4			2		1	1	1	2		
6														

Date of Approval	21.05.2021

Course Code	Course Title			L	T	P	C
PE7	INDUSTRIAL ELECTRICAL SYSTEMS			3	0	0	3
School	SOE			Syllabus version			

Pre-requisties	Power System Protection
Alternate Exposure	
Co-requisties	
Course Description	

This course is designed around industrial maintenance personnel, to help them diagnose and repair electrical faults. The significance of this course is to equip learners with the skills and knowledge necessary to successfully carryout basic service and maintenance. This course is basic for utilization of electrical energy

Course Objectives	
1	To introduce students to LT system wiring components
2	To train students about residential and commercial wiring systems
3	To import students about various illumination systems
4	To acquaint students about various substation equipment and DG systems
5	To demonstrate the students role industrial electrical system automation using PLC's and SCADA
6	

Course Outcomes	
1	Student will be able to explain the importance of protection components
2	Student will be able to demonstrate residential and commercial wiring systems
3	Student will be able to estimate lighting schemes for residential and commercial premises
4	Student will be able to distinguish different types of compensation devices
5	Student will be able to determine the role of automation
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	Electrical system components	8

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Pedagogy Tools	text book	coursera	nptel	ppt			

Unit II	Residential and Commercial Electrical Systems	8

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Pedagogy Tools	text book	coursera	nptel	ppt			

Unit III	Illumination Systems	8

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premise, flood lighting.

Pedagogy Tools	text book	coursera	nptel	ppt			

Unit IV	Industrial Electrical Systems	8

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels, Specifications of LT Breakers, MCB and other LT panel components. DG Systems, UPS System, Selection of UPS and Battery Banks.

Pedagogy Tools	text book	coursera	nptel	ppt			

Unit V	Industrial Electrical System Automation	6

Study of basic PLC, Role of PLC in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation

Pedagogy Tools	text book	coursera	nptel	ppt		

Total Number of Contact Hours	L	40	T	0	P	0

Text Books

1		S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating &Costing”, Khanna publishers, 2008
2		H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008
3		
4		

Reference Books

1	K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007
2	S. Singh and R. D. Singh, “Electrical estimating and costing”, DhanpatRai and Co., 1997.Web site for IS Standards
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	1		1		1					2		1	2		
2	2		2			3	3		2		1			2	1
3	1	2	1					1		2				1	
4	1			2		3		3			1		2		
5			2		2				1	3				3	
6															

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE8	Power Quality & FACTS		3	0	0	3
School	SOE		Syllabus version			

Pre-requisties	Electrical Power transimission and distribution , Power System Protection
Alternate Exposure	
Co-requisties	Power Electronics
Course Description	he basic concepts of reactive power compensation and power quality conditions are explained. Different configurations and con

Course Objectives	
1	Expose basic concepts of reactive power compensation.
2	Study various series and shunt compensating FACTS
3	Analyze the working of VSC, STATCOM, SSSC and UPFC
4	Expose the various power quality problems.
5	Interpret the working of DSTATCOM, DVR and UPQC
6	

Course Outcomes	
1	compare various reactive power compensation techniques. (L2)
2	identify various series and shunt compensating devices in FACTS (L3)
3	estimate the location of VSC, STATCOM, SSSC and UPFC (L6)
4	evaluate various power quality problems. (L4)
5	appraise the working of DSTATCOM, DVR and UPQC (L5)
6	

Specific Instructional Objectives	
1	Analysis and mathmatical modelling of various power quality issues using MATLAB, PSCAD
2	
3	

Unit I	Transmission Lines and Series/Shunt Reactive Power Compensation	8

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Pedagogy Tools	text book	coursera	nptel	PSCAD	MATLAB		
	ppts						

Unit II	Thyristor-based Flexible AC Transmission Controllers (FACTS)	8

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Pedagogy Tools	text book	coursera	nptel	PSCAD	MATLAB		
	ppts						

Unit III	Voltage Source Converter based (FACTS) controllers	10

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control.

Pedagogy Tools	text book	coursera	nptel	PSCAD	MATLAB		
	ppts						

Unit IV	Power Quality Problems in Distribution Systems	

Introduction of the Power Quality (PQ) problem, Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Sources of PQ problems, Remedies to improve PQ, power quality monitoring.

Pedagogy Tools	text book	coursera	nptel	PSCAD	MATLAB		

Pedagogy Tools	ppts						
Unit V	DSTATCOM, DVR, UPQC					8	
Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM. Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle							

Capabilities and Control Strategies.

Pedagogy Tools	text book	coursera	nptel	PSCAD	MATLAB		
	ppts						

Total Number of Contact Hours	L	45	T	0	P	150

Text Books

1		N. G. Hingorani and L. Gyugyi, “Understanding FACTS: Concepts and Technology of FACTS Systems”, Wiley-IEEE Press, 1999.
2		K. R. Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd. 2007.
3		T. J. E. Miller, “Reactive Power Control in Electric Systems”, John Wiley and Sons, New York, 1983.
4		

Reference Books

1	R. C. Dugan, “Electrical Power Systems Quality”, McGraw Hill Education, 2012.
2	G. T. Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1991
3	
4	

Evaluation Procedure					
Continuous Evaluation	Total 70 Marks				
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	2	1					1		1	2		3	1	2
2	3	2	1					1		1	2		2	1	2
3	3	2	1					1		1	2		2	1	3
4	1						2	1					1	1	
5	2	3	2					1			2		2	2	3
6															

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE9	HVDC Transmission Systems		2	1	2	4
School	SOE		Syllabus version			

Pre-requisties	19EEE443: HVDC Transmission Systems
Alternate Exposure	Electrical Power Systems ,Power Electronics
Co-requisties	

DC Machines and Transformers, AC Machines, Electric power transmission and didtribution

Course Description

operation and control of HVDC transmission systems. The historical aspects of HVDC systems, types of HVDC, Converter configurations, control of converters, faults in HVDC, harmonics and elimination of harmonics are discussed in this subject

Course Objectives

1	Study operational concerns of existing HVDC
2	Demonstrate Next generation HVDC Technologies
3	Expose HVDC Converter operation & control.
4	Train with the protection of HVDC system.
5	Study of Harmonic generation and Filtering
6	

Course Outcomes	After the completion of this course, the students will be able to
1	e historical developments, advantages and drawbacks, applications, types and economic factors of a.c. and d.c transmissi
2	Analyze various converter configurations
3	Develop equivalent circuit of HVDC system.
4	Conclude various faults and protection schemes employed in HVDC.
5	Develop the circuits for elimination of harmonics in HVDC systems.
6	

Specific Instructional

1	anlysis of various circuits using simulation tools like MATLAB, PSPICE
2	
3	

Unit I	General aspects and converter circuits	10

Historical developments, HVAC and HVDC links comparison, Economic technical performance, reliability, limitation. Modern Trends in HVDC Technology, Application of DC Transmission, Properties of thyristor converter circuits, assumptions, choice of best circuit for HVDC converters, Components of a HVDC system.

Pedagogy Tools							
	text	coursera	nptel		matlab		
	ppts	circuitlab					

Unit II	Bridge converters analysis	8

Assumptions, Analysis with gate control bus no overlap, Analysis with gate control and overlap less than 60 degrees. Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Equivalent circuit for rectifier, Operation of inverter, Equivalent and modified equivalent circuit of HVDC link.

Learning outcomes:

Pedagogy Tools							
	text	coursera	nptel		matlab		
	ppts	circuitlab					

Unit III	Bridge converters control	8

Basic means of control, power reversal, desired features of control, actual control characteristics, Basic characteristics, modification of control characteristics, System control hierarchy, firing angle control schemes

Pedagogy Tools							
	text	coursera	nptel		matlab		
	ppts	circuitlab					

Unit IV	Mis-operation of Converters and Protection	8

Converter disturbance, bypass action in bridges, Commutation failure, basics of protection, DC reactors, DC circuit breakers, over voltage protection

Pedagogy Tools							
	text	coursera	nptel		matlab		

Pedagogy Tools	ppts	circuitlab					

Unit V	Harmonics and Multi Terminal DC (MTDC) systems	8

ic harmonics, Troubles due to harmonics, harmonic filters, single tuned and double tuned filters, Multi-Terminal Systems: Series an

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts	circuitlab					

Total Number of Contact Hours	L	36	T	0	P	150

Text Books

1	E.W. Kimbark, “HVDC Transmission” , John Wiley publishers
2	K.R.Padiyar , “HVDC Transmission”, 3/e, New age Publishers, 2013.
3	
4	

Reference Books

1	A.Chakraborthy, M.L.Soni, P.V.Gupta,“A Text Book on Power System Engineering” , 1/e,
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	1		2			1					2		
2	3	1		2			1					2		
3	3	1		2			1		1			2		
4	3	3		2			1		2			2		
5	3	3		4			2		1	1	1	2		
6														

Date of Approval	21.05.2021

Course Code			L	T	P	C
19EEE444	HYBRID ELECTRIC VEHICLES		3	0	0	3
School	SOE		Syllabus version			

Pre-requisties	Electrical Machines
Alternate Exposure	
Co-requisties	Battery Technologies, Electric Drives
Course Description	

This course introduces the fundamental concepts, principles, analysis and design of hybrid and electric vehicles. The course will be useful for post-graduate students, teachers, practitioners and final year undergraduate students. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc. Each topic will be developed in logical progression with up-to-date information.

Course Objectives	
1	Study various basic concepts of hybrid and electric vehicles.
2	Expose various basic conventional vehicle performance and various hybrid drive-train topologies.
3	Familiarize various electric components used in hybrid and electric vehicles
4	Expose various energy storage requirements in hybrid and electric Vehicles
5	Interpret the energy management strategies used in hybrid and electric vehicles.

