

Electrical and Electronics Engineering Program

Preamble: The curriculum of B. Tech. (Electrical and Electronics Engineering) program offered by the Department of Electrical and Electronics Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like IEEE and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system is completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

The Vision

To attain academic excellence in electrical and electronics engineering by imbibing ethical and moral values and contributing to society through research

The Mission

- To impart technical knowledge through quality education and creating conducive environment through state-of-the-art infrastructure and facilities
- To promote academia - industry relationship for enhancing multidisciplinary research
- To imbibe core values of integrity, team work, professional ethics and societal responsibilities

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Electrical and Electronics Engineering of NSRIT will

1. Demonstrate the real-world engineering problem solving skills by applying the fundamental and conceptual engineering knowledge as a practicing electrical and electronics Engineer
2. Provide research-based engineering solutions addressing the environment and sustainability by maintaining the professional standards and ethical values
3. Foster self-directed learning through their professional experience, technology advancements in their relevant field of interest.

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behaviour with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Electrical and Electronics Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioural competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. 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 (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clear instructions (Communication)

11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Analyze, design and simulate diverse problems associated in the field of electrical, electronics and computer based systems by providing sustainable solutions adopting ethical practices
2. Apply appropriate methods and modern components to aid design, analysis and synthesis of solutions

Category-wise Credit Distribution of Courses

Category		AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	21.0
ES	Engineering Science	24.0	22.5	22.5
PC	Professional Core	48.0	55.5	52.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
Total no. of credits		160	160	160

Electrical and Electronics Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards

	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

Semester I								
No.	Code	Course	POs	Contact Hours				
				L	T ¹	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12 ¹	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1,3	3	1	0	3.0	BS
04	20ESX03	Basic Electrical Engineering	1, 2	3	0	0	3.0	ES
05	20ESX02	Programming for Problem Solving Using 'C'	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	10	0	0	3	1.5	HS
07	20BSX34	Applied Physics Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving Using 'C' Lab	1, 4	0	0	3	1.5	ES
Sub-total				15	02	09	19.5	
Semester II								
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20CS403	Python Programming	1	3	1	0	3.0	ES
04	20ESX04	Engineering Mechanics	1	3	1	0	3.0	ES
05	20ESX01	Engineering Drawing	1, 5, 10	1	0	4	3.0	ES
06	20BSX24	Applied Chemistry Lab	1, 4	0	0	3	1.5	BS
07	20CS407	Python Programming Lab	1	0	0	3	1.5	ES
08	20ESX06	Engineering Workshop	4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	MC
Sub-total				15	04	13	19.5	
Semester III								
01	20BSX13	Numerical Methods and Transforms	1	3	1	0	3.0	BS
02	20EC302	Electronic Devices and Circuits	1,2,3,4,10	3	0	0	3.0	PC
03	20EE303	Electrical Circuit Analysis	1, 2, PSO 1,2	3	1	0	3.0	PC
04	20EE304	DC Machines and Transformers	1,2, PSO 1,2	3	0	0	3.0	PC
05	20EE305	Power Generation and Transmission	1,2, PSO 1,2	3	0	0	3.0	PC
06	20EC306	Electronic Devices and Circuits Lab	1,2,3,4,5,9, PSO2	0	0	3	1.5	PC
07	20EE307	DC Machines and Transformers Lab	1,2,4,11,	0	0	3	1.5	PC
08	20EE308	Electrical Circuit Analysis Lab	1,2,4, PSO 1	0	0	3	1.5	PC
09	20EES01	Short-term Skill Oriented Elective	1,2,4,5,10, PSO 1,2	1	0	2	2.0	SC
10	20MCX02	Constitution of India ²	-	2	0	0	-	MC
Sub-total				18	02	11	21.5	

¹ Suggested tutorial hours will not carry any credits

² It is mandate for all students to pursue an online certification course for minimum duration of 30 hours covering the areas of Sustainability, Climate changes, Environmental Impact Assessment in line with Sustainable Development Goals (SDG)

Semester IV								
No.	Code	Course	POs	Contact Hours				
				L	T	P	C	
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	1	3	1	0	3.0	BS
03	20EE403	Control Systems	1,2,4, PSO 1,2	3	0	0	3.0	PC
04	20EE404	Induction Motors and Synchronous Machines	1,2,4,6, PSO 1,2	3	1	0	3.0	PC
05	20EE405	Electro Magnetic Field Theory	1,2, PSO 1,2	3	0	0	3.0	ES
06	20EE406	Induction Motors and Synchronous Machines Lab	1,4 PSO 1,2	0	0	3	1.5	PC
07	20EE407	Industrial Automation for Electrical & Electronics Engg.	1,4,5 PSO 1,2	0	0	3	1.5	PC
08	20EE408	Control Systems Lab	1,4, PSO 1,2	0	0	3	1.5	PC
09	20EES02	Short-term Skill Oriented Elective	1,4,5,10, PSO 1,2	1	0	2	2.0	SC
Sub-total				16	02	11	21.5	
Semester V								
01	20EC303	Signals and Systems	1,2	3	0	0	3.0	PC
02	20EE502	Power Electronics	1,2,4, PSO 1,2	3	1	0	3.0	PC
03	20EC305	Digital System Design	1, 2,3 PSO 2	3	0	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20EC308	Digital System Design Lab	1,2,3,4,9, PSO 1	0	0	3	1.5	PC
07	20EE507	Power Electronics Lab	1,4, PSO 1,2	0	0	3	1.5	PC
08	20EES03	Technical Paper Writing ³	-	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents ⁴	-	2	0	0	-	MC
10	-	Community Service Project ⁵	5, 8, 9, 10, PSO 1	0	0	0	1.5	IN
Sub-total				17	01	08	21.5	
Semester VI								
01	20EC603	Micro Processors and Micro Controllers	1,2,4,5, PSO 2	3	0	0	3.0	PC
02	20EE602	Electrical Measurements and Instrumentation	1,2,3,7, PSO 1,2	3	0	0	3.0	PC
03	20EE603	Power System Analysis	1,2, 3,PSO 1,2	3	1	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20EC606	Micro Processors and Micro Controllers Lab	1,2,3,4,5, PSO	0	0	3	1.5	PC
07	20EE607	Electrical Measurements and Instrumentation Lab	3,4, PSO 1,2	0	0	3	1.5	PC
08	20EE608	Power Systems and Simulation Lab	1,4, PSO 1,2	0	0	3	1.5	PC
09	20EES04	Short-term Skill Oriented Elective	1,4,PSO 1,2	1	0	2	2.0	SC
10	20MCX04	Indian Traditional Knowledge ⁶	-	2	0	0	-	MC
Sub-total				18	01	11	21.5	

³ The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

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⁵ The work pertaining to summer Internship #1 and #2 shall be completed at the end of the semesters IV & VI respectively. The assessment shall be carried out during the semesters V and VII

It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

⁶ It is mandate for all the students to pursue an online certification course for minimum duration of 30 hours covering the application of ITK in Science Engineering & Technology

Semester VII								
01	-	Full Semester Internship ³	5-10,PSO1, PSO2	0	0	0	6.0	IN
02	-	Summer Internship	5, 8, 9, 10	0	0	0	3.0	IN
Sub-total				0	0	0	9.0	
Semester VIII								
01	-	Professional Elective III	-	3	0	0	3.0	PE
02	-	Professional Elective IV	-	3	0	0	3.0	PE
03	-	Professional Elective V	-	3	0	0	3.0	PE
04	-	Open Elective III	-	3	0	0	3.0	OE
05	-	Open Elective IV	-	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20EES05	E- CAD	-	0	0	0	2.0	IN
08	-	Capstone Project ³	5-10, PSO1,PSO2	0	0	0	6.0	IN
Sub-total				0	0	0	26.0	
Total Credits				-	-	-	160	

List of Electives

Professional Elective #1								
1	20EE001	Advanced Power Electronics	-	3	0	0	3.0	PE
2	20EE002	Digital Control Systems	-	3	0	0	3.0	PE
3	20EE003	Utilization of Electrical Energy	-	3	0	0	3.0	PE
4	20EE004	Machine Modelling and Analysis	-	3	0	0	3.0	PE
5	20EE005	Sensors and Transducers	-	3	0	0	3.0	PE
Professional Elective #2								
6	20EE006	Solid State Electric Drives	-	3	0	0	3.0	PE
7	20EE007	Advanced Control Systems	-	3	0	0	3.0	PE
8	20EE008	Reactive Power Compensation and Management	-	3	0	0	3.0	PE
9	20EE009	Basic Industrial Automation	-	3	0	0	3.0	PE
10	20EE010	Process Instrumentation	-	3	0	0	3.0	PE
Professional Elective #3								
11	20EE011	Switchgear Protection	-	3	0	0	3.0	PE
12	20EE012	Digital Signal Processing	-	3	0	0	3.0	PE
13	20EE013	HVDC and FACTS	-	3	0	0	3.0	PE
14	20EE014	Programmable Control Devices and Applications	-	3	0	0	3.0	PE
15	20EE015	Virtual Instrumentation	-	3	0	0	3.0	PE
Professional Elective #4								
16	20EE016	Analysis of Power Converters	-	3	0	0	3.0	PE
17	20EE017	Multivariable Control System	-	3	0	0	3.0	PE
18	20EE018	Power System Operation and Control	-	3	0	0	3.0	PE
19	20EE019	Automotive Electrical Engineering	-	3	0	0	3.0	PE
20	20EE020	Wireless Sensors and Instrument Networks	-	3	0	0	3.0	PE
Professional Elective #5								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
Open Elective #1								
21	20CEO01	Urban Environmental Service	-	3	0	0	3.0	OE
22	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
23	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
24	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
25	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
26	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
27	20MEO01	Nano Technology	-	3	0	0	3.0	OE
28	20SHO01	Women and Society	-	3	0	0	3.0	OE
Open Elective #2								
29	20CEO02	Ecology, Environment and Resources	-	3	0	0	3.0	OE
30	20CSO02	Designing the Internet of Things	-	3	0	0	3.0	OE
31	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
32	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
33	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
34	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
35	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
Open Elective #3								
36	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
37	20CS404	Operating Systems	-	3	0	0	3.0	OE
38	20AIO03	Fundamentals of AI	-	3	0	0	3.0	OE
39	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
40	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
41	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
42	20MEO03	Industrial Automation	-	3	0	0	3.0	OE
43	20SHO02	Design Thinking	-	3	0	0	3.0	OE
Open Elective #4								

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								OE
B. Tech. (Honors)								
Category I								
1	20EEH01	Smart Grid	-	4	0	0	4.0	HO
2	20EEH02	Advanced Smart Power Grids	-	4	0	0	4.0	HO
3	20EEH03	Electric Power Quality	-	4	0	0	4.0	HO
Category II								
4	20EEH04	Electric Vehicle Technologies	-	4	0	0	4.0	HO
5	20EEH05	Energy Audit Conservation and Management	-	4	0	0	4.0	HO
6	20EEH06	Electrical Load Estimation	-	4	0	0	4.0	HO
Category III								
7	20EEH07	Challenges and Impact of Electric Vehicle on Smart Grids	-	4	0	0	4.0	HO
8	20EEH08	Optimization Techniques	-	4	0	0	4.0	HO
9	20EEH09	Illumination Engineering	-	4	0	0	4.0	HO
Category IV								
10	20EEH10	Design and Testing of Battery Management System for Electric Vehicle	-	4	0	0	4.0	HO
11	20EEH11	Advanced Power System Protection	-	4	0	0	4.0	HO
12	20EEH12	Power System Stability	-	4	0	0	4.0	HO
B. Tech. (Minor with Specialization)								
Category I								
1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Semi-Conductor Devices and Circuits	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI
8	20SHM01	Psychology	-	3	0	0	3.0	MI
9	20SHM02	Statistical Methods	-	3	0	0	3.0	MI
10	20MBM01	General Management	-	3	0	0	3.0	MI
11	20MBM02	Human Resource Planning	-	3	0	0	3.0	MI
Category II								
12	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
13	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
14	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
15	20EEM02	Basics of Electrical Machines and Drives	-	3	0	0	3.0	MI
16	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
17	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
18	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI
19	20SHM03	English for Media	-	3	0	0	3.0	MI
20	20SHM04	Statistical Inference	-	3	0	0	3.0	MI
21	20MBM03	Organization Behaviour	-	3	0	0	3.0	MI
22	20MBM04	Compensation Management & Employee Welfare Laws	-	3	0	0	3.0	MI
Category III								
23	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
24	20CSM03	Database Security	-	3	0	0	3.0	MI
25	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
26	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
27	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
28	20AIM03	Interpretable Machine Learning	-	3	0	0	3.0	MI
29	20DSM03	Data Governance	-	3	0	0	3.0	MI
30	20SHM05	Journalism	-	3	0	0	3.0	MI
31	20SHM06	Statistical Quality Control	-	3	0	0	3.0	MI
32	20MBM05	Entrepreneurship & Business Venture Planning	-	3	0	0	3.0	MI
33	20MBM06	Performance Management & Talent Management	-	3	0	0	3.0	MI