Course Outcomes	
1	List out various energy management strategies used in hybrid and electric vehicles (L1)
2	Classify various energy management strategies (L2)
3	Apply energy management strategies to electric vehicles (L4)
4	Justify the use of Underground cables (L5)
5	Predict various issues of energy management strategies. (L6)

Specific Instructional Objectives	
1	
2	
3	

Unit I	Basic concepts of Hybrid Electric Vehicles	No of Hours required :8L

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Pedagogy Tools							

Unit II	Conventional Vehicles:	No of Hours required :10L

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

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.

Pedagogy Tools							

Unit III	Electric Propulsion Unit	No of Hours required

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Pedagogy Tools							

Unit IV	Energy Storage:	No of Hours required :8L

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, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Pedagogy Tools							

Pedagogy Tools							

Unit V	Energy Management Strategies:	No of Hours required :8L

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Pedagogy Tools						

Total Number of Contact Hours	L	45	T	0	P	150

Text Books		
1		Chrismi, M. AbulMasrur and David WenzhangGao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectiv
2		Yang Sheng Xu, HuihuanQian, Jingyu Yan and Tin Cun Lam, Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectior
3		
4		

Reference Books	
1	Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.
2	MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment 1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1															
2															
3															
4															
5															
6															

Date of Approval	21.05.2021

Course Code		L	T	P	C
PE11	PROCESS CONTROL AND AUTOMATION (Elective)	3	0	0	3
School	SOE	Syllabus version			

Pre-requisties	
Alternate Exposure	
Co-requisties	
Course Description	

Proper application of process control improves the safety and profitability of a process, while maintaining consistently the desired product quality. Th

Course Objectives	
1	Familiarize the basic principles & importance of process control in industrial process plants;
2	Study the required instrumentation and final elements to ensure that well-tuned control is
3	Train the use of block diagrams & the mathematical basis for the design of control systems.
4	Create and tune process (PID) controllers.
5	Impart software tools for the modeling of plant dynamics and the design of well-tuned control
6	Expose the importance and application of good instrumentation for the efficient design of
7	

Course Outcomes	
1	Define Automation and Control and explain the differences in the sense of the terms. (L1)
2	Explain the relation between Automation and Information Technology. (L2)
3	Outline the basic objectives of a manufacturing industry and explain how automation and control technologies relate to these. (L2)
4	Explain the concept of a Product Life Cycle and explain how Automation and Control technologies relate to the various phases of the

Specific Instructional Objectives	
1	
2	
3	

Unit I	Fundamentals of process control:	No of Hours required :10L

Definition of industrial processes and control. Hierarchies in process control systems block diagram representation of process control system. Control

Pedagogy Tools							

Unit II	Strategies for computer aided process control:	No of Hours required :8L

Open loop control systems, closed loop (feed back) control system, feed forward control system, cascade control system, ratio control. Controller design, controller tuning, tuning of P, PI and PID controllers, Ziegler Nichols tuning method, selection of controllers, predictive control, model based predictive control, multivariable control system.

Pedagogy Tools							

Unit III	Programmable logic controllers (PLCs):	No of Hours required :8L

Introduction, principles of operation, architecture of programmable logic controllers. Programming the programmable controllers, software, configur

Pedagogy Tools							

Unit IV	Distributed control systems:	No of Hours required :8L

Introduction, functional requirements of distributed control system, system architecture, distributed control systems configuration and applications o

Pedagogy Tools							

Unit V	Industrial control applications:	No of Hours required :8L

Automation of thermal power plant, automation strategy, distributed system structure, automatic boiler controller, diagnostic function and protectio

Pedagogy Tools						

Total Number of Contact Hours	L	45	T	0	P	150

Text Books

1		Krishna Kant, “Computer based Industrial Control”, 2/e, Prentice,Hall India, 2010.
2		S.K.Singh, “Computer Aided Process Control”, 3/e, Prentice,Hall India, 2005.
3		
4		

Reference Books

1	D.E Seborg, T.F. Edgar, and D.A. Mellichamp . “Process Dynamics and Control”3/e, John Wiley, 2010.
2	Johnson D Curtis, “Instrumentation Technology” ,8/e , Prentice,Hall India, 2008.
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1															
2															
3															
4															
5															
6															

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE12	Digital Control systems		3	0	0	3
School	SOE		Syllabus version			

Pre-requisties	ENGINEERING MATHEMATICS-III COMPLEX VARIABLES & TRANSFORM TECHNIQUES
Alternate Exposure	Control Systems Engineering
Co-requisties	

Course Description	

Digital control is a branch of control theory that makes use of digital systems for acting as controllers in a system. Digital Control systems are an integral part of everyday life in today's society. They control appliances, entertainment centers, office environments, industrial processes and our transportation systems. Almost all of these applications use digital controllers implemented with computers, microprocessors, or digital electronics. Every electrical engineering student should therefore be familiar with the basic theory of digital controllers as it lays the foundation for advanced

Course Objectives	
1	Expose digital representation of continuous systems.
2	Analyze a discrete time system with mathematical tools like Z transforms .
3	Analyze stability of discrete time system .
4	Interpret state variable analysis.
5	Design a digital control system.

Course Outcomes	Upon successful completion of the course the students will be able to
1	Represent continuous systems in discrete domain.
2	Analyze a discrete time system using Z transforms .
3	Determine the time response of discrete time system.
4	Evaluate the stability of discrete system .
5	Construct state space models of discrete systems and performing their stability analysis.
6	Design a digital control system for different applications.

Specific Instructional Objectives	
1	Use of Control systems toolbox in MATLAB for design and simulation
2	
3	

Unit I	Discrete Representation of Continuous Systems	8

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Pedagogy Tools	Chalk board	PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit II	Discrete System Analysis	10

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Pedagogy Tools	Chalk board	PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit III	Stability of Discrete Time System	8

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Pedagogy Tools	Chalk board	PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit IV	State Space Approach for discrete time systems	10

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Re-constructability and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Pedagogy Tools	Chalk board	PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit V	Design of Digital Control System	10

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control

Pedagogy Tools	Chalk board	PPTs	MATLAB	NPTEL	Moodle	Coursera	

Total Number of Contact Hours										L	45	T	0	P	45
Text Books															
1		K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs, 1995.													
2		M.Gopal, “Control Systems Engineering” , 3/e , Wiley Eastern Ltd., TMH ,2008													
3															
4															
Reference Books															
1	G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.														
2	B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston, 1980.														
3															
4															
Evaluation Procedure															
Continuous Evaluation	Total 70 Marks														
	Quiz 1		Quiz 2		Quiz 3		Assignment		CAT 1		CAT 2				
	10		**10**		**10**		**10**		**15**		**15**				
Sem End Examination	Total 30 Marks														
Course Outcome - Programe Outcome Mapping															
Course Outcomes	Programme Outcomes												PSO1	PSO2	PSO3
	1	2	3	4	5	6	7	8	9	10	11	12			
1	2	3											3		
2		2	2										3		
3		2	3										3		
4		2			2								3		
5		2	1		2								3		
6	2			3										2	
Date of Approval													21.05.2021		

Course Code	Course Title		L	T	P	C
PE13	ADVANCED CONTROL SYSTEMS (Elective)		3	0	0	3
School	SOE		Syllabus version			

Pre-requisties	19EEE331: LINEAR CONTROL SYSTEMS,
Alternate Exposure	Linear Control Systems Laboratory and graphical and analytical approcaches of control system
Co-requisties	
Course Description	This course is aimed to Advanced linear mathematical modeling of different systems and their representation as open loop and

Course Objectives	
1	to conceptualize state variable systems.
2	to enlist common types of non linear characteristics, linearization.
3	to exemplify basic concepts describing function.
4	to familiarize pole placement technique by state feedback for linear siso time invariant system.
5	to theorize optimal control, adaptive control, robust control and intelligent control methods. introduction to
6	

Course Outcomes	
1	to understand state variable systems.
2	to infer common types of non linear characteristics, linearization.
3	to learn basic concepts describing function.
4	to comprehend pole placement technique by state feedback for linear siso time invariant system.
5	to apply optimal control, adaptive control, robust control and intelligent control methods. introduction to
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	State space analysis	10

State space analysis .State variable systems. Controllability and observability .State variable feedback and its effect on controllability and observability. Elements of observer theory.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	CS lab		
	animation	text					

Unit II	Common types of non linear characteristics	8

Common types of non linear characteristics, linearization. Singular points. Phase plane methods, construction of phase trajectories. Isocline Method. Pell's method. Delta method. Stability analysis using phase trajectories.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	CS lab		
	animation	text					

Unit III	Basic concepts of describing function	8

Basic concepts of describing function, derivation of describing functions of Common types of non linear characteristics. Stability of non linear systems by describing function method, Lyapunov's method of stability studies , Popov's criterion.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	CS lab		
	animation	text					

Unit IV	Pole placement technique by state feedback for linear SISO time invariant system	8

Pole placement technique by state feedback for linear SISO time invariant system. Design of state observations and servo system.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	CS lab		

Pedagogy Tools	animation	text					

Unit V	Optimal control	8

Optimal control, adaptive control, robust control and intelligent control methods. Introduction to distributed control systems.

Pedagogy Tools	ppts	chalk boart	mat lab	nptel	CS lab	
	animation	text				

Total Number of Contact Hours	L	42	T	0	P	150

Text Books

1		Nagarath and Gopal, “Control System Engineering”, 2/e, Wiley Eastern, 2001.
2		Stanley M.Shiners, “Modern Control System theory and Design”, 2/e, John Wiley and Sons,
3		
4		

Reference Books

1	Ogata. K, “Modern Control Engineering” ,4/e, PHI,2002.
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2	3											3		
2		2	2										3		2
3		2	3										3		2
4		2			2								3		2
5		2	1		2								3		
6	2			3										2	

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE15	NONLINEAR CONTROL SYSTEMS		3	0	0	3
School	SOE		Syllabus version			

Pre-requisties	Control Systems Engineering,ENGINEERING MATHEMATICS-III COMPLEX VARIABLES & TRANSFORM TECHNIQUES
Alternate Exposure	
Co-requisties	
Course Description	

This course is aimed to introduce concepts of Non-linear systems, and characteristics of Non-linear systems. Equilibrium points in the non-linear systems, and their classification are studied. Different methods for analysis of nonlinear systems are studied. Stability assessment methods for nonlinear systems are investigated.

Course Objectives	
1	To introduce the need and concept of nonlinear system.
2	To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
3	To familiarize with the design of different types of nonlinear controllers.
4	
5	

Course Outcomes	Upon successful completion of the course the students will be able to
1	Construct the phase plane trajectory of a given nonlinear system
2	Explain describing function for various nonlinearities
3	Identify the stability of the given linear and nonlinear system using Lyapunov stability theory
4	Design systems using concept of tracking
5	Analyze the stability of the nonlinear system

Specific Instructional Objectives	
1	Use of Control systems toolbox in MATLAB for design and simulation
2	
3	

Unit I	Introduction	10

Characteristics of nonlinear systems –Phase plane method- Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis.Describing function Method.

Pedagogy Tools	Chalk board PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit II	Stability of Nonlinear Systems	10

Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method.

Pedagogy Tools	Chalk board PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit III	Stability of Nonlinear Systems	8

Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilization-Analysis of feedback systems- Circle Criterion – Popov Criterion.

Pedagogy Tools	Chalk board PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit IV	Feedback linearization	7

Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling

Pedagogy Tools	Chalk board PPTs	MATLAB	NPTEL	Moodle	Coursera		

Unit V	Exact Feedback Linearization	7

Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control

Pedagogy Tools	Chalk board PPTs	MATLAB	NPTEL	Moodle	Coursera	

Total Number of Contact Hours												L	45	T	0	P	45
Text Books																	
1		Hassan K Khalil, Nonlinear Systems, Prentice - Hall International (UK), 2002.															
2		Jean-Jacques E. Slotine and Weiping Li, “Applied Nonlinear Control”, Prentice-Hall, NJ, 1991.															
3																	
4																	
Reference Books																	
1	M Vidyasagar, ”Nonlinear systems Analysis”, 2nd Edition, Prentice Hall, 1993.																
2	Alberto Isidori, ”Nonlinear Control System”, Vol I and II, Springer, 1999																
3																	
4																	
Evaluation Procedure																	
Continuous Evaluation	Total 70 Marks																
	Quiz 1		Quiz 2		Quiz 3		Assignment		CAT 1		CAT 2						
	10		**10**		**10**		**10**		**15**		**15**						
Sem End Examination	Total 30 Marks																
Course Outcome - Programe Outcome Mapping																	
Course Outcomes	Programme Outcomes																
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3		
1	2		3										3				
2	2		2		1								3				
3	2	3	3										3				
4	2		2		1		1						3				
5			1										3				
Date of Approval													21.05.2021				

Course Code	Course Title			L	T	P	C
PE16	ROBOTICS			3	0	0	3
School	SOE			Syllabus version			

Pre-requisties	Electronics, Computer Science
Alternate Exposure	Artificial Intelligence
Co-requisties	Programming with python
Course Description	Robotics and automation is a branch of Engineering that involves the design, manufacturing, and

Course Objectives	
1	To be familiar with history of robotics, technological advances and to gain insight on different types of End
2	To learn about different robotic drive systems, actuators and their control.
3	To analyze the robotic Kinematics in different degrees of freedom
4	To study the principles of various Sensors used in robotics
5	To explore industrial applications of Robotics.
6	

Course Outcomes	
1	get acquainted with history of robotics, technological advances and many types of End Effectors (L2).
2	gain knowledge on different robotic drive systems, actuators and their control (L2).
3	understand the robotic Kinematics (Robotic movements, Position and Orientation) (L2).
4	select the Sensors based on different applications (L4).
5	understand industrial applications of Robotics (L2)
6	

Specific Instructional Objectives	
1	Black board
2	ppt
3	blended resources

Unit I	Unit Title	No of Hours required:9

Introduction: Historical robots, robots in science fiction, future trends of robots, definitions of robots, present application status. Robot End Effectors: Classification of end effectors, drive systems for grippers, mechanical grippers, magnetic grippers, vacuum grippers, adhesive grippers, hooks, scoops and other miscellaneous devices, active and passive grippers.

Pedagogy Tools	Small Robot Kits						

Unit II	Unit Title	No of Hours required:9

Robot Drives, Actuators and Control: Functions of drive systems, general types of control, pump classification, introduction to pneumatic systems, electrical drives, dc motors and transfer functions, stepper motor, drive mechanisms.

Pedagogy Tools	Google Classroom						

Unit III	Unit Title	No of Hours required:7

Robot Kinematics: Forward and reverse kinematics of 3 degrees of freedom robot arm, forward and reverse kinematics of a 4 degree of freedom, arm manipulator in 3-D, homogeneous transformations.

Pedagogy Tools	Small Robot Kits						

Unit IV	Unit Title	No of Hours required:9

Robot Sensors: Need for sensors, types of sensors, robot vision systems, robot tactile systems, robot proximity sensors, robot speech and hearing, speech synthesis, noise command systems, speech recognition systems.							
Pedagogy Tools	Classcraft						
Unit V	Unit Title						No of Hours required:9
Robot Intelligence & Programming the Robots: AI and Robotics, Expert Systems, Interpreting Sensory Inputs, Intelligent Tutoring Systems. Robot Languages, Robot Operating System, Robot Application Programming, Teaching Robots							
Pedagogy Tools	Small Robot Kits						

Total Number of Contact Hours	L	45	T	0	P	15

Text Books		
1		S.R. Deb, Robotics Technology and Flexible Automation, TMH, 2010
2		
3		
4		

Reference Books	
1	SatyaRanjan, Robotics Technology and Flexible Automation, TMH, 2001.
2	James L.Fuller, Robotics: Introduction, Programming and Projects, Maxwell Macmillan, 2000
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping															
Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3		2					1				1		
2	2			2									1		
3	3	2	3						2				1		1
4	2													1	
5															
6															

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE17	Robot Kinematics and Dynamics		2	0	2	3
School			Syllabus version			

Pre-requisties	Engineering Mechanics,Higher Engineering Mathematics, Basic electrical and Electronics Engineering
Alternate Exposure	
Co-requisties	Kinematics and Dynamics of Machinery
Course Description	

This course teaches the fundamentals of robotics required to design the robot anatomy, kinematics of robots, robot dynamics, robot drive systems, robot programming and its applications. The Knowledge gained from this course is to apply the concepts in handling the automated systems like assembly systems, material handling systems, storage, and retrieval systems

Course Objectives	
1	To familiarize the concepts of forward kinematics.
2	To familiarize the concepts of robot manipulator kinematics
3	To explain the concepts related to invese kinematics
4	To illustrate the working of actuators robotic links and joints
5	To develop the ability to understand trajectory generation

Course Outcomes	After the completion of this course, the students will be able to
1	Comprehend and interpret various aspects relating to Kinematics of robots
2	Analyse the Forward and inverse kinematic models of robots
3	Understand the basic concepts related to flexibility of links and joints.
4	Interpret and conceptualize the functional elements of robot mechanisms
5	Understand the path control paradigms in robots

Specific Instructional	
1	Presentation, videos, DIY, Lab sessions
2	
3	

Unit I	Forward Kinematics		8

Forward Kinematics, Product of Exponentials Formula, First Formulation: Screw Axes in the Base Frame, examples, Second Formulation: Screw Axes in the End-Effector Frame, examples

Pedagogy Tools	text book	coursera	nptel	Robotics Lab				
	ppts							

Unit II	Velocity Kinematics and statics		6

Velocity Kinematics and Statics, Manipulator Jacobian, Space Jacobian, Body Jacobian, Visualizing the Space and Body Jacobian, Relationship between the Space and Body Jacobian

Pedagogy Tools	text book	coursera	nptel	Robotics Lab				
	ppts							

Unit III	Inverse Kinematics		8

Introduction to Inverse Kinematics, Numerical Inverse Kinematics: Newton–Raphson Method, Inverse Velocity Kinematics.

Pedagogy Tools	text book	coursera	nptel	Mechatronics Lab				
	ppts							

Unit IV	Robot Dynamics		8

Actuation, Gearing, and Friction: DC Motors and Gearing, Apparent Inertia, Newton–Euler Inverse Dynamics Algorithm Accounting for Motor Inertias and Gearing, Friction, Joint and Link Flexibility								
Pedagogy Tools	text book	coursera	nptel	Robotics Lab				
	ppts							
Unit V	Trajectory Generation						6	
jectories: Straight-Line Paths, Time Scaling a Straight-Line Path, Polynomial Time Scaling, Trapezoidal Motion Profiles, S-Curve Time Scalings, Pol								
Pedagogy Tools	text book	coursera	nptel	Robotics Lab				
	ppts							

Total Number of Contact Hours	L	36		T	0	P	150

Text Books	
1	"Modern Robotics: Mechanics, Planning, and Control" (Lynch and Park, Cambridge University Press 2017).
2	Mark W. Spong, Seth Hutchinson, M. Vidyasagar, "Robot Modeling and Control", Wiley, 2012
3	
4	

Reference Books	
1	Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley & Sons Inc, 2011
2	

Evaluation Procedure					
Continuous Evaluation	Total 70 Marks				
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping															
Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	3	3	3	2	1	3	0	1	1	2	2	1			2
2	3	3	3	2	1	2	0	1	1	2	3	1		3	
3	3	3	2	2	1	3	0	1	1	1	2	1	3		
4	3	3	3	2	1	1	0	1	1	2	2	1			2
5	3	3	3	2	1	2	0	1	1	2	3	1	2		

Date of Approval		

Course Code	Course Title		L	T	P	C
PE18	ROBOT MOTION PLANNING AND CONTROL(EECE)		2	0	2	3
School	SOE		Syllabus version			

Pre-requisties	LINEAR CONTROL SYSTEMS,ENGINEERING MATHEMATICS-III COMPLEX VARIABLES & TRANSFORM TECHNIQUES.Knowledge of linear algebra, a reasonable amount of calculus and continuous mathematics, a strong interest in robotics, artificial intelligence, planning and logical reasoning.
Alternate Exposure	
Co-requisties	Modern Robotics, Course 4: Robot Motion Planning and Control (Offered by Northwestern University)

Course Description

This course is about motion control and planning for robots.Robot Motion Planning and Control introduces key concepts of robot motion generation: planning a motion for a robot in the presence of obstacles, and real-time feedback control to track the planned motion.