Short Term Skill Oriented Electives								
34	23EES01	MATLAB		0	0	4	2.0	SC
35	23EES02	PLC		0	0	4	2.0	SC
36	23EES04	P-SPICE						
37	23EES05	ECAD		0	0	4	2.0	SC
Industry Connect Courses (Skill Oriented Courses) ⁷								
38	23ICC01	Competitive Programming	-	2	0	8	6.0	ICC
39	23ICC02	Web Technologies – Theory to Practice	-	2	0	8	6.0	ICC
40	23ICC03	Java and Springboard	-	2	0	8	6.0	ICC
41	23ICC04	Robotics Process Automation (RPA)	-	2	0	8	6.0	ICC
42	23ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
43	23ICC06	Battery System Design Engineering	-	2	0	8	6.0	ICC
44	23ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
45	23ICC08	Network Administration	-	2	0	8	6.0	ICC
46	23ICC09	Product Engineering	-	2	0	14	9.0	ICC
47	23ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
48	23ICC11	Data Scientist	-	2	0	8	6.0	ICC
49	23ICC12	Industrial IoT	-	2	0	8	6.0	ICC

⁷ The credits earned through Industry Connect Courses (Skill Oriented Course) can be tradeoff with any other 3-Credit course other than Professional Core

HS 20HSX01 Communicative English**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO10	PO12	
20HSX01.1	Appreciate and comprehend social as well as business dialogues spoken by the native speakers of English by identifying the topic, context and specific information	3	1	L1, L2
20HSX01.2	Question and respond to queries on familiar topics as well as to use appropriate expressions for various functions of language	3	1	L1, L2
20HSX01.3	Implement suitable strategies for scanning the idea of the text so as to be able to find exact information	3	1	L1, L2
20HSX01.4	Grasp paragraph structure and be able to implement the same in their writing	3	1	L1, L2
20HSX01.5	Articulate fluently and accurately as per the context and need	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Presidential Address by Dr. A. P. J. Abdul Kalam**9 Hours**

Chapter titled "Presidential Address by Dr. A. P. J. Abdul Kalam" from "Fluency in English – A Course Book for Engineering Students" published by Orient Black Swan, Hyderabad.

Listening: Listening to discussion on "Presidential Address by Dr. A.P.J. Abdul Kalam." Speaking: Elocution for short duration. Reading: Reading and Its Importance - Techniques for Effective Reading - Signal Words. Writing: Sentences - Techniques for Effective Writing - Paragraph Writing - Types, Structure and Features of a Paragraph. Vocabulary: Word Formation - Root Words - The Use of Prefixes and Suffixes - Collocations. Grammar: Punctuation - Parts of Speech. Non-Detail: "Deliverance" by Munshi Prem Chand from the book Individual Society

Intrapersonal skills and Interpersonal Skills

Unit II: Nehru's Letter to Daughter Indira on her Birthday**9 Hours**

Chapter titled "Nehru's Letter to Daughter Indira on Her Birthday" from InfoTech English Language referred from JNTUK.

Listening: Interpretation of the motive behind the letter related to the subject. Speaking: Discussion in Pairs/Small Groups on specific topics. Reading: Identifying sequence of ideas; recognizing verbal techniques. Writing: Letter Writing - Format, Styles, Parts, Language to be used in Formal Letters - Letter of Apology - Letter of Complaint - Letter of Inquiry with Reply - Letter of Requisition. Vocabulary: Antonyms and Synonyms; Homonyms, Homophones, Homographs. Grammar: Articles & Prepositions. Non-Detail: "Bosom Friend" by Hira Bansode from the book Individual Society

Creative Thinking and Teamwork

Unit III: Satya Nadella - Email to Employees on his First Day as CEO**9 Hours**

Chapter titled "Satya Nadella: Email to Employees on his First Day as CEO" from Fluency in English – A Course Book for Engineering Students" Published by Orient Black Swan, Hyderabad. Listening: Discussion on innovative methods of communication. Speaking: Change in the style of communication i.e., Face book, twitter, Instagram etc. Reading: Sub-skills of Reading - Skimming, Scanning and Skipping. Writing: Email Etiquette; Cover Letter; Resume writing. Vocabulary: One-word substitutes. Grammar: Verb & its kinds and Tenses. Non-Detail: "Shakespearean Sister" by Virginia Woolf from the book Individual Society

Communication Skills and Leadership Skills

Unit IV: Stay Hungry, Stay Foolish

9 Hours

Chapter titled "Stay Hungry, Stay Foolish"– from InfoTech English Language referred from JNTUK. Listening: Answering a set of questions (from the context of the lesson) in a group. Speaking: Formal oral Presentations on topics from Academic contexts. Reading: Intensive and extensive Reading. Writing: Psychological stressors; Summarizing & Paraphrasing. Vocabulary: Similar words, elaborate meaning of the words. Grammar: Reported Speech: Exercises; Reporting Verbs for academic purposes, Editing Texts. Non-Detail: "Telephone Conversation" by Wole Soyinka from the book Individual Society

Thinking Skills and Problem Solving

Unit V: Stephen Hawking – Positivity Benchmark

9 Hours

Chapter titled "Stephen Hawking – Positivity Bench Mark" from InfoTech English Language referred from JNTUK. Listening: Listening to discussions on "Stephen Hawking – positivity Bench Mark." Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Reading: Reading between the lines; Critical Reading for Evaluation. Writing: Precise writing & Essay Writing. Vocabulary: Connotation & Denotation. Grammar: Voice, Concord (Subject – Verb Agreement). Non-Detail: "Still I Rise" from Maya Angelou from the book Individual Society

Positive Attitude and Self Esteem

Text Books

1. "Infotech English Language" – A Text book referred by the JNTUK University Marathi, Publications, 2019
2. "Fluency in English– A Course book for Engineering Students" Published by Orient Black Swan, Hyderabad, 2017
3. "The Individual and Society" – Non-Detailed book referred by the JNTUK University, Pearson Publications, 2020

Reference Books

1. Bailey, Stephen, "Academic writing: A handbook for international students", Routledge, 2014
2. Chase, Becky Tarver, "Pathways: Listening, Speaking and Critical Thinking" Henley ELT; 2nd Edition, 2018
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational Publishers, 2013
4. Hewing's, Martin, "Cambridge Academic English" (B2), CUP, 2012

Web References

1. <https://www.youtube.com/watch?v=Zd9mE0d2M9k>
2. <https://www.thenewlearn.com/2019/11/the-letters-that-cultivated-indira-gandhi/>
3. <https://www.youtube.com/watch?v=PK2XvOs8e1s>
4. <https://www.youtube.com/watch?v=U36o3UzGY-I>
5. <https://blogs.microsoft.com/blog/2014/02/04/microsoft-employees-give-new-ceo-satya-nadella-a-12th-man-welcome>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What suggestions did Nehru give to Indira in his letter?
2. "The only way to do great work is to love what you do." Do you think that Steeve Job's statement is worthy in every one's life? Why?
3. What does the phrase 'great drama' refer to?
4. During the freedom movement, what did Gandhiji focus on? Answer with reference to the text
5. Steve Jobs said, "You have to trust in something – your gut, destiny, life, karma, whatever." can you explain a few instances where Steeve Jobs followed his philosophy in his life
6. Write about the early life and education of Stephen Hawking
7. Who did Virginia Woolf sketch the character of Judith?
8. What was the second story of Steve jobs is all about?
9. What was the work done by Steve Jobs in mobile industry?

BS 20BSX11 Linear Algebra and Differential Equations

3 1 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX11.1	Solve homogenous & non- homogenous linear system of equations using rank of a matrix	3	1	L1, L2, L3
20BSX11.2	Apply Cayley Hamilton theorem to find inverse & powers of a matrix and identify the nature of the quadratic forms	3	1	L1, L2, L3
20BSX11.3	Solve linear differential equations of first order	3	1	L1, L2, L3
20BSX11.4	Solve higher order ordinary D.E's with constant coefficients related to various engineering fields	3	1	L1, L2, L3
20BSX11.5	Relate the mean value theorems and find Jacobian, Maxima and Minima of functions of several variables in calculus to engineering problems	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Solving Systems of Linear Equations, Eigen Values and Eigen Vectors

11 + 1 Hour

Rank of a matrix-Echelon form - Normal form; solving homogeneous and non-homogeneous system of linear equations – Gauss Elimination for solving system of equations; Eigen values and Eigen vectors

Types of Matrices, Rank by using Minor Method, By using Elementary Transformation Method to find Inverse of the Matrix, Gauss- Jordan Method: Properties of Eigen Values and Eigen Vectors

Unit II: Cayley-Hamilton Theorem and Quadratic Forms

11 + 1 Hour

Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem, Reduction to Diagonal form. Quadratic forms: Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to Canonical forms by diagonalization and Orthogonal transformation. Singular values of a matrix- singular value decomposition- Pseudo inverse by singular value decomposition

Symmetric and Skew-Symmetric Matrices, Orthogonal Matrix, Complex Matrix, Hermitian of a Matrix, Unitary of a Matrix

Unit III: Differential Equations of First Order and First Degree

11 + 1 Hour

Linear differential equations–Bernoulli's equations – Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal Trajectories

Formation of Ordinary Differential Equation, Variable and Separable, Homogeneous and Non- Homogeneous Differential Equations by using Substitution Method

Unit IV: Linear Differential Equations of Higher Order

11 + 1 Hour

Homogeneous and Non-homogeneous equations of higher order with constant coefficients – with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, Polynomials in x , $e^{ax}V(x)$ and $xV(x)$ – Method of Variation of parameters. Applications: LC circuits - CR circuits - LCR circuits

Simple Harmonic Motion, Higher Order Differential Equation with Variable Coefficient

Unit V: Mean Value Theorems and Functions of Several Variables

11+1 Hour

Mean Value Theorems (without proof): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's series expansion of functions of one variable. Functions of Several Variables: Introduction – Partial differentiation - Homogeneous function – Euler's theorem –Jacobian – Functional dependence - Taylor's and Maclaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables with and without constraints - Lagrange's method of undetermined multipliers

The Chain Rule of Partial Differentiation, Total Derivative, Implicit Function and Jacobian Implicit Function

Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2015

1. Apply Cayley-Hamilton theorem to find inverse and A^4 of the matrix $A = \begin{bmatrix} 2 & -1 & 2 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and also verify the Cayley-Hamilton theorem
2. The number N of bacteria in a culture grew at a rate proportional to N . The Value of N was initially 100 and increased to 332 in one hour. What is the value of N after $1\frac{1}{2}$ hours
3. A condenser of capacity C discharged through an induction L and resistance R in series and the charge q at time t satisfies the equation $L \frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{q}{C} = 0$, Given $L = 0.25$ henries, $R = 250$ ohms, $C = 2 \times 10^{-6}$ farads and that when $t=0$, charge q is 0.002 coulombs and the current $\frac{dq}{dt} = 0$. Obtain the value of q in terms of t
4. Find the volume of the largest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$
5. A body is originally at 80°C and cools down to 60°C in 20 minutes if the temperature of air is 40°C . Find the temperature of body after 40 minutes
6. Find the shortest distance from origin to the surface $xyz^2 = 2$
7. Prove that system of parabola $y^2 = 4a(x + a)$ is self-orthogonal
8. Find the points on the surface $z^2 = xy + 1$ that are nearest to the origin
9. Find the orthogonal trajectories of the family of cardioids $r = a(1 - \cos\theta)$
10. A generator having emf 100 volts is connected in series with a 10 ohm resistor and an inductor of 2 henries. If the switch is closed at a time $t = 0$, find the current at time $t > 0$

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 Head of the Department
 (Mathematics)
 Dept. of Science & Humanities
 N.S.Raju Institute of Technology
 Sontyam, Visakhapatnam-531173

Band Theory of Solids: Bloch's theorem (Qualitative), Kronig-Penny model (Qualitative), energy bands in crystalline solids, E vs K diagram, effective mass electron-concept of hole. Semiconductor Physics: Origin of energy band formation in solids, classification of materials into conductors, semiconductors and insulators using band diagram, Intrinsic and Extrinsic semiconductors. Hall Effect, Hall coefficient and applications of Hall Effect.

Concept of Brillouin Zones, Density of States-Fermi Energy, Carrier Concentration in Semiconductors

Text Books

1. Dekker A. J., "Solid State Physics", 1st Edition, McMillan India Ltd., 2000
2. Avadhanulu M. N. and K Shirasagar P.G., "A Text Book of Engineering Physics", 1st Edition, S. Chand Publications, 2011
3. Palanisamy P. K., "Engineering Physics", 4th Edition, SciTech Publishers, 2014
4. Srinivasan M. R., "Engineering Physics", 2nd Edition, New Age International Publishers, 2014

Reference Books

1. Charles Kittel, "Introduction to Solid State Physics", 5th Edition, Wiley, India Pvt. Ltd., 2012
2. Anumugam M., "Applied Physics", 4th Edition, Anuradha Agencies, 2013
3. Bhattacharya D. K., "Engineering Physics", 2nd Edition, Oxford University Press, 2010
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", 1st Edition, University Press, 2010
5. Pandey B. K. and Chaturvedi S., "Engineering Physics", 1st Edition, Cengage Learning, 2012
6. Robert Rensnick, Jearl Walker and David Halliday, "Principles of Physics", 10th Edition, Wiley, 2015
7. Gour R. K. and Gupta S. L., "Engineering Physics", 1st Edition, Dhanpatrai Publications, 2011

Web References

1. <http://link.springer.com/physics>
2. <http://www.thphys.physics.ox.ac.uk>
3. <http://www.sciencedirect.com/science>
4. <http://www.e-booksdirectory.com>
5. <https://nptel.ac.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Principle of Superposition
2. Define types of polarization
3. State Dielectric polarization and Dielectric polarizability
4. What are Newton's rings? How are they formed?
5. What is meant by diffraction of light?

L2: Understand

1. Explain the construction and working principle of Nicol's prism
2. Demonstrate working principle of Ruby laser with energy level diagram
3. Outline de Broglie concept of matter waves
4. Discuss polarization by reflection
5. Explain the pumping mechanisms of lasers

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 Head of the Department
 Dept. of Science & Humanities
 Chairman
 N.S. Raju Institute of Technology
 Board of Studies (Physics)
 S. , Visakhapatnam-53113.

Web References

1. <https://nptel.ac.in/courses/108/108/108108076/>
2. <https://nptel.ac.in/courses/108/105/108105053/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	10
L2	40	40
L3	20	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

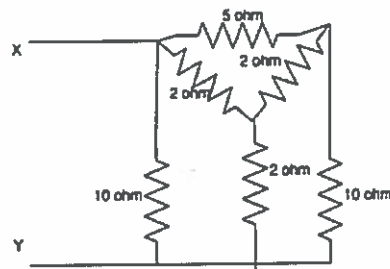
1. What is ohm's law?
2. Define RMS and Peak values
3. What is form factor?
4. Define time period
5. What is the purpose of commutator in DC machines?

L2: Understand

1. Explain in detail about Kirchoff's Current and Voltage Law
2. Explain working principle of DC shunt generator
3. Explain the operation of single phase transformer
4. Explain speed torque characteristics of 3 phase induction motor
5. Explain the operation of single phase induction motor

L3: Apply

1. Three resistances 750 Ω , 600 Ω and 200 Ω are in parallel. The total current is 1 A. Determine the voltage applied and current in each branch
2. Find the equivalent resistance between X and Y



3. Determine the efficiency of a 15 KVA transformer for the following conditions:
 - (i) Full-load, unity power factor
 - (ii) 0.8 full-load, unity power factor
 - (iii) Half full-load, 0.8 power factor
 Assume that iron losses are 200 W and the full-load copper loss is 300 W
4. A 3-phase star connected alternator is rated at 100 kVA. On short-circuit a field current of 50 amp gives the full load current. The emf generated on open circuit with the same field current is 1575 V/phase. Calculate the voltage regulation at (a) 0.8 power factor lagging, and (b) 0.8 power factor leading by synchronous impedance method. Assume armature resistance is 1.5 Ω

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 Head of the Department
 Dept. of Electrical & Electronics Engg.
 Chairman
 N.S.Raju Institute of Technology Autonomous
 Board of Studies (EEE)
 Sontyām, Visakhapatnam-531 173

3. Dromey R .G., "How to solve it by Computer", Pearson Education India, 2008

Reference Books

1. Kanetkar Y., "Let us C", 8th Edition, BPB Publication, 2004
2. ISRD Group, "Programming and Problem Solving Using C", Tata McGraw Hill, 2008
3. Prasad F. E. V., "C Programming: A Problem-Solving Approach", Giliberg, Cengage, 2010
4. Balagurusamy E., "Programming in ANSI C", 3rd Edition ,TMH, 2004

Web References

1. <https://www.geeksforgeeks.org/c-programming-language>
2. <https://www.tutorialspoint.com/cprogramming/index.html>
3. <https://www.javatpoint.com/c-programming-language-tutorial>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by flowchart? What are the components in the flowchart and explain with example?
2. List the steps involved in creating and running a C program
3. What are various storage classes in C? Discuss their uses and scope?
4. What is string? Explain about declaration and initialization of string in C. How strings are displayed with different formats with examples?
5. Write a C program to copy one string to another
6. Write a C program to read and display the content of a file
7. What is recursive function? What are the constraints for defining a recursive function with an example?
8. Why switch statement is more advantageous than nested if-else statement
9. What is meant by a variable in C programming? How a variable is initialized? What are the rules of defining a variable name? Give an example?
10. Write a c program to count number of vowels and consonants in a string using pointers

L2: Understand

1. Explain about enumerated types with example
2. Explain counter controlled and exit controlled loops with examples
3. Write a program to compare 2 strings for equality without using strcmp() function
4. What is string? Demonstrate about declaration and initialization of string in C. How strings are displayed with different formats? Explain with examples?
5. Illustrate a C program to find the sum of first and last digit of a number
6. Illustrate a C program to merge two files into single file
7. Explain different looping statement with syntax and example
8. Classify looping statement with syntax and example
9. Explain function prototype and explain different methods to call the function
10. Explain in detail about array of structure and pointer to structure with example
11. Discuss the usage of bitwise logical operators used in C? Compare them from logical operators with suitable program
12. Explain about call by value and call by reference with reference to functions with example
13. Explain the term dynamic memory allocation and the terms malloc(), calloc() and realloc() functions

L3: Apply

1. Write a C program to check whether the given number is palindrome or not
2. Write a C program to solve the factorial of a given number using for loop

HS 20HSX02 Communicative English Lab

0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO10	PO12
20HSX02.1	Developed better understanding nuances of English Language through audio – visual experience and group activities	3	3
20HSX02.2	Learnt to use neutralization of accent for intelligibility	3	3
20HSX02.3	Improved communicative competence that include clarity and confidence which in turn enhances their employability skills and ability to communicate in formal and informal situations	3	3
20HSX02.4	To Cultivate communicative Competence	3	3
20HSX02.5	To make them ready for Industry	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Understand: Listening Skill- Its importance – Purpose – Process – Types - Barriers
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Consonant Clusters
2. Understand: Spoken vs Written language - Formal and Informal English
3. Practice: Ice - Breaking Activity and JAM Session - Dialogues – Greetings – Taking Leave – Introducing Oneself and Others
4. Understand: Structure of Syllables – Word Stress – Sentence Stress – Intonation
5. Practice: Basic Rules of Word Accent - Stress Shift - Sentence Stress – Intonation
6. Understand: Features of Good Conversation – Strategies for Effective Communication. Practice: Situational Dialogues – Role-Play - Expressions in various Situations
7. Understand: Descriptions- Picture Description - Story Narrations - Giving Directions. Practice: Giving Instructions – Seeking Clarifications– Making Suggestions, Describing people, places and things
8. Understand: Public Speaking – Exposure to Structured Talks – Non-verbal Communication-Presentation Skills
9. Practice: Making a short speech – Extempore - Making a Presentation
10. Understand: Group Discussion - Interview Skills. Practice: Participation in Group Discussion and Mock Interviews

References

1. Lab Manual for Communicative English, Department of Basic Science and Humanities, NSRIT

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Board of Studies (English)
Head of the Department
 Dept. of Science & Humanities
 N.S.Raju Institute of Technology
 Bontyam, Visakhapatnam-531173

ES 20ESX07 Programming for Problem Solving Using 'C' Lab

0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20ESX07.1	Demonstrate the process of problem-solving using algorithm, pseudo code , flowchart, Compile and Debug programs	3	3	1
20ESX07.2	Summarize the concepts of control statements, pointers & functions and solve the problem using C programming	3	3	1
20ESX07.3	Implement the concepts of Arrays, Strings & functions	3	3	1
20ESX07.4	Demonstrate the use of Pointers & Structures	3	3	1
20ESX07.5	Demonstrate the use of Files	3	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Demonstrate to usage of computer system, installation of operating systems
2. Write programs to illustrate the usage of operators and input-output statements
3. Write programs to demonstrate the use of selective flow control statements
4. Write programs to demonstrate the use of loop control statements
5. Write programs to demonstrate the use of one-dimensional arrays
6. Write programs to demonstrate the use of multi-dimensional arrays
7. Write programs to demonstrate the usage of strings
8. Write programs to demonstrate the usage of user-defined functions
9. Write programs to demonstrate the usage of structures and array of structures
10. Write programs to demonstrate the usage of pointers
11. Write programs to demonstrate the usage of files

References

1. Lab Manual for Programming for Problem Solving using 'C', Department of Computer Science and Engineering, NSRIT

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Head of the Department
 Dept. of Science & Humanities
 Board of Studies (CSE)
 M. S. Raju Institute of Technology
 Bapatla, Andhra Pradesh

Web References

1. <http://nptel.ac.in/courses/>
2. <https://onlinecourses.nptel.ac.in>
3. <https://nptel.ac.in/courses/111/108/111108144/>
4. <https://ocw.mit.edu/courses>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define PDE
2. Solve the PDE $z = px + qy - 2\sqrt{pq}$
3. Solve $(D^2 - 2DD' + D'^2)z = 0$
4. Find P.I of $(D^2 - DD' + D'^2)z = e^{xy}$
5. Define Gamma and Beta function

L2: Understand

1. Solve $(D^2 - DD' + D'^2)z = \cos(x+2y) + ey - x$
2. Solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$ by the method of separation of variables
3. Find the directional derivative of the function $\phi = xy^2 + yz^3$ at the point $(2, -1, 1)$ in the direction of the normal to the surface $x \log z - y^2 + 4 = 0$ at $(-1, 2, 1)$
4. If $F = x^2yz, G = xy^{-3}z^2$ Then find $\text{div}(\text{grad } F \times \text{grad } G)$
5. Find $\iint \vec{f} \cdot \vec{n} \, ds$ if $\vec{F} = xy\vec{i} + z^2\vec{j} + 2yz\vec{k}$ over the tetrahedron bounded by $x=0, y=0, z=0$ and the plane $x + y + z = 1$

L3: Apply

1. Solve $(1 + q)p = qz$
2. Solve $z^2 (p^2x^2 + q^2) = 1$
3. Find the area of the circle using double integral
4. Find by double integration the area lying between the curve $y = x^2 - 2x - 8$
5. Evaluate by Gauss divergence theorem $F = (x^3 - yz)\vec{i} - 2x^2y\vec{j} - z\vec{k}$ taken over the surface of the cube formed by the planes $x = y = z = a$

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Chairman Board of Studies
(Mathematics)

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Dept. of Science & Humanities
NSRIT
Institute of Technology
Sakshatnam-1
18

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources. Programming: Introduction to Programming Concepts with Scratch. Mathematical Libraries: NumPy, SciPy, Sympy, Pandas, StatsModels, Matplotlib and Gnuplot.