Course Objectives	
1	Understand and learn how to implement motion planning and decision-making approaches in robotics
2	Understand the challenges and basic approaches to interleaving planning and execution in robotic systems
3	Learn common uses of planning/decision-making in robotics
4	
5	

Course Outcomes	Upon successful completion of the course the students will be able to
1	Understand motion planning problem and C-space.
2	Select the appropriate path planner Algorithms
3	Understand feedback control for motion control in the joint space
4	Understand feedback control for motion control in the task space
5	Will be able to apply concepts learned to force control, hybrid motion–force control, and impedance control.
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	Motion Planning-1	10

Overview of Motion Planning, Types of Motion Planning Problems, Properties of Motion Planners, Motion Planning Methods, Configuration Space Obstacles, 2R Planar Arm, Circular Planar Mobile Robot, Polygonal Planar Mobile Robot That Translates, Polygonal Planar Mobile Robot that Translates and Rotates.

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit II	Motion Planning-2	8

Distance to Obstacles and Collision Detection, Graphs and Trees, Graph Search, Complete Path Planners, Grid Methods, Multi-Resolution Grid Representation, Grid Methods with Motion Constraints, Grid-Based Path Planning for a Wheeled Mobile Robot, Grid-Based Motion Planning for a Robot Arm.

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit III	Sampling methods and virtual potential fields	8

Sampling Methods, The RRT Algorithm, The PRM Algorithm, Virtual Potential Fields, A Point in C-space, Navigation Functions, Workspace Potential, Wheeled Mobile Robots, Use of Potential Fields in Planners, Nonlinear Optimization, Smoothing.

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit IV	Robot control-1	10

Robot control, Control System Overview, Error Dynamics, Error Response, Linear Error Dynamics, First-Order Error Dynamics, Second-Order Error Dynamics, Motion Control with Velocity Inputs: Motion Control of a Single Joint, Motion Control of a Multi-joint Robot, Task-Space Motion Control. Motion Control with Torque or Force Inputs: Motion Control of a Single Joint, Motion Control of a Multi-joint Robot.

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit V	Robot control-2	9
Task-Space motion Control; Force Control, Hybrid Motion–Force Control: Natural and Artificial Constraints, A Hybrid Motion–Force Controller; Impedance Control, Impedance-Control Algorithm, Admittance-Control Algorithm, Low-Level Joint Force/Torque Control.		

Pedagogy Tools	Chalk boarc	PPTs	ROS	NPTEL	Moodle	Coursera	

Total Number of Contact Hours	L	45	T	0	P	45

Text Books

1		"Modern Robotics: Mechanics, Planning, and Control" (Lynch and Park, Cambridge University Press 2017).
2		
3		
4		

Reference Books

1	"Robotics: Modelling, Planning and Control",1st edition,Bruno Siciliano,Lorenzo Sciavicco,Luigi Villani,Giuseppe OrioloSpringer-Verlag London 2009
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	**10**	**10**	**10**	**15**	**15**
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2		2				1						3		
2	3												3		
3			2		2									2	
4					2		1						2		
5	2		2										3		

Date of Approval	21.05.2021

Course Code	Course Title	L	T	P	C
PE19	ROBOT SIMULATION USING OPEN SOURCE TOOLS (EECE)	2	0	2	3
School	SOE	Syllabus version			

Pre-requisties	Strong interest in robotics, artificial intelligence, planning and logical reasoning.
Alternate Exposure	
Co-requisties	
Course Description	

This course is about General purpose robot simulators with integrated development environment

Course Objectives	
1	Understand and learn how to implement general purpose robot simulator(V-REP)
2	Understand the core concepts ,elements and usage of robot simulation made with Gazebo
3	Wheel robot modelling using Gazebo and ROS.
4	
5	

Course Outcomes	Upon successful completion of the course the students will be able to
1	Test the design robot especially the mobility and navigation systems
2	Write scripts and simulate wheeled mobile robot
3	Design and simulate wheel robot modelling using Gazebo and ROS.
4	
5	
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	V-REP	10

Introduction - Need for V-REP - user interface - scenes and models - modeling of environment - entities: shapes - joints - dummies - sensors - lights – camera

Pedagogy Tools	Chalk board	PPTs	ROS	V-REP	Moodle	Coursera		

Unit II	V-REP Calculation Modules	8

Distance - collision - forward - inverse - path/motion - geometric constrain Solvers

Pedagogy Tools	Chalk board	PPTs	ROS	V-REP	Moodle	Coursera		

Unit III	V-REP Scripts	8

Main and child scripts - call back scripts - Simulation: Line following of differential wheeled mobile robot - Serial Manipulator – Hexapod

Pedagogy Tools	Chalk board	PPTs	ROS	V-REP	Moodle	Coursera		

Unit IV		10

Introduction - Need for gazebo - Core concepts - elements within simulation: world - models - links - joints- sensors - visual objects - collision objects - plug-ins - Element Hierarchy and Types

Pedagogy Tools	Chalk board	PPTs	ROS	gazebo	Moodle	Coursera		

Unit V	Gazebo Animations And Dynamics Control	9

Differential wheeled mobile robot modeling and controlling - Environment Modeling - ROS integration

Pedagogy Tools	Chalk board	PPTs	ROS	gazebo	Moodle	Coursera	

Total Number of Contact Hours	L	45	T	0	P	45

Text Books		
1		AnisKoubaa , "Robot Operating System – The complete reference V1", Springer International Publishing, 2016.
2		AnisKoubaa , "Robot Operating System – The complete reference V2", Springer International Publishing, 2017.
3		V-REP user manual, http://www.coppeliarobotics.com/assets/VRepoverviewpresentation.
4		

Reference Books		
1	Lentin Joseph , "Learning Robotics Using Python", Packt Publishing, May 2015.	
2		
3		
4		

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	**10**	**10**	**10**	**15**	**15**
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2		2				1						3		
2	3												3		
3			2		2									2	
4					2		1						2		
5	2		2										3		

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE20	ROBOT OPERATING SYSTEMS(EECE)		2	0	2	3
School	SOE		Syllabus version			

Pre-requisties	Familiarity with linux based operating system, at least have beginner level experience with a programming language
Alternate Exposure	
Co-requisties	ROS Basics: Program Robots! (https://www.udemy.com/course/ros-basics-program-robots/)

Course Description

ROS is a robotic middleware which offers a collection of packages for commonly used functionality, low level control, hardware abstraction and message passing. ROS is all you need to transition from a hobbyist to a professional developer in the robotics domain!

Course Objectives	
1	Understand and learn how to implement motion planning and decision-making approaches using ROS
2	Learn the fundamentals behind the open source robotics framework - ROS
3	Learn common uses of planning/decision-making in robotics
4	
5	

Course Outcomes	Upon successful completion of the course the students will be able to
1	Understand ROS concepts and programming
2	Master the basics of ROS
3	Build distributed software and drivers for a robot
4	Learn to program robots in a professional way
5	
6	

Specific Instructional Objectives	
1	
2	
3	

Unit I	INTRODUCTION TO ROS	10

Introduction - history - distributions - difference from other meta - operating systems -services - ROS framework - operating system – releases

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit II	INTRODUCTION TO LINUX COMMANDS	8

UNIX commands - file system - redirection of input and output - File system security - Changing access rights - process commands - compiling, building and running commands -handling variables

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit III	ARCHITECTUREOF OPERATING SYSTEM	10

SFile system - packages - s tacks - messages - services – catkin workspace - working with catkin workspace - working with ROS navigation and listing commands

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit IV	COMPUTATION GRAPH LEVE	8

Navigation through file system - Understanding of Nodes - topics - services - messages - bags - master - parameter server - interfacing of Sensors and Actuators

Pedagogy Tools	Chalk board	PPTs	ROS	NPTEL	Moodle	Coursera		

Unit V	DEBUGGING AND VISUALIZATION	9

Debugging of Nodes - topics - services - messages - bags - master parameter - visualization using Gazebo - Rviz - URDF modeling - Xacro - launch files.

Pedagogy Tools	Chalk boarc	PPTs	ROS	NPTEL	Moodle	Coursera	

Total Number of Contact Hours	L	45	T	0	P	45

Text Books

1		Aaron Martinez, Enrique Fernández , "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013.
2		2 Jason M O'Kane , "A Gentle Introduction to ROS", CreateSpace, 2013.
2		
4		

Reference Books

1	
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Quiz 3	Assignment	CAT 1	CAT 2
	10	**10**	**10**	**10**	**15**	**15**
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	2		2				1						3		
2	3												3		
3			2		2									2	
4					2		1						2		
5	2		2										3		

Date of Approval	21.05.2021

Course Code	Course Title			L	T	P	C
PE22	COMPUTER VISION			2	0	2	3
School	SOE			Syllabus version			

Pre-requisties	Image Processing, Programming with Python
Alternate Exposure	
Co-requisties	
Course Description	

This course provides an overview of computer vision. Camera models, multi-view geometry, reconstruction, some low-level image processing, and high-level vision tasks such as picture categorization and object identification are all covered.