Other Useful GUI Resources

Text Books

1. Kenneth A. Lambert, "Fundamentals of Python First Programs", 1st Edition, Cengage Learning, Inc., 2017
2. Vamsi Kurama, "Python Programming: A Modern Approach", 1st Edition, Pearson Education, 2018
3. Mark Lutz, "Learning Python", 1st Edition, Orieilly, 2019

Reference Books

1. Gowrishankar S., Veena A., "Introduction to Python Programming", CRC Press, 2019
2. Daniel Liang Y., "Introduction to Programming Using Python", 1st Edition, Pearson, 2012
3. Allen Downey, "Think Python", 2nd Edition, Green Tea Press, 2017
4. Chun W., "Core Python Programming", 2nd Edition, Pearson, 2006

Web References

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the difference between list and tuples in Python?
2. What are the key features of Python?
3. What type of language is python?
4. How is Python an interpreted language?
5. What is pep 8?

L2: Understand

1. Give a comparison between lists, tuples, dictionaries and sets
2. Explain about methods in Lists of Python with appropriate examples
3. Explain the operators in python with appropriate examples
4. Explain how to implement inheritance in Python
5. Explain modules and Packages

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Chairman

Board of Studies (CSE)

Head of the Department
Dept. of Science & Humanities
M.S. Raju Institute of Technology
am. Visakhapatnam-521124
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Text Books

1. Timoshenko S. and Young D. H., "Engineering Mechanics", 5th Edition. McGraw Hill Publications, 2013
2. Bavakatti S. S., "Engineering Mechanics Statics", 4th Edition, New Age International Publications, 2012
3. Tayal. A. K., "Engineering Mechanics Statics and Dynamics", 6th Edition, Umesh Publications, 2006

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1. Kurmi R. S., "Engineering Mechanics Statics", 10th Edition, S. Chand Publications, 2005
2. Vijay Kumar Reddy K. and Suresh Kumar J., "Mechanics: Statics and Dynamics", 3rd Edition, B S Publications, 2010
3. Ferdinand P. Beer, Russell Johnston Jr. E., "Vector Mechanics for Engineers Statics and Dynamics", 9th Edition, McGraw Hill Publications, 2011

Web References

1. <https://www.iitg.ac.in/rkbc/me101/Presentation/L01-03.pdf>
2. https://drive.google.com/file/d/12V_O8G7OrSnZMiFDjrJhF5sOEbGXstkQ/view

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	20	20
L3	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

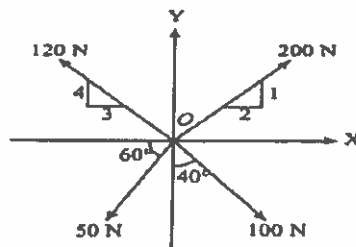
1. State the conditions for equilibrium of a rigid body in three dimensions
2. What is the principle of transmissibility?
3. State the Parallel axis theorem
4. Define centroid and centre of gravity
5. State triangular law of forces. What is the use of this law?

L2: Understand

1. Explain Pappus theorem I & II
2. Differentiate between polar moment of inertia and product of inertia
3. Write impulse momentum equation
4. What is a rolling body? Explain its importance
5. Explain work-energy method for a plane motion

L3: Apply

1. Two forces of magnitude 50 N and 30 N are acting at a point. If the angle between the two forces is 60°, determine the magnitude and direction of the resultant force
2. A force has the components $F_x = 100\text{ N}$; $F_y = 65\text{ N}$; $F_z = 80\text{ N}$. Find the magnitude of the force and the angles θ_x , θ_y and θ_z from the axes X, Y and Z respectively
3. A system of four forces acting on a body is shown in figure. Determine the resultant force and its direction



ES 20ESX01 Engineering Drawing**1 0 4 3**

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO5	PO10	PO12	
20ESX01.1	Apply BIS standards and conventions while drawing Lines, curves, polygons and scales.	3	3	3	1	L1, L2, L3, L4
20ESX01.2	Classify the systems of projection of points and Lines with respect to the observer, object and the reference planes	3	3	3	1	L1, L2, L3, L4
20ESX01.3	Classify the systems of projection of planes and solids with respect to the observer, object and the reference planes	3	3	3	1	L1, L2, L3, L4
20ESX01.4	Construct orthographic views of an object when its position with respect to the reference planes is defined	3	3	3	1	L1, L2, L3, L4
20ESX01.5	Construct 2D (orthographic) and 3D (isometric) views in CAD environment	3	3	3	1	L1, L2, L3, L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction of Geometrical Constructions**10 Hours**

Overview of the course: Types of lines, Lettering and Dimensioning. Geometrical Constructions of Polygons: Constructing regular polygons by general methods, Inscribe and Circumscribe polygons. Curves: Ellipse, Parabola and Hyperbola by general and special methods, tangent and normal for the curves. Scales: Plain scales, diagonal scale and vernier scale.

Involutes, Cycloids, Epi-Cycloids and Hypo-Cycloids

Unit II: Introduction of Orthographic Projections**10 Hours**

Reference plane and planes projections. Projections of Straight lines: line parallel to both the planes, line inclined to one plane and parallel to other plane and line inclined to both the planes. Determination of true lengths, angle of inclination and traces.

Principle of Auxiliary Plane

Unit III: Projections of Planes**10 Hours**

Planes parallel / Perpendicular to one reference plane and inclined to the other and inclined to both the reference planes.

Projection of Plane Surface using Auxiliary Planes

Unit IV: Projections of Solids**10 Hours**

Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

Auxiliary Projections of solids, Sectional Views

Unit V: Conversion of Views**20 Hours**

Part A: Conversions of isometric to orthographic views; Conversion of orthographic to isometric views.

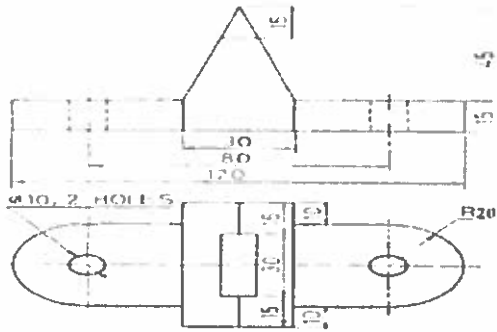
Part-B: Auto-CAD Practice: Introduction To Auto-CAD, DRAW Tools, MODIFY Tools, TEXT, DIMENSION And PROPERTIES.

Note: In the End Examination there will be no question from PART-B

Development of Surfaces

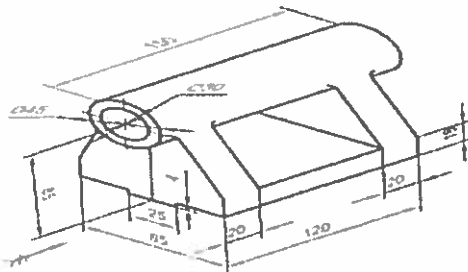
Text Books

1. Bhatt N. D., "Engineering Drawing", 53rd Edition, Chariot Publications, 2018
2. Agarwal and Agarwal, "Engineering Drawing", 3rd Edition Tata McGraw Hill Publisher, 2017
3. Sham Tickoo, "AutoCAD 2017", Engineers & Designers", 23rd Edition, Dreamtech Press, 2016

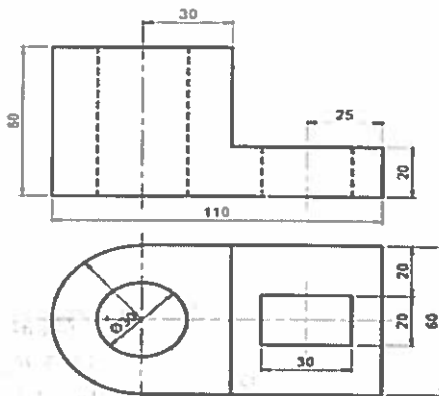


L 4: Analyze

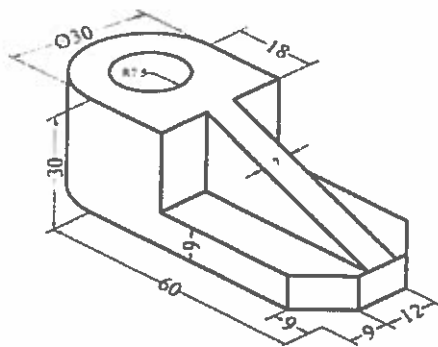
1. Examine (i) Front View (ii) Top View (iii) Side View



2. Analyze the front and top views of an object and Construct the isometric view



3. Draw the three orthographic views



BS 20BSX24 Applied Chemistry Lab

0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20BSX24.1	Estimate of Vitamin-C	3	3	1
20BSX24.2	Determine the cell constant and conductance of solutions	3	3	1
20BSX24.3	To Prepare advanced polymer materials	3	3	1
20BSX24.4	Calculate the hardness of water	3	3	1
20BSX32.5	Determine the functioning of the instruments such as pH and Potentiometric meters	3	3	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Determination of HCl using standard Na_2CO_3 solution (Acid-Base Titration)
2. Determination of Mn using standard oxalic acid solution (Redox Titration)
3. Determination of ferrous iron using standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution (Redox Titration)
4. Determination of copper (II) using standard hypo solution (Iodimetric Titration)
5. Determination of temporary and permanent hardness of water using standard EDTA solution
6. Determination of iron (III) by a colorimetric method
7. Estimation of Vitamin C
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method)
9. Determination of the concentration of strong acid vs strong base (by Conductometric method)
10. Determination of strong acid vs strong base (by Potentiometric method)
11. Determination of Viscosity of lubricating oil by Red Viscometer
12. Determination of percentage Moisture content in a coal sample
13. Determination of acid value and saponification value of a given lubricant
14. Adsorption of acetic acid by charcoal
15. Preparation of a polymers: Nylon-6,6 and phenol-formaldehyde (Bakelite)
16. Preparation of Nanomaterials (ex: Fe/ Zn/ Ferrite)

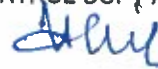
Text Books

1. Arthur J Vogel, "A Textbook of Quantitative Analysis", 2nd Edition, 1909

References

1. Mendham J., Denney R. C., Barnes J. D., Thomas M. and Sivasankar B., "Vogel's Quantitative Chemical Analysis" 6th Edition, Pearson Education, 2000
2. Bhasin N. K. and Sudha Rani, "Laboratory Manual on Engineering Chemistry" 3rd Edition, Dhanpat Rai Publishing Company, 2007
3. Lab Manual for Applied Chemistry, Department of Basic Science and Humanities, NSRIT, 2017

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 Chairman

Board of Studies (Chemistry)

Head of the Department

Dept. of Science & Humanities

N.S Raju Institute of Technology


Visakhapatnam-531173

- value of n be 100
- c. Write a function called merge that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list: i. Do this using the sort method ii. Do this without using the sort method
9.
 - a. Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
 - b. Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt.
10. Write programs to demonstrate the usage of class
11. Write programs to demonstrate the usage of GUI
12. Write programs to demonstrate the usage Matplotlib library

References

1. Lab Manual for " Python Programming ", Department of Computer Science Engineering, NSRIT

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Head of the Department
Board of Studies (CSE)
Dept. of Science & Humanities
N.S.Raju Institute of Technology
Sontyam, Visakhapatnam-531173

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MC 20MCX01 Environmental Science

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20MCX01.1	Gain in-depth knowledge on importance of environment, natural resources utilization and exploitation	3	1	L1, L2
20MCX01.2	Understand the concept of an ecosystem and Identify their interconnections	3	1	L1, L2
20MCX01.3	Develop an understanding on values, threats and conservation of biodiversity	3	1	L1, L2
20MCX01.4	Illustrate the impacts of ever increasing environmental pollution and understand the issues on global environment	3	1	L1, L2
20MCX01.5	Understand various acts formulated by Govt. of India and apply the knowledge gained in conserving energy and environmental protection	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Natural Resources**12 Hours**

Introduction: Definition, Scope and Importance-Need for Public Awareness

Natural Resources: Classification of resources–Forest resources: Use and Over-exploitation, Deforestation- Mining, Water resources –Use and over utilization of surface and ground water–Floods, Drought, Conflicts over water, Dams-Benefits and Problems – Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources–Energy resources: Renewable and Non- Renewable sources of energy- Solar energy, Wind energy.

Unit II: Ecosystems**12 Hours**

Concept of an Ecosystem–Structural features of ecosystem- Producers, Consumers and Decomposers–Biogeochemical cycles- Carbon cycle and Nitrogen cycle-Ecological succession-Food chains, Food webs and Ecological pyramids–Energy flow in the ecosystem-Types of ecosystems (a) Forest ecosystem (b) Aquatic ecosystems.

Unit III: Biodiversity and Its Conservation**12 Hours**

Introduction, Definition, Genetic, Species and Ecosystem diversity, India as a mega-diversity nation, Hot spots of biodiversity, Values of biodiversity, Threats to biodiversity, Endemic, Endangered and Extinct species of India, In-Situ and Ex-situ conservation of biodiversity.

Unit IV: Environmental Pollution and Global Environmental Issues**12 Hours**

Environmental Pollution: Air pollution, Water pollution, Noise pollution, Effects-Global warming, Acid Rain and Ozone layer depletion and controlling measures.

Global Environmental Issues: Population Growth, Urbanization, Climate change and impacts on human environment.

Solid Waste Management: Causes, Effects and Control measures of Municipal solid wastes – E - Waste Management, Role of an individual in prevention of pollution.

Unit V: Environmental Legislation, Laws, Policies for Sustainable Development**12 Hours**

Environmental Legislation, Environmental Protection act – Air Prevention and Control of Pollution act–Water Prevention and control of Pollution act– Wildlife protection act – Forest conservation act.

From Unsustainable to sustainable development, Role of IT in Environment-Remote Sensing and GIS methods for Sustainable development

Text Books

1. Erach Bharucha, "Text Book of Environmental Studies", 1st Edition, University Grants Commission, University Press (India) Pvt. Ltd., 2010
2. Kaushik A. and Kaushik C. P., "Environmental Sciences", 5th Edition, New Age International Publishers, 2015
3. Anji Reddy M., "Text Book of Environmental Science and Technology", 3rd Edition, B. S. Publications, 2010

Reference Books

BS 20BSX13 Numerical Methods and Transforms 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX13.1	Calculate the approximate roots of the algebraic equations & Transcendental equations by different techniques	3	1	L1, L2, L3
20BSX13.2	Make use of the concepts of interpolation to estimate the unknown functional values	3	1	L1, L2, L3
20BSX13.3	Find approximate values of finite integrals using different numerical techniques and use different algorithms for approximating solutions of ordinary differential equation to its analytical computations.	3	1	L1, L2, L3
20BSX13.4	Apply the Laplace transform to solve ordinary differential equations with initial conditions.	3	1	L1, L2, L3
20BSX13.5	Solve engineering problems using Fourier Transforms	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Solutions of Algebraic and Transcendental Equations 11+1 Hours Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method– Jacobi and Gauss-Seidel methods solving system of equations.

Convergence of – Bisection method, Secant method, Method of false position Newton - Raphson Method

Unit II: Interpolation. 11+1 Hours

Introduction — Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

Errors in Polynomial Interpolation – Error Propagation in a Difference Table- Numerical differentiations

Unit III: Numerical integration and solution of ordinary differential equations. 11+1 Hours

Numerical integration; Trapezoidal rule – Simpson's 1/3rd and 3/8th rule
Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method.

Runge-Kutta method (second order)

Unit IV: Laplace Transforms 11+1 Hours

Laplace Transforms of Standard Functions - Shifting Theorems – Transforms of Derivatives and Integrals – Multiplication by t^n – Division by t – Unit Step Function - Unit Impulse function - Laplace Transforms of Periodic Functions - Inverse Laplace Transforms - Convolution Theorem (Without Proof).
Applications: Solving Ordinary Differential Equation (Initial Value Problems) using Laplace Transforms.

Unit Step Function - Unit Impulse function

Unit V: Fourier Transforms 11+1 Hours

Fourier Transforms: Fourier Integrals - Fourier Cosine and Sine Integrals - Fourier Transform- Sine and Cosine Transform – Properties-Inverse Fourier Transforms.

Finite Fourier Sine Transforms, Finite Fourier Cosine Transforms, Inverse Finite Fourier Transforms.

Textbooks:

1. Grewal. B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018

2. Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2015
2. Bali. N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018.
3. Peter O'Neil, "Advanced Engineering Mathematics", 8th Edition, Cengage, 2017.
4. Iyenger.T.K.V, Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Engineering Mathematics II& III ", S. Chand publications, 2nd Edition ,2019.

Web References:

1. <https://nptel.ac.in/courses/122/102/122102009/>
2. <https://nptel.ac.in/courses/111/106/111106139/>
3. <https://nptel.ac.in/courses/111/102/111102129/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	40
L3	30	40
Total (%)	100	100

L1: Remember

1. Identify the root lies between which values for $x^3 - 5x + 1 = 0$
2. Prove that $(1+\Delta)(1-\nabla)=1$
3. Find the First difference of the polynomial $x^4-12x^3+42x^2-30x+9$ with interval of Differencing $h=2$.
4. Define unit step function
5. State Convolution theorem

L2: Understand

1. Find a real root of $x \tan x + 1 = 0$ using false position method.
2. Find a real root of the equation $x e^x - \cos x = 0$ using Newton-Raphson method.
3. Use Gauss backward interpolation formula to find $f(32)$ given that $f(25)=0.2707$, $f(30)=0.3027$, $f(35)=0.3386$, $f(40)=0.3794$
4. Using Lagrange's formula find the value of $f(1)$ given that

x	-2	-1	2	7
y	-1	0	4	11

5. Find $\int_0^1 \frac{1}{1+x} dx$ by (i) Trapezoidal rule (ii) Simpson's $\frac{1}{3}$ rd rule (iii) Simpson's $\frac{3}{8}$ th rule.

L3: Apply

1. Using Newton-Raphson method compute $\sqrt[3]{37}$ correct to 4 decimal places
2. Find $\sqrt{12} & \frac{1}{\sqrt{12}}$ by the fixed point iteration method
3. The population of a nation in the decadal census was given below. Estimate the population in the year 1925 using appropriate interpolation formula

Year x	1891	1901	1911	1921	1931
Population y	46	66	81	93	101

4. Given that $\sin 45^\circ = 0.7077$, $\sin 50^\circ = 0.766$, $\sin 55^\circ = 0.8192$, $\sin 60^\circ = 0.866$ find $\sin 40^\circ$ using Newton's forward difference formula.
5. Solve $y' = y - x^2, y(0) = 1$ using Picard's method up to fourth approximation.

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 Dept. of Electrical & Electronics Engg.
 N.S.Raju Institute of Technology, Autonomous
 Sontyam, Visakhapatnam-531 173

PC 20EC302 Electronic Devices and Circuits

3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs							PSO1	PSO2	DoK
		PO1	PO2	PO3	PO4	PO5	PO12				
20EC302.1	Understand the behavior, characteristics and various applications of PN junction diode	3	1	1	1	1	1	2	2	L1,L2	
20EC302.2	Analyze the principles ,operations and applications of various semiconductor devices	3	1	3	1	2	1	2	2	L2,L3,L4	
20EC302.3	Analyze and characterize BJTs, FETs, MOSFETs and evaluate their performance in different configurations.	2	1	3	1	1	1	3	2	L1,L2	
20EC302.4	Comprehend and apply various biasing and stabilization methods to achieve stable operation to BJTs and FETs	2	1	3	1	2	1	1	1	L2,L3,L4	
20EC302.5	Perform generalized analysis of transistor amplifier circuits using h-parameters, and apply both exact and approximate methods to analyze different amplifier configurations.	2	2	3	1	2	1	2	2	L2,L3,L4	

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Junction Diode Characteristics

12 Hours

Open circuited PN junction, Biased PN junction, current components in PN junction Diode, diode current equation,V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode, Quantitative theory of PN junction diode.

Diode switching times, PN diode clipping circuits.

Unit II: Special Semiconductor Diodes and Rectifiers

12 Hours

Zener Diode, Breakdown mechanisms, Zener diode applications, Construction, operation and characteristics of LED, Photo diode, Tunnel Diode, SCR, UJT. Operation, Derivations of parameters of rectifiers, Input and output waveformsof half wave rectifier, Full wave rectifier and bridge rectifier, Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

Liquid crystal display (LCD), Pin diode, LC filter.

Unit III: Transistor Characteristics

12 Hours

BJT: Junction transistor, Transistor current components, Transistor equation, Transistor configurations, Transistor as an amplifier and characteristics of transistor in CB, CE and CC configurations, Ebers-Moll model of a transistor, Punch through/reach through, Photo transistor, Typical transistor junction voltage values.

FET: JFET- types, Construction, Operation, Characteristics and parameters, MOSFET-types, Construction, Operation and characteristics, Comparison between JFET and MOSFET.

Transistor switching times, FET working as voltage variable resistor.

Unit IV: Transistor Biasing and Thermal Stabilization

12 Hours

Need for biasing,-operating point, Load line analysis, BJT biasing methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE} , I_c , and β , Stability factors, (S, S', S''), Thermistor and Sensistor bias compensation techniques, Thermal runaway, Thermal stability, JFET Biasing methods and stabilization.

Diode compensation technique, transistor compensation technique.

Unit V: Small Signal Low Frequency Transistor Amplifier Models

12 Hours

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Conversion of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB, CE and CC amplifiers, Comparison of transistor amplifiers.

FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, Comparison of FET amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response.

Text Books

1. Lal Kishore K, "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016.
2. Millman J, Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010.
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 5th Edition, 2009.
4. Boylestad R.L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009.

Reference Books

1. Salivahanan S, Suresh Kumar N, Vallavaraj A, "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012.
2. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010.
3. J. Millman, C. Halkias, "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009.
4. B.P. Singh, Rekha, Electronic Devices and Integrated Circuits, Pearson publications, 3rd Edition, 2009.
5. Mittal G.K., "Electronic Devices and Circuits", 3rd Edition, Khanna Publishers, 2008.

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. <http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html>
3. <http://nptel.ac.in/courses/117103063/11>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	20	20
L3	30	30
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define cut-in Voltage
2. What is diffusion capacitance?
3. What is break down voltage?
4. List any three applications of SCR
5. Define pinch off voltage
6. What is rectifier?
7. Define ripple factor
8. Give any two applications of full wave rectifier
9. Give the classification of filters
10. Write any two disadvantages of half wave rectifier

L2: Understand

1. Draw and explain V-I characteristics of PN junction diode
2. Describe the construction and operation of tunnel diode
3. With neat circuit diagram describe the operation of bridge rectifier
4. Explain why Zener diode is used in reverse bias with the help of characteristics
5. Draw and explain the input and output Characteristics of Common base configuration
6. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration

7. Write a short note on (i) Thermal Runaway (ii) Thermal stability
8. Explain the Drain and transfer characteristics of n-Channel JFET
9. With the help of diagram explain self bias method of JFET
10. Explain thermister compensation technique


L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expression for voltage divider bias method of JFET
6. With the help of circuit diagram explain voltage divider bias method of JFET
7. Give the comparison of BJT, JFET and MOSFET
8. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier
9. Obtain the expressions for voltage gain and current gain of small signal low frequency common source amplifier

L4: Analyze

1. Derive the equation for ripple factor for half wave rectifier with capacitor filter
2. Determine the peak load voltage, peak current and power dissipation in a 495Ω load resistor connected to a bridge rectifier circuit that has a 26 V ac input. The rectifier diodes are germanium
3. Derive the equation for ripple factor of half wave rectifier with LC filter
4. Derive the expression for stability factor for voltage divider bias of BJT
5. Derive the expression for stability factor for self bias of JFET
6. For the fixed bias circuit $R_B = 150\text{ k}\Omega$ and $R_B = 100\text{ k}\Omega$. Calculate I_B , I_C and V_{CE} if $V_{CC} = 12\text{ V}$, $R_C = 1.1\text{ k}\Omega$ and $\beta = 100$ and also state the region of operation
7. Analyse the h-parameters from transistor characteristics
8. Discuss the analysis for small signal model of JFET
9. Analyse the h-parameters of common base amplifier
10. Investigate the h-parameters of common drain amplifier

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Head of the Department
Chairman
Dept. of Electrical & Electronics Engg.
N.S.Raju Institute of Technology Autonomous
Sectvam, Visakhapatnam-531 173

PC 20EE303 Electrical Circuit Analysis

3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs							DoK
		PO1	PO2	PO3	PO5	PO12	PSO1	PSO2	
20EE303.1	Understand various network elements and circuits	3	2	1	1	1	2	2	L1,L2,L3
20EE303.2	Interpret single phase and three phase circuits under Balanced and Un-Balanced loads.	2	3	2	1	1	2	2	L1,L2,L3
20EE303.3	Apply the network theorems on electrical circuits.	2	3	2	1	1	3	2	L1,L2,L3
20EE303.4	Apply the concepts of various parameters using two-port network configurations.	1	2	3	1	1	1	1	L1,L2,L3
20EE303.5	Analyze the transient and steady-state behaviors of R-L, R-C, and R-L-C circuits for different types of inputs	1	2	3	1	1	2	2	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Electrical Circuits:

11+1 Hour

Network elements classification, Electric charge and current, Electric energy and potential, Resistance parameter series and parallel combination, Inductance parameter series and parallel combination, Capacitance parameter series and parallel combination. Energy sources: Ideal, Non-ideal, Independent and dependent sources, Source transformation, Kirchhoff's Laws, Mesh Analysis and Nodal analysis, Principal of Duality with examples.