Course Objectives	
1	Introduce the fundamental problems of computer vision
2	To support further research in this field, provide a grasp of the methodologies, mathematical ideas, and algorithms employed in computer vision.
3	Provide pointers into the literature and exercise a project based on a literature search and one or more research papers.
4	Practice software implementation of different concepts and techniques covered in the course.
5	Utilize programming and scientific tools for relevant software implementation.
6	

Course Outcomes	After the completion of this course, the students will be able to
1	perform various image processing operations like image morphology , resizing and image transforms
2	understand about the contours, segmentation and tracking
3	analyze various camera models and calibration.
4	develop programs for different low level, high level vision algorithms
5	understand the basic operation of the Robotic Operating System (ROS)
6	

Specific Instructional	
1	
2	
3	

Unit I	Image Processing And Transforms	8

Introduction, Applications, operations on Images Smoothing - Image Morphology - Flood Fill - Resize - Image Pyramids – Image Transforms: Convolution - Gradients and Sobel Derivatives - Laplace - Canny - Hough Transforms – Remap - Stretch - Shrink - Warp - and Rotate - Cart to Polar and Polar to Cart - Log Polar - DFT - DCT - Integral Images – Distance Transform - Histogram Equalization Threshold

Pedagogy Tools							
	text book	coursera	nptel	matlab			
	ppts						

Unit II	Contours, Segmentation, Tracking And Motion	8

Parts and Segments - Background Subtraction – Watershed Algorithm Image Repair by Inpainting - The Basics of Tracking - Corner Finding - Subpixel Corners - Invariant Features - Optical Flow - Mean - Shift and Camshift Tracking

Pedagogy Tools							
	text book	coursera	nptel	matlab			
	ppts						

Unit III	Camera Calibration and 3d Vision	8

Camera Model - Calibration - Undistortion - Rodrigues Transform - Projection3D Pose Estimation - Stereo Imaging - Structure from Motion - Fitting Lines in Two and Three Dimensions

Pedagogy Tools							
	text book	coursera	nptel	matlab			
	ppts						

Unit IV	Low Level, High level Vision Algorithms & Object Recognition	8

Image representation, image subtraction, image averaging, Segmentation, Thresholding, Object recognition, Approaches to Object Recognition, Recognition by combination of views							
Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						
Unit V	Robot Vision					8	
Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV – The cv_bridge Package							
Pedagogy Tools	text book	coursera	nptel	matlab			
	ppts						
Total Number of Contact Hours					L	40	T	0	P	0

Text Books	
1	Computer Vision by Linda Shapiro and George Stockman, Prentice Hall, Year: 2001
2	Jayneil Dalal & Sohil Patel , "Instant OpenCV Starter: Get Started With OpenCV Using Practical Hands-On Projects", 1st Edition, Shroff/Packt, 2013
3	R.Patrick Goebel, " ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I", A Pi Robot Production, 2012.
4	Bernd Jahne, "Digital Image Processing", Springer Publication, 2013

Reference Books	
1	Digital Image processing – R.C. Gonzalez & R.E. Woods, Addison Wesley, Pearson Ed., 2nd Education, 2002
2	Fundamentals of Digital Image processing – A.K.Jain, Prentice Hall of India
3	Digital Image processing using MAT LAB – Rafael C. Gonzalez, Richard EWoods and Steven L. Edition, PEA, 2004
4	Digital Image Processing – William K. Pratt, John Wiley, 3rd Edition, 2004

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1	1							3					1	
2	1	1		1			1				2	2		
3		1			2									2
4	1	1				2			1				2	
5										2		1		
6														

Date of Approval	21.05.2021

Course Code	Course Title		L	T	P	C
PE23	Introduction to AI in Robotics		2	0	2	3
School	SOE		Syllabus version			

Pre-requisties	DATA STURCUTERS, BASIC MATH
Alternate Exposure	XXX
Co-requisties	XXX

Course Description	
This course enables the students to think critically about what makes humans intelligent, and how computer scientists are designing computers to act more like us Artificial Intelligence (AI) is the study of how to make computers make things which at the moment people do better espcially in Robotics erana. The primary objective of this course is to provide an introduction to the basic principles and applications of Artificial Intelligence and how it is useful in design and development of Robotics systems. Upon successful	
Course Objectives	
1	ntals of Artificial Intelligence, the concept of Intelligent Agents and problem solving process through uninformed and infor
2	How to gain an insight into competitive environments and robot paradigms
3	Viewing many problems in AI as Multiagent scenarios
4	To familiarize concepts of Path planning
5	To acquire the knoledge of localization in the view of Robotics

Course Outcomes	After the completion of this course, the students will be able to
1	solve various search problems (L3).
2	contrast hierarchical and reactive paradigms (L2).
3	demonstrate multi-agent scenarios of robot design (L2).
4	apply concepts of metric plalning in design process of robos (L5).
5	determine dampster shafer theory and HMM models (L3).
6	
Specific Instructional	
1	XXX
2	
3	

Unit I	Introduction	8

Introduction To AI And Intelligent Agents : Foundations, History - Intelligent agents, Agents - Nature of Environments, Structure of agents - Problem solving agents - Problem formulation - State space, Search space - Problem reduction - Searching for solutions: Uninformed search strategies – Informed search strategies - Heuristic functions

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit II	Robotic Paradigms - I:	8

ctive paradigm: attributes - subsumption architecture - potential field methodologies - Designing a reactive implementation: a primiti

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit III	Robotic Paradigms II:	8

The Hybrid Deliberative/Reactive Paradigm- Attributes - Architectural Aspects- Managerial Architectures- State-Hierarchy Architectures Model-Oriented Architectures – Multi Agents: Overview – Heterogeneity – Control – Cooperation – Emergent Social Behaviour

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit IV	Topological And Metric Path Planning:	8

Landmarks and gateways - relational methods – associative methods - case study - Metric Planning: Configuration Space-Cspace representations - graph based planners - wavefront based planners - Interleaving Path Planning and Reactive Execution

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit V	Localization And Map Making	8

: Sonar sensor model - Bayesian – Dampster-Shafer theory - HIMM - comparison of methods - localization – exploration

Pedagogy Tools	text book	coursera	nptel	va circuit simulat	matlab		
	ppts						

Total Number of Contact Hours	L	40	T	0	P	32

Text Books

1	Robin R. Murphy, "Introduction to AI Robotics", MIT Press, 2000.
2	Start Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education, New Delhi, 2015
3	
4	

Reference Books

1	Francis X. Govers, "Artificial Intelligence for Robotics", Packt, 2018.
2	Roland Siegwart, Illah R. Nourbakhsh , "Introduction to Autonomous Mobile Robots", MIT Press, 2004
3	Kevin Knight, Elaine Rich, Nair , "Artificial Intelligence", Tata McGraw Hill, New Delhi, 2017
4	on Gabriel, "Artificial Intelligence: Artificial Intelligence for Humans", 1 st Edition, Createspace Independent Publishers, 201

Evaluation Procedure						
Continuous Evaluation	Total 40 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	20	20
Sem End Examination	Total 60 Marks					

Course Outcome - Programe Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1														
2														
3														
4														
5														
6														

Date of Approval	11.12.2021

Course Code	Course Title				L	T	P	C
PE24	Introduction to ML in Robotics				2	0	2	3
School	SOE				Syllabus version			

Pre-requisties	DATA STURCUTERS, BASIC PROBABLITY
Alternate Exposure	XXX
Co-requisties	XXX

Course Description	
Machine Learning is a flourishing subject in Computer Science which devises models that can automatically learn from data and detect patterns from data. The applications of machine learning are diverse ranging from self-driven cars to disaster management systems. With easy availability of data from different devices and measurements, machine learning techniques become imperative in analysing trends hidden in the data. This course focuses on the major tasks of machine learning viz., supervised, unsupervised	
Course Objectives	
1	Introduce the concepts of machine learning and the complete process model for working with real data wih uncertainity
2	Impart the various approaches to supervised learning
3	Demonstrate unsupervised learning approaches
4	Illustrate the performance of reinforcemnet leanring techinques for intlligent machines
5	Differentiate between shallow and deep neural networks by considering various case studies

Course Outcomes	After the completion of this course, the students will be able to
1	Demonstrate basic machine learning approach using real world data (L2)
2	Apply supervised learning models to make good predictions (L3)
3	Illustrate various clustering techniques (L2)
4	apply function approximation for adoptabity of learning(L3)
5	Show the working of neural networks in the view of robotic applications(L3)
6	
Specific Instructional	
1	XXX
2	
3	

Unit I	Introduction	8
Introduction to Machine learning, types of Machine learning, supervised, unsupervised, basic concept of machine learning. Gaussian Model: Introduction, Gaussian discernment analysis, Quadratic discriminant analysis, Liner discriminant analysis		

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit II	Foundations Of Supervised Learning & Advanced Supervised Learning:	8
Perceptron – Binary classification, Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilis		

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit III	Unsupervised Learning:	8
Clustering – K-means – Expectation Maximization Algorithm – Gaussian Mixtures, anomaly detection, selecting number of clusters, Bayesian Gaussian Mixture Models, anomaly and novelty detection algorithms. Curse of dimensionality, Dimensionality Reduction, PCA,		

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit IV	Reinforcement learning:	8
Markov Decision Process - Temporal Difference Learning - Function Approximation		

Pedagogy Tools	text book	coursera	nptel	ava circuit simulato	matlab		
	ppts						

Unit V	Neural Networks and applications:	8

ess of the Bias-variance. Case study on Obstacle avoidance and navigation of a mobile robot – Case study on Use of stochastic PCA and

Pedagogy Tools	text book	coursera	nptel	va circuit simulat	matlab		
	ppts						

Total Number of Contact Hours	L	40	T	0	P	32

Text Books

1	Kevin P. Murphy , "Machine Learning – A Probabilistic Perspective", The MIT Press, 2010
2	Ethem Alpaydin , "Introduction to Machine Learning", The MIT Press, 2004
3	Michalski, Carbonell, Tom Mitchell, 'Machine Learning', Springer, 2014.
4	Peter Flach, 'Machine Learning: The Art and Science of Algorithms that make sense of data', Cambridge, 2014.

Reference Books

1	e, Robert Tibshirani, Jerome Friedman , "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Spr
2	Ian Good fellow, Yoshua Bengio, Aaron Courville , "Deep Learning", MIT Press, 2012.
3	Tom M Mitchell , "Machine Learning", Mc Graw Hill, 2017.
4	Gilbert Strang , "Linear Algebra and Learning from data", 2019.

Evaluation Procedure						
Continuous Evaluation	Total 40 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	20	20
Sem End Examination	Total 60 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes													
	1	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
1														
2														
3														
4														
5														
6														

Date of Approval	11.12.2021

Course Code	Course Title					L	T	P	C
PE25	smartgrid architectural design					3	0	0	3
School	SOT					Syllabus version			

Pre-requisties	19EEE234: POWER SYSTEMS-I
Alternate Exposure	Basics of power systems

Co-requisties	
Electric power transmission and distribution, power system analysis, power system planning and design	
Course Description	

This course is aimed to introduce the basic concepts of smartgrid which are needed for the design and development of smartgrid power system networks and has potential applications in electrical power system network development. This is base course for subjects like smartgrid communication systems, energy management in smartgrids. The students are provided with theorital concepts of smart grid architecture and its design.

Course Objectives	
1	To familiarize power system networks and fundamentals of smartgrid.
2	To understand the basic architecture of smartgrid.
3	To teach the concepts of design for smartgrid.
4	To familiarize concepts of communication network architecture for smartgrid .
5	To acquire power system parameters for evaluation of smartgrid network.
6	To solve the problems associated with the design and development of smartgrid networks.

Course Outcomes	After the completion of this course, the students will be able to
1	Solve various smartgrid networks single line diagrams (L3).
2	Examine the behavior of smartgrid network for power flow(L4).
3	calculate voltage, current, real power, reactive power and power factor in smartgrid networks with sinusoidal excitation(L3).
4	apply concepts of design and architectural concepts for smart grid networks(L5).
5	determine the various power system parameters for design of the smartgrid networks (L3).
6	

Specific Instructional	
1	anlysis of smartgrid power networks using simulation tools like MATLAB, SIMULINK
2	
3	

Unit I	Introduction to smart grid	8

Basics of power systems, definition of smart grid, need for smart grid, smart grid domain, enablers of smart grid, smart grid priority areas, regulatory challenges, smart-grid activities in India.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit II	Smart grid architecture	6

Smart grid architecture, standards-policies, smart-grid control layer and elements, network architectures, IP-based systems, power line communications, supervisory control and data acquisition system, advanced metering infrastructure. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit III	Introduction to smartgrid design	8

Approach to Designing the Smart Grid, Challenges to Smart Grid Development, Top-Down and Bottom-Up Design Approaches, Bottom-Up Smart Grid Design and Smart Grid Top-down Design.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit IV	communication network architectures for the smartgrid	8

Architecture Framework, Core-Edge Architecture, Smart Grid Network Protocols, Wide Area Networks for Smart Grids, Local Traffic Aggregation, Field Area Networks and Transmission Management System (TMS).

Pedagogy Tools	text book	coursera	nptel		matlab		

Pedagogy Tools	ppts						

Unit V	Smart Grid Network Design Process	6

Network Traffic, Smart Grid Traffic, Characterization, Traffic Aggregation and Routing Architecture, Network Performance, Delay and priority requirements for Smart Grid applications, QoS Considerations in Smart Grid Networks, Differentiated Services for Smart Grid Application Functions and Smart Grid Network Reliability.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	36	T	12	P	0

Text Books

1	Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley
2	Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3	ka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, W
4	

Reference Books

1	laude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19. 5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12			
1	3	2	1		2			1	2	2	2	2			
2	3	2	1		2			1	2	2	3	3			
3	3	3	1		2			1	1	1	3	3			
4	3	3	3		2			1	1	2	2	2			
5	3	2	3		4			2	2	1	1	1			
6															

Date of Approval	

Course Code	Course Title					L	T	P	C
PE26	Fundamentals of power systems					3	0	0	3
School	SOT					Syllabus version			

Pre-requisties	Basic Electrical and Electronics Engineering
Alternate Exposure	Basics of Electrical Engineering
Co-requisties	Physics

Course Description

In this course it is aimed to introduce to the students the working principles of various power generating sources, transmission and distribution of power in practical power systems. The basic concepts of solar energy, wind energy, biomass energy, geothermal energy and ocean energy are explained. Transmission line modeling parameters, fault conditions and mechanical conditions of transmission lines are

Course Objectives

1	To Study various basic concepts of conventional power sources
2	To Expose various basic concepts of renewable energy sources.
3	To Familiarize various parameters in transmission lines
4	To Interpret the effect of sag and usage of underground cables
5	To Expose various AC and DC distributions systems

Course Outcomes — After the completion of this course, the students will be able to

1	understand power generating techniques by various sources (L1).
2	identify various renewable energy sources for power generation(L3).
3	estimate the various parameters in transmission lines(L5)
4	appraise the effect of sag on transmission lines(L5)
5	assess various AC and DC distribution systems for concentrated and uniformly distributed loads(L5)

Specific Instructional

1	
2	
3	

Unit I	Conventional Power Generation Hydroelectric Power Generation	8

Plant layout, working of hydroelectric power plant and selection of site. Thermal Power Generation: Plant layout, working of thermal power plant and selection of site. Nuclear Power Generation: Plant layout, working of nuclear power plant and selection of site.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit II	Renewable Energy Sources Solar Power Generation:	6

Physical principles of conversion of solar radiation into heat, working principle of Flat plate collectors and Photovoltaic Cell.
Wind power generation: Basic components of Wind energy conversion systems, working principle of HAWT and VAWT. Energy from Biomass: Biomass conversion technologies, working principle of Floating drum and fixed dome plants.
Geothermal energy: Working principle of Vapor and Liquid dominated systems Energy from Oceans: Working principle of closed cycle OTEC.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit III	Transmission line Parameters Overhead Transmission Lines	8

Capacitance and Inductance calculations for single phase two wire line, three phase lines, proximity effect, skin effect.
Sinusoidal Steady state representation of Lines: Short, medium, and long lines, Characteristics of transmission lines. Surge Impedance Loading.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit IV	Mechanical design of overhead lines Sag and insulators:	8

Line supports, insulators, voltage distribution in suspension-type insulators. Testing of insulators, String efficiency, tension and sag calculation, effects of wind and ice loading.
Underground cables: Comparison with overhead line. Types of cables, Insulation resistance, potential gradient, Capacitance of single core cables.
Corona: Formation of corona. Critical voltages, effect on line performance.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit V	Distribution Systems	6
Overview of Distribution systems, Types of DC & AC Distributors: Radial, and Ring systems. Voltage drop calculation with concentrated loads and uniformly distributed loads.		

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	36	T	12	P	0

Text Books

1	"Generation, Distribution and Utilization of Electrical Energy" - C.L.Wadwa. (New Age International, 1989, Reprint edition 20
2	"Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A text book on Power Systems Engg.', Dhanpat Rai and Sons, New
3	J.B.Gupta, 'A course in Power Systems', S.K.Kataria and sons, reprint 2010-2011.

Reference Books

1	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley,2012.
2	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12			
1	2	2	3		2		1	1	3	2	2	3			
2	3	2	1		2		2	1	3	3	2	2			
3	3	3	1		3		2	1	2	3	3	2			
4	3	3	3		2		3	1	2	2	2	2			
5	3	2	3		3		1	2	2	1	2	1			

Date of Approval	

Course Code	Course Title				L	T	P	C
PE27	Renewable Energy Systems				3	0	0	3
School	SOT				Syllabus version			

Pre-requisties	Basic Electrical and Electronics Engineering, Fundamentals of Power Systems
Alternate Exposure	
Co-requisties	Physics
Course Description	

To impart knowledge of renewable Energy Sources and technologies and sufficient inputs on a variety of issues in harnesing renewable Energy by recognize curent and posible future role of renewable energy sources.

Course Objectives	
1	To Study various basic concepts of renewable sources of energy
2	To understand the operating principles of Wind energy conversion.
3	To Evaluate the control methods used in PV and Wind energy systems.
4	To understand the operating principles of biomass.
5	To know various energy sources.

Course Outcomes	After the completion of this course, the students will be able to
1	understand power generating techniques by various renewable sources (L1).
2	identify various renewable energy sources for power generation(L3).
3	develop and design PV and wind models(L3)
4	analyze biomass energy concersion and operation (L4)
5	interpret various energy sources(L5)
Specific Instructional	
1	
2	
3	

Unit I	Renewable Energy Sources	8

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit II	Wind Energy	6

Power in the Wind – Types of Wind Power Plants (WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit III	Solar PV and Thermal Systems	8

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 & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit IV	Biomass energy	8

Introduction-Biomass resources –Energy from Bio mas: conversion process, Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit V	Other Energy Sources	6

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.							
Pedagogy Tools	text book	coursera	nptel				
	ppts						

Total Number of Contact Hours	L	36	T	12	P	0

Text Books

1	Bin_Wu,_Yongqiang_Lang, _Navid_Zargari,_Samir_Kour,"Power Conversion and Control of Wind Energy Systems", IEEE Press
2	S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
3	G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
4	G.D. Rai, "Non-conventional Energy Sources", Khanna Publishers.