Basic Concepts of passive elements of R, L, C and their V-I relations.

Unit II: Single Phase AC Circuits and Three – Phase AC Circuits:

11+1 Hour

R.M.S, Average Values and Form Factor for Different Periodic Waveforms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power. Relation between Line and Phase Voltages and Currents, Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems, Two – Wattmeter method, Mutual coupled circuits.

Addition and subtraction of phasor, mathematical representation of sinusoidal quantities

Unit III: Network Theorems (DC & AC Excitation):

11+1 Hour

Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Superposition Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Milliman's Theorem and Compensation Theorem for circuits with independent and dependent sources, Applications and Limitations of theorems

Tellegens Theorem

Unit IV: Two Port Networks

11+1 Hour

Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.

Concept of Duality and Dual Networks

Unit V: Transient Analysis in DC and AC circuits

11+1 Hours

Transient response of R-L, R-C, R-L-C circuits using AC & DC excitations, solution using differential equations and Laplace transforms.

Solutions using Laplace transform method.

Textbooks

1. Alexander K and Mathew N.O.Sadiku, "Fundamentals of Electrical Circuits", 6th Edition, McGraw Hill Publications 2019
2. ME Van Valkenburg, "Network Analysis", 3rd Edition, Prentice Hall of India, 2000

Reference Books

1. Abhijit Chakrabarti, "Circuit Theory Analysis and Synthesis", 6th edition, Dhanpat Rai & Co., 2014
2. William Hayt and Jack E. Kemmerley, "Engineering Circuit Analysis", 6th edition, McGraw Hill Company, 2015
3. Sudhakar and Shyamohan S Palli, "Circuits & Networks", 5th Edition, Tata McGraw – hill Higher Education, , 2015

Web References:

1. <https://nptel.ac.in/courses/108/106/108106172/>
2. <https://nptel.ac.in/courses/108/104/108104139/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	30
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

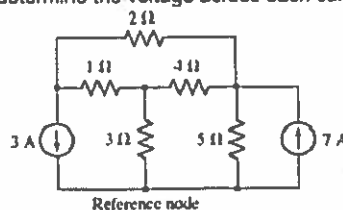
1. Classify the Network elements
2. Define Source Transformation with an example
3. State Principle of Duality
4. State Maximum Power transfer theorem and Compensation Theorem
5. Define Time constant of RL circuit

L2: Understand

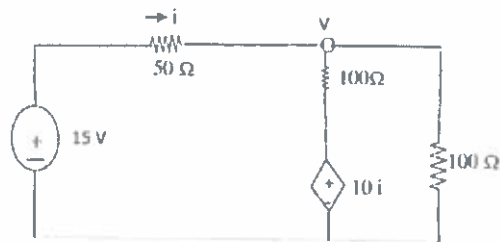
1. Explain the Transient response of RC circuit for AC excitation
2. Explain the concept of Impedance and Power Factor
3. Explain the Types of Energy Sources
4. Discuss the Principle of Duality
5. Explain the Cascading of Two port networks

L3: Apply

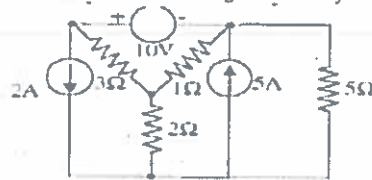
1. For the circuit shown in figure, determine the voltage across each current source



2. Using source transformation, find the voltage V in the circuit shown in figure



3. Find the power delivered by the 5A current source using nodal analysis



4. A resistance of $12\ \Omega$ and an inductance of $0.025\ \text{H}$ are connected in series across a $50\ \text{Hz}$ supply. What values of resistance and inductance when connected in parallel will have the same resultant impedance and pf? Find the current in each case when the supply voltage is $230\ \text{V}$?
5. Two inductively coupled coils have self inductances $L_1 = 50\ \text{mH}$ and $L_2 = 200\ \text{mH}$. If the coefficient of coupling is 0.5 i) find the value of mutual inductance between the coils and ii) what is the maximum possible mutual inductance?

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PC 20EE304 DC Machines and Transformers

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

Code	Course Outcomes	Mapping with POs							DoK
		PO1	PO2	PO3	PO6	PSO1	PSO2	PSO 1	
20EE304.1	Comprehend the principle of electromagnetic energy conversion	2	2	2	-	3	2	3	L1, L2
20EE304.2	Evaluate the performance characteristics of various DC generators based on excitation	2	2	3	1	2	2	1	L1,L2,L3, L4
20EE304.3	Evaluate the performance characteristics of various DC Motors based on excitation	2	2	3	2	1	1	1	L1,L2,L3, L4
20EE304.4	Summarize the performance of transformers under various conditions	2	3	2	2	1	2	1	L1, L2
20EE304.5	Understand three-phase transformers to achieve phase conversion	2	3	2	2	3	2	1	L1,L2,L3, L4

Unit I: Principles of Electromechanical Energy Conversion

11+1 Hour

Energy in magnetic system, field energy and mechanical force, multiply-excited magnetic field systems, forces/torques in systems with permanent magnets, energy conversion via electric field, dynamical equations of electro mechanical systems

permanent magnets, and applications of permanent magnet materials.

Unit II: DC Generator

11+1 Hour

Constructional details Principle of operation, Armature winding Lap & Wave, Emf equation, Methods of excitation, Armature Reaction
Characteristics of D.C. Generators: O.C.C, internal-external characteristics, losses-power flow, efficiency calculation

Purpose Equalizer rings, Different methods of commutation

Unit III: DC Motors:

11+1 Hour

Principle of operation of DC motors, Back EMF, Torque equation, Types of DC motors, Speed-Torque characteristics of DC motors

Speed Control & Testing of DC Machines:

Starting of DC motors: 3-point starter, 4-point starter, Losses and efficiency, Condition for maximum efficiency, Speed control methods, Brake test, Swinburne's test, Retardation test, Hopkinson's test, fields test, application of DC motors to industries

Separation of iron and frictional losses

Unit IV: Transformers I

11+1 Hour

Constructional features, Principle of operation, EMF equation, Transformer on No load and Load Phasor diagram, equivalent circuit, Regulation, losses and efficiency, transformer cooling-natural cooling and forced cooling. All day efficiency.

polarity test, back-to-back test

11+1 Hour

Unit V: Transformers II

Open circuit and short circuit test, Sumpner's test, parallel operation, separation of core losses test, auto transformers, 3- ϕ transformer connections, Scott connection

applications and comparison with two winding transformers, phase conversion topics

Text Books

1. Bhimbra P.S. "Electrical Machines", 4th Edition, Khanna Publishers, 2015
2. Theraja B.L., Theraja A.K., "A Textbook Of Electrical Technology: AC And DC Machines", volume 2, S Chand, 1999
3. A.E.Fitzgerald, Charles kingsley, Stephen D. Umans "Electric Machinery", 6th Edition, Tata McGraw- Hill 2013

Reference Books

4. Kothari D. P., Nagarthi .J., "Electrical Machines", 4th edition, Mc Graw Hill Publications, 2010
5. Rajput R.K. "Electrical Machines", 5th edition, Lakshmi publications, 2016
6. Mulukulla S.Sarma & Mukesh k.Pathak "Electric Machines", 4th Edition, CENGAGE Learning, 2012
7. Gupta J.B., "Theory & Performance of Electrical Machines", 6th Edition, S.K.Kataria & Sons, 2008

Web References

1. <https://nptel.ac.in/courses/108/105/108105017/>
2. <https://www.youtube.com/watch?v=AECBgmkWvo0&list=PLbMVogVj5Njqbg9363J1uq5Fnq4m1Ygxl>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	30	40
L4	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is a back e.m.f? Why the e.m.f generated in the armature of a DC motors is called back emf
2. Discuss briefly the principle of energy conversion
- 3: List any three advantages of three – phase transformer over three single – phase transformers
4. Define voltage regulation of a transformer
5. Why OC test is performed on LV side of a single phase transformer?
6. Define all day efficiency of a single phase transformer?
7. Write the applications of series, shunt and compound DC motors
8. Why is armature control superior to field control scheme in case of a DC shunt motor
9. Why the main flux in a transformer is remains practically constant from no load to full load

L2: Understand

1. A 6-pole lap wound DC generator has 720 conductors; a flux of 80 mWb/pole is driven at 1000 rpm. Find the generated e.m.f.
2. Explain what would happen if the DC Motor is directly switched on to the supply without any starter
3. Distinguish between core type and shell type transformers
4. Explain the concept of Scott connection (three phase to two phase) conversion with a neat circuit diagram

5. Explain the effects of third harmonic component in a three phase transformer
6. Explain with relevant diagrams, the different methods of excitation of DC machines
7. Explain the speed torque characteristics of DC shunt, series and cumulative compound motors
8. Derive the emf equation of a transformer
9. Explain the significance of swinburne's test on dc machine?
10. Explain the necessity of commutating poles and compensating windings in a dc machine?
11. Explain the significance of interpoles in DC machines?

L3: Apply

1. Calculate (i) the total torque developed (ii) the useful torque of a 250 V, 4 pole series motor with 782 wave connected conductors developing 8 kW and taking 40 A with a flux per pole of 25 mWb. The armature resistance of the motor is 0.75 ohms
2. In a retardation test on a D.C motor, with its field normally excited, the speed fell from 1525 to 1475 in 25 seconds. With an average load of 1 kW supplied by the armature, the same speed drop occurred in 20 seconds. Find the moment of inertia of the rotating parts in kg.m²?
3. In a 400 V, 50 Hz transformer, the total iron loss is 2300 W. When the supply voltage and the frequency reduced to 200 V and 25 Hz respectively the corresponding loss is 800 W. Calculate the eddy current loss at normal voltage and frequency
4. A 2-winding 10 kVA, 440/110 V transformer is reconnected as a step-down 550/440 V autotransformer. Compare volt-ampere rating of the autotransformer with that of original 2-winding transformer. Calculate power transferred to the load: (i) inductively (ii) conductively
5. A balanced 3-phase, 100 kW load at 400V and 0.8 p.f. lag is to be obtained from a balanced 2-phase, 1100V lines. Determine the kVA rating of each unit of the Scott-connected transformer
6. A 20 kW, 250 V, 6 pole lap connected dc generator runs at 1250 rpm. Armature has 550 conductors. For full load armature – ohmic loss of 250 W, find the useful flux per pole. Take 2 V as the brush drop at full load
7. A DC series motor, with unsaturated magnetic circuit and negligible resistance, when running at a certain speed on a given load, takes 60 A at 600 V. If the load torque varies as the cube of the speed, find the resistance to be inserted to reduce the speed by 50 %.
8. A 4.5 kVA, 400/210 V, 50 Hz single phase transformer has the following test data
:O.C. test (l.v.side) 210V, 1A, 70 W
S.C. test (h.v.side) 15 V, 10.8A, 100 W
Calculate (i) Equivalent circuit referred to l.v side and
(ii) Secondary load voltage on full load at 0.8 power factor lagging
(iii) Efficiency of transformer at $\frac{3}{4}$ th load and 0.7 power factor (lag).
9. A balanced 3-phase, 250 kW load at 415 V and 0.88 power factor lagging is to be supplied from a two – phase 1100 V supply. Determine voltage and current rating of each winding of scott connected transformers and kVA rating of each unit.
10. A 8 kW, 220 V, 4 – pole wave connected dc motor has 450 armature conductors. At full load, the useful flux per pole is 0.023 Wb and rotational losses are 110 W. Find the full load speed

L4: Analyse

1. In a DC generator, if the load increases the flux per pole decreases. Justify the statement
How can determine the direction of rotation of a DC motor? And also explain how to change the direction of rotation?
2. Analyse the condition for maximum efficiency of any DC machine?
3. Draw and Analyse the load characteristics of a separately-excited dc generator
4. Analyse the purpose of using equalizing bars in parallel operation
5. Indirect test is superior to the direct test justify this statement with proof
6. A 22.38 kw, 440 V, 4-pole wave wound D.C. shunt motor has 840 armature conductors and 140 commutator segments. Its full-load efficiency is 88% and the shunt field current is 1.8 A. If brushes are shifted backwards through 1.5 segments from the geometrical neutral axis, find the demagnetizing and distorting amp-turns/pole
7. A 500 kw, 500 V, 10 pole d.c. generator has a lap wound armature with 800 conductors. Calculate the number of pole face conductors in each pole of a compensating winding if the pole face covers 75 percent of pole pitch
8. Two shunt generators A and B operate in parallel and their load characteristics may be taken as straight lines. The voltage of A falls from 240 V at no-load to 220 V at 200 A, while that of B falls from 245 V at no-load to 220 V at 150 A. determine the current which each machine supplies to a common load of 300 A and the bus bar voltage at this load

9. In d.c. machine the total iron losses is 8 kw at its rated speed and excitation. If excitation remains the same, but speed is reduced by 25%, the total iron loss is found to be 5 kw. Calculate the hysteresis and eddy current losses at (i) full speed (ii) half the rated speed
10. Two generators each having no load voltage of 500 V, are connected in parallel to a constant resistance load consuming 400 kw. The terminal p.d. of one machine falls linearly to 470 V as the load is increased to 850 A while that of the falls linearly to 460 V when the load is 600 A. find the load current and voltage of each generator. If the induced e.m.f. of one machine is increased to share load equally find the new current and voltage

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PC 20EE305 Power Generation and Transmission

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

Code	Course Outcomes	Mapping with POs											DoK
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO12	PSO1	PSO2		
20EE305.1	Identify the different components of thermal, hydro, and nuclear power plants	1	2	2	-	2	-	2	1	3	2	L1	
20EE305.2	Describe and assess economic aspects and tariff methods in power generation	2	2	1	2	-	2	2	1	1	2	L1 - L3	
20EE305.3	Calculate the transmission line parameters for three-phase, single, and double circuit lines	2	3	3	-	2	-	-	1	3	3	L1 - L3	
20EE305.4	Analyse the transmission line models, effects and performance parameters	2	3	3	3	-	2	1	1	1	1	L1 - L3	
20EE305.5	Analyze the sag, tension and voltage distribution of a transmission lines	2	3	2	-	-	2	1	1	2	3	L1 - L3	

Unit I: Conventional Power Generating Systems

12 Hours

Thermal Power: Block Diagram of Thermal Power Station (TPS), Brief Description of TPS Components. Hydro Power: Selection of Site, Classification, Layout, Description of Main Components. Nuclear Power: Nuclear Fission and Chain Reaction-Principle of Operation of Nuclear Reactor - Description of Main Components.

Fundamentals of electromechanical energy conversion, Combined cycle power plants

Unit II: Economic Aspects of Power Generation & Tariff

12 Hours

Economic aspects - Load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, Base and peak load plants. Tariff methods - Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a Tariff method, Tariff methods: simple rate, flat rate, block-rate, two-part, three-part, and power factor tariff methods.

Basic concepts of power and energy

Unit III: Transmission Line Parameters

12 Hours

Types of conductors, calculation of resistance for solid conductors, Gauss law, Ampers Law, calculation of inductance for single phase and three phase, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition, calculation of capacitance for 2-wire and 3-wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical-single and three phase circuits, numerical problems.

R, L, C parameters and their definitions, Ferranti, Skin and proximity effects

Unit IV: Modelling of Transmission Lines

12 Hours

Classification of transmission lines, models and their representations, nominal-T, nominal- π and A, B, C, D constants, mathematical solutions to estimate regulation and efficiency of all types of lines, long transmission line-rigorous solution, evaluation of A, B, C, D constants, interpretation of the long line equations, surge impedance and surge impedance loading (SIL), skin effect, Ferranti effect, proximity effect charging current, numerical problems.

Fundamentals of voltage regulation and efficiency, ABCD parameter calculations

Unit V: Sag and Tension Calculations and Overhead Line Insulators

12 Hours

Sag and Tension calculations with equal and unequal heights of towers–Effect of wind and ice on weight of conductor– Numerical problems–Stringing chart and sag template and its applications–Types of insulators–String efficiency and methods for improvement–Numerical problems–Calculation of string efficiency

Properties of insulators, Grading of Insulators

Text Books

1. Soni M.L., Gupta P.V., Bhatnagar U.S. and Chakrabarti A, "A Text Book on Power System Engineering", 4th Edition, Dhanpat Rai & Co. Pvt. Ltd., 2016
2. Wadhawa C.L., "Generation, Distribution and Utilization of Electric Energy", 3rd Edition, New age International Pvt. Ltd., 2015
3. Nagarath I.J. and Kothari D.P., "Modern Power System Analysis", 2nd Edition, Tata McGraw Hill, , 2003

Reference Books

1. Kamaraju V, "Electrical Power Distribution Systems", 8th Edition, Tata McGraw Hill, New Delhi, 2009
2. Deshpande M.V., "Elements of Electrical Power Station Design" 8th Edition, Prentice Hall India, New Delhi 2009
3. John J Grainger and William D Stevenson, "Power System Analysis", 4th Edition, Tata McGraw Hill, 2014
4. Gupta B.R., "Power System Analysis and Design", 4th Edition, Wheeler Publishing, 2005
5. Murthy P.S.R, "Electrical Power Systems", 3rd Edition, B. S. Publications, 2019

Web References

1. <https://nptel.ac.in/courses/108/102/108102047/>
2. <https://www.digimal.in/nptel/courses/video/108102047/L01.html>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	30
L3	20	30
L4	-	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the meaning of travelling surges?
2. What is the importance of surge impedance?
3. What is the wavelength and velocity of propagation?
4. What is meant by Skin and Proximity effects?
5. What is meant by the Ferranti effect?

L2: Understand

1. Give the reasons why the lightning is a severe power system transient
2. Explain the concept of attenuation of travelling waves
3. Explain the various properties of corona and derive the expression for power loss due to corona
4. On which parameters the variation of conductor tension depends?
5. Explain string efficiency. Why is it necessary to have high string efficiency?

L3: Apply

1. A three phase, 220 kV, 50 Hz transmission line consists of a 1.2 cm radius of conductor spaced 2 m apart as an equilateral triangle configuration. Calculate disruptive critical voltage between the lines. Irregularity factor = 0.96, temperature = 25°, barometric pressure = 72.2 cm of Hg. Dielectric strength of air = 21.1 KV (rms)/cm. Also calculate corona power loss
2. A 3 phase 220 kV, 50 Hz transmission line consists of a 30 mm diameter conductor 2.51m apart in the form of an equilateral triangle. If the temperature is 38°C and atmospheric pressure is 76 cm. Find the corona loss per km of the line? The irregularity factor is 0.83 and the stress is 21.21kV/cm
3. Calculate the inductance of a conductor per phase of a three phase, three-wire system. When the conductors are arranged at the corners of an equilateral triangle of 3.5 m sides and the diameter of each conductor is 2 cm
4. A single phase line has two pairs of conductors each pair comprises two 1.25 cm diameter conductors in parallel spaced vertically and 75 cm apart. But two parallel parts are spaced laterally by a distance of 1.5 m. Calculate the inductance of the line per km. Assuming current to be equal distributed
5. A single phase transmission line delivers 1 MVA at a power factor of 0.71 lagging, 22 kv, 50 Hz. The loop resistance is 15 ohms and inductance is 0.2H and capacitance is 0.5 microfarad. Find a) the voltage (b) the current (c) the power factor at sending end using nominal pi method

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PC 20EC306 Electronic Devices and Circuits Lab

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

Code	Course Outcomes	Mapping with POs								
		PO1	PO2	PO3	PO5	PO7	PO8	PO12	PSO1	PSO2
20EC306.1	Identify and Demonstrate different semiconductor devices and measuring instruments.	3	1	3	1	3	1	2	1	2
20EC306.2	Experiment with the semiconductor devices and observe the characteristics.	3	1	3	1	3	1	2	1	2
20EC306.3	Design and analysedifferent types of rectifier circuits usingPN Junction Diodes and interpret the results.	3	1	3	1	3	1	2	1	2
20EC306.4	Summarize the characteristics of BJT and FET.	3	1	3	1	3	1	2	1	2
20EC306.5	Design different amplifiers and evaluate their frequency responses.	3	1	3	1	3	1	2	1	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Identification, Specifications and Testing of active devices, passive devices (Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT).
2. Study the operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, FunctionGenerator, Regulated Power Supply and CRO.
3. P-N Junction Diode V-I Characteristics (Forward bias& Reverse bias).
4. Zener Diode as voltage regulator.
5. Half-wave Rectifiers (without and with c-filter).
6. Full-wave Rectifiers (without and with c-filter).
7. BJT Input & Output Characteristics (CE Configuration&CB Configuration).
8. FET Drain& Transfer Characteristics (Common Source Configuration).
9. SCR Characteristics.
10. UJT Characteristics.
11. BJT CE Amplifier.
12. Emitter Follower-CC Amplifier.
13. FET Amplifier (Common Source Configuration).

References

1. Lab Manual for Electronic Devices and Circuits Lab of Electronics and CommunicationEngineering, NSRIT

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PC 20EE307 DC Machines & Transformers Lab

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

Code	Course Outcomes	Mapping with POs					
		PO1	PO4	PO6	PO12	PSO1	PSO2
20EE307.1	Comprehend the principle of electromagnetic energy conversion	3	2	1	1	1	1
20EE307.2	Evaluate the performance characteristics of various DC generators based on excitation	3	3	2	1	2	2
20EE307.3	Evaluate the performance characteristics of various DC Motors based on excitation	3	3	2	1	1	2
20EE307.4	Summarize the performance of transformer under various conditions	3	3	3	1	2	2
20EE307.5	Understand three-phase transformers to achieve phase conversion	3	2	2	1	1	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

1. Magnetization characteristics of DC shunt generator.
2. Brake test on DC shunt motor.
3. Speed control of DC shunt motor by Field and Armature Control.
4. OC & SC test on single phase transformer.
5. Sumpner's test on single phase transformer.
6. Parallel operation of Single-phase Transformers
7. Separation of core losses of a single-phase transformer
8. Hopkinson's test on DC shunt machines.
9. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
10. Separation of losses in DC shunt motor.
11. Scott connection of transformers
12. Load test on DC series generator
13. Load test on DC compound generator

References

1. Lab Manual for DC Machines & Transformers, Department of Electrical and Electronics Engineering, NSRIT
2. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', 6th Edition, Tata McGraw Hill Publishing company Ltd, 2008.
3. Gupta J.B., 'Theory and performance of Electrical Machines', 6th Edition, S.K.Kataria and sons, 2008

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SC 20EES01 MATLAB

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

Code	Course Outcomes	Mapping with POs						
		PO1	PO4	PO5	PO10	PO12	PSO1	PSO2
20EES01.1	Learn the basic MATLAB commands	2	3	3	1	2	2	3
20EES01.2	Apply basic knowledge of on matrices, vectors	1	3	3	1	2	1	2
20EES01.3	Develop user- defined functions Loops ,Branches and other control Statements	2	3	3	1	2	2	3
20EES01.4	Solve mathematical problems using MATLAB programming	2	3	3	1	2	2	2
20EES01.5	Analyse electric networks using MATLAB	1	3	3	1	2	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

Part-I: Introduction and theory

1. Introduction to MATLAB
2. MATLAB environment (command window, command history, workspace etc.)
3. Using the help system in MATLAB

Part-II: Practical experiments

4. MATLAB basics (operation, arrays, vectors, matrices)
5. Introduction to Linear algebra and different operations on vectors and matrices
6. Creation of M-files, scripts and user-defined functions
7. Plotting using MATLAB
8. Flow control and loops in MATLAB
9. Basic Math functions (trigonometry functions, complex numbers etc.)
10. Introduction to MATLAB Simulink.
11. Analyse performance of electric networks to determine parameters.
12. Application of network theorems using MATLAB/Simulink
13. Solving numerical methods using MATLAB programming.