Reference Books

1	H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd.,2006.
2	al, "Renewable Energy Applications", Narosa Publications,2004. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processe

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12			
1	3	2	1		2		1	1		2	2	2			
2	3	3	1		2		2	1		3	2	2			
3	3	1	1		2		2	1		3	2	1			
4	3	2	3		2		2	1		3	3	3			
5	3	3	3		4		3	2		2	1	1			

Date of Approval	

Course Code	Course Title				L	T	P	C
PC2	Smart grid communication systems				3	1	0	4
School	SOT				Syllabus version			

Pre-requisties	19EEI371: SENSORS AND SIGNAL CONDITIONING
Alternate Exposure	Basics of communication systems
Co-requisties	

Electric power transmission and distribution, power system analysis, communication systems

Course Description

This course is aimed to introduce the basic concepts of smartgrid communication systems which are needed for the communication in smartgrid power system networks and has potential applications in smart grid communication systems development. This is base course for subjects like smartgrid architectural design, energy management in smartgrids. The students are provided with theorital concepts of smart grid communication technologies.

Course Objectives

1	To familiarize communication technologies for power system.
2	To understand the information systems for control centres.
3	To teach the concepts of Integration, Control and Operation of Distributed Generation
4	To familiarize concepts of smart metering.
5	To acquire smartgrid parameters for monitoring of smartgrid network.
6	To solve the problems associated with the communication systems of smartgrid networks.

Course Outcomes	After the completion of this course, the students will be able to
1	Solve various smartgrid communication topologies (L3).
2	Examine the behavior of smartgrid network by means of information from control centres(L4).
3	calculate the power system parameters for distributed generation(L3).
4	apply concepts of smart metering for monitoring of smart grid networks(L5).
5	determine the various power system parameters for design of communication networks for smartgrid networks (L3).
6	

Specific Instructional	
1	anlysis of smartgrid power networks using simulation tools like MATLAB, SIMULINK
2	
3	

Unit I	Communication Technologies for Power System	8

Fibre Optical Networks, WAN based on Fibre Optical Networks, IP based Real Time data Transmission, Substation communication network, Zigbee.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit II	Information System for Control Centres (ICCS)	6

ICCS Configuration, ICCS communication Network, ICCS Time Synchronization, E-Commerce of Electricity, GIS, GPS.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit III	Integration, Control and Operation of Distributed Generation	8

Distributed Generation Technologies and its benefits, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit IV	Smart metering	8

Load dispatch centres, wide area monitoring system (WAMS), PMU; Smart sensors/telemetry, advanced metering infrastructure (AMI), smart metering

Pedagogy Tools	text book	coursera	nptel		matlab		

Pedagogy Tools	ppts						

Unit V	smart grid system monitoring	6

s; self-healing. Micro grid: Integration of distributed energy sources; concept, operation, control, and protection of Micro grid. Integration of conv

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	36	T	0	P	150

Text Books

1	Ali Keyhani, Mohammad N. Marwali, Min Dai, “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley.
2	Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press.
3	
4	

Reference Books

1	Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley.
2	laude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell 19. 5. Stuart Borlase, “Smart Grids (Power Engineering)”, CRC
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping	

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12			
1	2	3	1	1	2	2		2	2	3	3	2			
2	3	3	1	1	2	2		2	2	2	2	3			
3	3	2	1		2	3		2	2	1	2	3			
4	3	2	3	2	2	2		1	2	2	3	3			
5	3	2	3		3	1		2	1	1	1	1			

Date of Approval	

Course Code	Course Title				L	T	P	C
PC2	Energy management in smart grids				3	1	0	4
School	SOT				Syllabus version			

Pre-requisties	Fundamentals of power systems
Alternate Exposure	Basics of energy management systems
Co-requisties	

Electric power transmission and distribution, power system analysis, energy management

Course Description

This course is aimed to introduce the basic concepts of smartgrid energy management systems which are needed for the energy monitoring and management in smartgrid power system networks and has potential applications in smart grid energy development. This is base course for subjects like smartgrid architectural design, smartgrid communication systems. The students are provided with theorital concepts of smart grid energy management techniques.

Course Objectives

1	To familiarize energy management technologies for power system.
2	To understand the smart metering for energy management.
3	To teach the concepts of Energy management of smart transmission systems
4	To familiarize concepts of Energy management of smart distribution systems
5	To acquire smartgrid parameters for Design of Energy Management Systems for smartgrid

Course Outcomes	After the completion of this course, the students will be able to
1	Solve various topologies for energy management (L3).
2	Examine the behavior of smartgrid network by means of energy monitoring(L4).
3	calculate the power and energy for smartgrid networks(L3).
4	apply concepts of smart metering for energy mangement of smart grid networks(L5).
5	determine the various power system parameters for design of energy management solution for smartgrid networks (L3).
6	

Specific Instructional	
1	anlysis of smartgrid power networks using simulation tools like MATLAB, SIMULINK
2	
3	

Unit I	Introduction	8

Early smart grid initiatives, overview of the technologies required for the smart grid, information security for the smart grid.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit II	Smart metering for energy management	6

g, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit III	Energy management of smart transmission systems	8

centralized optimization, utilization of large-scale wind and solar power, flexible loads in demand response. Fluctuation of load and wind power output, impact of mediation of electric vehicles and renewable energy sources into a smart grid, scheduling the thermal units along with the electric vehicles and renewable energy sources.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit IV	Energy management of smart distribution systems	8

Introduction, evolution of electricity metering, key components of smart metering, overview of the hardware used for smart meters, smart metering protocols.

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Unit V	Design of Energy Management Systems	6

Diagnostics and Situational Awareness, energy management Planning Issue, Diagnostics, Self-Healing and Reliability of Smart Grids, Demand Resp

Pedagogy Tools	text book	coursera	nptel		matlab		
	ppts						

Total Number of Contact Hours	L	36	T	12	P	0

Text Books

1	Nick Jenkins, Janaka Ekanayake, [et al.] Smart Grid Technology and Applications, Wiley India Ltd.
2	Ali Keyhani, Muhammad Marwali, Smart Power Grids 2011, Springer-Verlag Berlin Heidelberg 2012.
3	
4	

Reference Books

1	hani, Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEE Press 2016.Unit I: Communication Technologies for Power Sy
2	
3	
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping

Course Outcomes	Programme Outcomes														
	1	2	3	4	5	6	7	8	9	10	11	12			
1	3	2	1	3	2	1	1	1	2	3	3	3			
2	3	2	1	3	2	2	2	1	2	2	3	3			
3	3	2	1	2	2	1	1	1	2	1	2	3			
4	3	3	3	2	2	2	1	1	2	2	2	3			
5	3	3	3	2	4	2	1	2	3	1	2	1			
6															

Date of Approval	

Course Code	Course Title			L	T	P	C
PC2	Cyber Security			3	1	0	4
School	SOT			Syllabus version			

Pre-requisties	19LOE301: FUNDAMENTALS OF CYBER LAW
Alternate Exposure	Network Security, web technologies
Co-requisties	Internet security, TCP/IP Protocols
Course Description	In this course it is aimed to introduce to the students the knowledge of various cyber security terminologies, technologies, protocols, threat analysis, security principles, security mechanisms, policies, forensics, incidence response and methods/practices to secure systems etc.

Course Objectives	
1	To Study fundamentals of the cybersecurity domain and related issues
2	To Expose various basic concepts of cyber security terminologies, technologies
3	To Familiarize various protocols of cyber security
4	To Interpret the effect of security principles, security mechanisms
5	To Expose various policies, forensics of cyber security

Course Outcomes	After the completion of this course, the students will be able to
1	Solve various problems for cybersecurity domain and related issues(L3).
2	Examine the behavior of cyber security terminologies, technologies (L4).
3	calculate the network security parametersL3).
4	apply concepts of various policies and forensics(L5).
5	determine the various threats associated with cyber crime (L3).

Specific Instructional	
1	anlysis of cyber security tools
2	
3	

Unit I	Introduction	8
Introduction, Psychology, Usability, Thinking like a Hacker CIA Triad, Security Terminologies, Security Protocols Security Policies and Management, Multilevel and multilateral Policies, Security Mechanisms		

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit II	software security	6
Security Design Principles, Threat Analysis and Risk Assessment, Securing a System Cryptography, Basic Techniques, Digital Signatures, Cryptanalysis		

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit III	Network security	8
Fall-Break, Student Project Idea Discussion Network Security, Vulnerabilities, Attacks, Defenses Internet and Smartphone Security, Anonymous vs Secure Browsing		

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit IV	cyber security applications	8
Information Economics, Economics of Security, Physical Protection, Biometrics Banking Security, Cyber Forensics, Cyber Warfare, Surveillance and Privacy		

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Unit V	Issues and ethics	6
Incident Response and Mitigation, Business Continuity, Legal issues and Ethics		

Pedagogy Tools	text book	coursera	nptel				
	ppts						

Total Number of Contact Hours	L	36	T	0	P	0

Text Books	
1	Ross Anderson, Security Engineering. 2nd Edition. John Wiley
2	Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book bykogent
3	XML: The Complete Reference –(by Williamson Heather published by Osborne publications 1/e)
4	

Reference Books	
1	Charles P. Pfleeger, Security in Computing, 5th Edition,
2	Jason Hunter, William Crawford, Java Servlet Programming, 2/e, O'Reilly,2003
3	Robert W.Sebesta, Programming the World Wide Web, 4/e, PearsonEducation,2007.
4	

Evaluation Procedure						
Continuous Evaluation	Total 70 Marks					
	Quiz 1	Quiz 2	Assignment1	Assignment 2	CAT 1	CAT 2
	10	10	10	10	15	15
Sem End Examination	Total 30 Marks					

Course Outcome - Programe Outcome Mapping														
Course Outcomes	Programme Outcomes													
	1	2	3	4	5	6	7	8	9	10	11	12		
1	2	1	2	2		2	1	3		2	2	3		
2	3	1	2	2		2	1	3		1	2	3		
3	2	1	3	2		3	1	2	1	3	2	3		
4	3	3	3	2		3	1	2	2	3	3	3		
5	3	3	3	4		2	2	2	1	2	1	2		

Date of Approval	

Electrical Vehicle Technology
LIST of ALL COURSES

1) Introduction to Electric Vehicle Technology
2) Sensors and Communications in Electric Vehicles
3) Vehicle Dynamics, Modeling and Simulations
4) Electrical Drives and Control for Electrical Vehicles
5) Battery management system
6) Self-Driving Vehicle Technology

Course 1: Introduction to Electric Vehicle Technology

Unit I:
Introduction:
Air pollution, global warming, petroleum resources, induced costs, and development strategies for future oil supply, Overview of Past, current and future of electric vehicles.

Unit II:
Vehicles' classification:
Classification of vehicles: Conventional IC engines, electric vehicles, hybrid electric vehicles, plug-in hybrid vehicles, and fuel cell vehicles. Basic principles and operation of electric vehicles.

Unit III:
Configuration and Architecture:
Configuration of electric vehicles, performance of electric vehicles: traction motor characteristics, requirement of tractive and transmission effort and energy consumption.Architecture of hybrid vehicles: series and parallel

Unit IV:
Basic electric propulsion systems:
(Elementary treatment only) Principle, operation and performance of DC motors, induction motors, brushless DC motors and switched reluctance motors

Unit V:
Overview of communication in EVs:
Vehicle to grid communication, vehicle to vehicle communications, and grid to vehicle communication.

Text Book(s):
Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. M. (2018). *Modern electric, hybrid electric, and fuel cell vehicles*. CRC press.

Larminie, James, and John Lowry. *Electric vehicle technology explained*. John Wiley & Sons, 2012.

Reference Book(s):
Lu, J. and Hossain, J., 2015. *Vehicle-to-grid: linking electric vehicles to the smart grid*. Institution of Engineering and Technology.

Course 2: Sensors and Communications in Electric Vehicles

Unit I: Sensors: 1

Concepts of Hall effect sensors, piezoelectric sensors, optical sensors, ultrasonic sensors.

Position sensor, velocity sensor, acceleration sensor, linear variable displacement sensors, inertial sensors (gyros, accelerometers).

Unit II: Sensors: 2

Temperature sensor, voltage sensor, current sensor, MEMS, tire pressure sensors, wireless sensors, level sensor, occupancy sensor, image sensor, LIDAR, RADAR, GNSS.

Unit III: Communications in EV-1

Data transmission types and modes, wired communication protocols - ethernet, CAN, Modbus, UART. Wireless communication protocols (elementary treatment only).

Unit IV:

Communications in EV-2

Vehicle to grid communication, overall flow of communication, ISO communication standards: ISO 15118 (series 1, 2, 3, 5 and 5).

SAE Recommended Practice J2836/1, SAE Recommended Practice J2847/1, SAE Surface Vehicle Recommended Practice J1772.

Unit V:

Charging protocols:

Open Charge point protocol, open charge point interface, open automated demand response, open smart charging protocol, open clearing house protocol, open interchange protocol, eMobility interoperation protocol

TextBook(s):

Basu, A.K., Tatiya, S. and Bhattacharya, S., 2019. Overview of electric vehicles (EVs) and EV sensors. In *Sensors for Automotive and Aerospace Applications* (pp. 107-122). Springer, Singapore.

IEC/ISO 15118-1: 2013, 2013. Road vehicles–vehicle to grid communication interface–part 1: general information and use-case definition.

Reference Book(s):

Pratt, R.M., Tuffner, F.K. and Gowri, K., 2011. *Electric Vehicle Communication Standards Testing and Validation Phase I: SAE J2847/1* (No. PNNL-20913). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).

https://www.kpit.com/insights/smart-charging-vehicle-to-grid-communication/

https://driivz.com/blog/ev-charging-standards-and-protocols/

Course 3: Vehicle Dynamics, Modeling and Simulations

Unit I:

Introduction:

Vehicle movement, vehicle resistance – rolling resistance, aerodynamic drag and grading resistance. Dynamic equation, vehicle power plant and transmission characteristics, vehicle performance – maximum speed of a vehicle, acceleration performance

Unit II:

Fuel Economy:

Operating fuel economy – fuel economy characteristics of internal combustion engines, calculation of vehicle fuel economy. Braking performance – braking force, braking distribution

Unit III:

Kinematics:

Coordinate Systems, active safety systems, equations of motion – ground vehicles, quarter car model – kinematics, force and torques and simulation

Unit IV:

Road and tire models:

Deterministic and random profiles of a road. Tire development, forces and torques, typical tire characteristics, contact geometry, steady-state forces and torques. First order tire dynamics and simulation.

Unit V:

Lateral and longitudinal dynamics:

Kinematic tire model, Ackermann geometry, vehicle model with trailer, steady-state cornering.

Dynamic wheel loads, maximum acceleration, driving and braking, anti-lock system, drive and brake pitch.

TextBook(s):

Ehsani, M., Gao, Y., Longo, S. and Ebrahimi, K.M., 2018. *Modern electric, hybrid electric, and fuel cell vehicles*. CRC press.

Rill, G. and Castro, A.A., 2020. *Road Vehicle Dynamics: Fundamentals and Modeling with MATLAB®*. CRC Press.

Reference Book(s):

Larminie, James, and John Lowry. *Electric vehicle technology explained*. John Wiley & Sons, 2012.

Course 4: Electrical Drives and Control for EVs

Unit I:
Introduction to converters:
AC-DC converters (single phase), DC-DC converters: buck converter, boost converter, buck-boost converter, SEPIC converter, Cuk converter, pulse-width modulation techniques

Unit II:
Control of dc motor:
Control of a DC motor drive: block diagram of dc motor drive, state space model, speed-torque characteristics, speed control and sensor-less speed control

Control of an induction motor drive: block diagram of an induction drive, state space model,speed-torque characteristics, speed control and sensor-less speed control

Unit III:
Control of brushless dc (BLDC) motor:
Block diagram of aBLDC drive, state space model,speed-torque characteristics, speed control and sensor-less speed control

Unit IV:
Control of a permanent magnet synchronous motor (PMSM):
Block diagram of a PMSM drive, state space model, speed-torque characteristics, speed control and sensor-less speed control

Unit V:
Control of switched reluctance motor:
Block diagram of a SRM drive, state space model, speed-torque characteristics, speed control and sensor-less speed control

TextBook(s):
Ehsani, M., Gao, Y., Longo, S. and Ebrahimi, K.M., 2018. *Modern electric, hybrid electric, and fuel cell vehicles*. CRC press.
Chau, K.T., 2015. *Electric vehicle machines and drives: design, analysis and application*. John Wiley & Sons.

Reference Book(s):
Emadi, A. ed., 2014. *Advanced electric drive vehicles*. CRC Press.

Course 5: Battery Management System

Unit I:
Introduction:
Types of energy storage devices: Fuel cells, hydrogen storage systems, and super-capacitors.
Types of batteries: Lead-Acid batteries, Nickel metal hydride batteries, Li-S batteries, Li-Air batteries and Li-ion batteries

Unit II:
Equivalent electrical circuit of a cell Model:
Various electrical parameters of a cell – voltages, charge, current, energy stored, specific energy, energy density, specific power, energy efficiency, battery temperature, battery life.
Equivalent electrical circuit model of a Li-ion cell, derivation of key parameters.

Unit III:
State of Charge and State of Health:
Introduction to state estimation – Luneberger observer and Kalman filter. SoC and SoH estimation using Luenberger observer and Kalman filter for simple linear battery model

Unit IV:
Battery charging methods:
Slow charging and fast charging methods.
Charging Methods - Float Charge, Trickle Charge, Bulk Charge, Equalization Charge
Charging Techniques - Constant Current, Constant Voltage, Constant Current–Constant Voltage

Unit V:
Battery management System: Thermal management – active and passive cooling methods, high-voltage control, safety and protection

TextBook(s):

Xiong, R., 2020. *Battery Management Algorithm for Electric Vehicles*, Springer, Singapore.
Gregory L.. Plett, 2015. *Battery management systems: Battery modeling*. Artech House.

Reference Book(s):
Notten, P., Bergveld, H. and Kruijt, W., 2002. *Battery management systems: design by modelling*, Springer.

Course 6: Self-Driving Vehicle Technology

Unit I:
History of Self-Driving Vehicles
Brief history of self-driving vehicles and benefits of SDV. Localization based on wheel odometry, INS, lidar, cameras, multi-sensor data fusion.

Unit II:
Localization
Localization with GNSS, GNSS Overview, GNSS Error Analysis, Satellite-Based Augmentation Systems, Real-Time Kinematic and Differential GPS, Precise Point Positioning, GNSS/INS Integration

Unit III:
Mapping
Occupancy grid maps, feature maps, relational maps.
Introduction to Kalman filter, Object detection: feature extraction using scale-invariant feature transform, introduction to simultaneous localization and mapping:

Unit IV:
Architecture
Functional architecture: perception, planning, vehicle control. System architecture: hardware layer, middleware layer, application layer. SDV middleware examples: robot operating system, automotive data and time-triggered framework, automotive open system architecture

Unit V:
SDV applications:
Private passenger cars, public buses, trucks, driverless tractors. Basics of deep learning, applying deep learning for SDVs using semantic abstraction learning and end-to-end learning.

TextBook(s):
Sjafrie, H., 2019. *Introduction to Self-Driving Vehicle Technology*. Chapman and Hall/CRC.
Cheng, H., 2011. *Autonomous intelligent vehicles: theory, algorithms, and implementation*. Springer Science & Business Media. & Business Media

Reference Book(s):
Fallon, M., 2018. *Self-driving cars: The new way forward*. Twenty-First Century Books (Tm).