Text Books

1. Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma, "MATLAB and its Applications in Engineering", 2nd Edition ,Pearson Education, 2012
2. Steven C Chapra, "Applied Numerical Methods with MATLAB for Engineers and Scientists", 3rd edition, Mc Graw Hill, 2016

MC 20MCX02 Constitution of India

2 0 0 0.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20MCX02.1	Summerizing the basic features and modalities about Indian Constitution	3	3	1	L1
20MCX02.2	Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution	3	3	1	L1
20MCX02.3	Identify the Legislature and Judiciary systems in Indian Constitution	3	3	1	L2
20MCX02.4	Interpreting the political system that exists in India	3	3	1	L1, L2
20MCX02.5	Categorising the contemporary issues in global politics and Election commission in India	3	3	1	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Indian Constitution

10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Indian Constitution and its Salient Features, The role of B. R. Ambedkar in the making of the Indian Constitution, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional, The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

Unit II: Indian Federalism

10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rd Amendment, Panchayath Raj Institutions.

Unit III: Union Government

10 Hours

Powers of Indian Parliament, Functions of Rajya Sabha and Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and Lok Ayukta, The Lokpal and Lokayuktas Act 2013.

Unit IV: Challenges to Indian Political System

10 Hours

Caste: A General Overview of the Indian Scenario, The Caste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact. The Politics of Caste in the Post Independence Period, Mandal Commission Reservation Policy in Government Jobs. The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

Unit V: India's External Relations and Election Commission

10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21st Century. Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi, 2004
2. Basu D. D., "An Introduction to the Constitution of India", Prentice Hall, New Delhi, 2005
3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press, New Delhi, 2009
4. Jayal N. G. and Maheta P. B., "Oxford Companion to Indian Politics", Oxford University Press, New Delhi, 2010
5. Vanaik A. and Bharghava R. "Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

Reference Books

1. Noorani A. G., "Constitution Questions in India: The President, Parliament and the States", Oxford University Press, New Delhi, 2000
2. Chakravarthy B. and Pandey K. P., "Indian Government and Politics", Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh, "India's Foreign Policy: A Reader", Oxford University Press, New Delhi, 2013
4. Laxmikanth M., "Indian Polity for Civil Services Examinations", Tata McGraw Hill, New Delhi, 2016
5. Singh M. P. and Saxena R., "Indian Politics: Contemporary Issues and Concerns", PHI Learning, New Delhi, 2008

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1. <https://en.wikipedia.org/wiki/Federalism.in.India>
2. <https://legislative.gov.in/constitution-of-india>
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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HS 20HSX03 Managerial Economics and Financial Analysis

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1,L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1,L2
20HSX03.3	Understand the basic accounting principles and capital formation and planning	3	1	L1,L2
20HSX03.4	Apply accounting concepts to analyze financial strength of business	3	1	L3,L4
20HSX03.5	Gain theoretical knowledge on the entrepreneurship management and types of firms	3	1	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Managerial Economics and Demand Analysis 9 Hours

Definition of Managerial Economics – Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand Forecasting and Methods of Forecasting.

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis

9 Hours

Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Accounting and Financial Planning 9 Hours

Financial Accounting- Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time Value of Money- Methods of Appraising Project Profitability -Traditional Methods and Modern Methods.

Branches of Accounting, Concept of Working Capital

Unit IV: Financial Analysis through ratios 9 Hours

Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt- Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio, Operating Ratio, P/E Ratio and EPS).

Cash Flow Statement and Funds Flow Statement (Theory Only)

Unit V: Introduction of Entrepreneurship and New Economic Environment 9 Hours

Definition of Entrepreneur and Entrepreneurship, Internal and External Factors; Types of Entrepreneurs; Classification of Entrepreneurship.
Characteristic Features of Business, Features and Evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises, Changing Business Environment in Post-Liberalizations Scenario.

Industrial Policy 1991

Text Books

1. AppaRao N., Vijay Kumar P., "Managerial Economics and Financial Analysis", Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., "Managerial Economics and Financial Analysis", New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., "Managerial Economics and Financial Analysis", Himalaya Publishing House, 2014
4. Aryasri A. R., "Managerial Economics and Financial Analysis", Tata Mcgraw Hill, 2011

Reference Books

1. Maheswari V., "Managerial Economics", Sultan Chand, 2014
2. Suma Damodaran, " Managerial Economics", Oxford, 2011
3. Vanitha Agarwal, " Managerial Economics", Pearson Publications, 2011
4. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
5. Maheswari V., "Financial Accounting", Vikas Publications, 2012
6. Dominick Salvatore, "Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

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1. https://btechgeeks.com/mefa-notes/#google_vignette
2. <https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa>
3. <https://www.scribd.com/document/259129127/Mefa-course-plan>
4. <https://www.coursera.org/browse/business/entrepreneurship>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	20	20
L4	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Managerial Economics?
2. What is meant by Elasticity of demand? How do you measure it?
3. Define different product curves
4. Define Accounting
5. Define Partnership

L2: Understand

1. Explain the role of a Managerial Economist in a Business firm
2. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
3. Explain the formation of a Joint Stock Company
4. Distinguish between a partnership and a joint stock company
5. Explain accounting principles

L3: Apply

1. Journalise the following transactions
2013 Jan 1st ABC Firm commenced business with Rs.40000
Jan 2nd Deposited into bank Rs.30000
Jan 3rd Bought goods worth Rs.48000 from Kamala
Jan 4th Sold goods worth Rs.60000
2. Calculate Net Profit Ratio from the following data
Sales returns Rs.100000 Administration expences Rs.10000

- Gross Profit Rs.40000
Income from investment Rs.5000
- Selling expences Rs.10000
Loss on account of fire Rs.3000
3. From the following particulars findout
Selling price Rs.200 per unit
Variable cost Rs.100 per unit
Total fixed cost Rs.96000
i) Break even units and values
ii) Sales to earn a profit Rs.20000
4. The following are the Ratios related to XYZ Limited company.
Inventory holding period 2 months
Gross profit ratio 25 %
Gross profit for the current year announced Rs.200000
Closing stock is excess of Rs 40000 over opening stock. Findout
A) Sales
B) Cost of goods sold
C) Closing stock
D) Opening stock

L4: Analyze

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calculate IRR for the project
2. The cost of project is Rs.500000 The annual cash inflows for the next 4 years are Rs.250000 what is the PBP for the project
3. A firm is considering two different investment options A & B details of both the options are given below (Rs,in Lakhs)

	Investment cost	Inflow 1	Inflow 2	Inflow 3
Option A	(25)	10	10	12
Option B	(40)	15	20	24

4. ARR method (ARR on original investment)
Initial investment Rs.1200000

Year	Cashinflows (Rs)	
	Project A	Project B
1	600000	500000
2	500000	300000
3	200000	200000
4	-	300000

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20BSX15 Probability and Statistics

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

	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Descriptive statistics methods.

11+1 Hours

Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data-Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

Measures of Dispersion – Range – Quartile Deviation

Unit II: Probability and Probability Distributions.

11+1 Hours

Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

Moment generatingfunction

Unit III: Sampling Theory.

11+1 Hours

Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters, statistics.

Unit IV: Tests of Hypothesis.

11+1 Hours

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means -Small samples: Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance-Chi-square - Test for goodness of fit

Test for single proportion, difference of proportions(large samples)

Unit V: Curve fitting, Correlation and Regression

11+1 Hours

Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.
Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

Power curves by the method of least squares

Textbooks:

1. Miller and Freund J. E, "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011.
2. Iyenger.T.K.V, Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Probability & Statistics", 2nd Edition, S. Chand publications, 2019.

Reference Books:

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005.
2. Shahnaz Bathul, "A text book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007.
3. Murugesan and Gurusamy, "A text book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011.

Web References:

1. <https://nptel.ac.in/courses/111106112/>
2. <https://nptel.ac.in/courses/111105090/>
3. <https://nptel.ac.in/courses/111101004/>
4. <https://nptel.ac.in/courses/111102111/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis.
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem.
2. Write the differences of collection of primary and secondary data type of variable.
3. Find out the Kurtosis of the data

Class Interval	0 -10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Y on X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group
3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative.

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PC 20EE403 Control Systems

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

Code	Course Outcomes	Mapping with POs								DoK
		PO1	PO2	PO3	PO4	PO5	PO12	PSO1	PSO2	
20EE403.1	Understand the concepts of various mathematical representations of control systems.	2	2	2	1	1	1	2	1	L1-L3
20EE403.2	Obtain the time responses of first and second order systems and study the effects of P, PI and PID Controllers.	1	3	2	1	1	1	3	2	L1-L4
20EE403.3	Apply root loci to determine stability criterion for control systems.	1	2	3	1	1	1	1	2	L1-L4
20EE403.4	Analyze the stability of systems using frequency response methods	2	2	3	1	1	1	1	1	L1-L4
20EE403.5	Derive state models in linear time-invariant system	1	2	3	1	1	1	1	1	L1-L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Mathematical Modeling of Control Systems

12 Hours

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems, transfer of DC servo motor - AC servo motor - Reduction using Mason's Gain formula

Effect of feedback on disturbance and Noise

Unit II: Time Response Analysis

12 Hours

Standard test signals - time response of first and second order systems - step response of 2nd order system - time domain specifications, steady state errors, P, PI, and PID controllers. AC servo motor - synchro, transmitter and receiver - block diagram algebra - representation by signal flow graph - Reduction using Mason's Gain formula

Ramp response of 2nd order system

Unit III: Stability and Root Locus Technique

12 Hours

The concept of stability - characteristic equation - location of roots in s-plane for stability - Routh's Stability Criterion - limitations of Routh's stability, Root locus concept - construction of root loci (simple problems) Effect of addition of poles and zeros root locus, MATLAB programming for root locus.

Effect of addition of poles and zeroes on root locus

Unit IV: Frequency Response Analysis

12 Hours

Introduction to frequency domain specifications - Bode diagrams - transfer function from the Bode diagram - phase margin and gain margin stability analysis from Bode plots Polar plots, Nyquist stability criterion. Lag, lead, lag-lead compensators, MATLAB programming for BODE PLOT

M & N circles, Nicholas Charts

Unit V: State Space Analysis of LTI Systems:

12 Hours

Concepts of state, state variables and state model, state space representation of transfer function, derivation of state

models from block diagrams, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Eigen Vectors and Diagonalization

Textbooks:

1. Nagarath I.J. and .Gopal M, "Control Systems Engineering", 2nd Edition, New age International Publications, ,2018.
2. Benjamin C.Kuo, "Automatic control systems", 8th Edition, John Wiley and sons, , 2014.

Reference Books:

1. Norman S Nise, "Control Systems Engineering", 3rd Edition, John Wiley and sons, 2018.
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd, , 2015.
3. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.
4. Alice Mary K and Ramana P, "Control Systems", 1st Edition, Universities Press, 2016.

Web References:

<https://nptel.ac.in/courses/107/106/107106081/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	10
L2	30	30
L3	40	30
L4	-	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various standard test signals?
2. Define electrical zero position of synchro transmitter.
3. Define concept of observability
4. What is compensation? What are the different types of compensators?
5. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Compare different characteristics of A.C servo motor and D.C servo motor
3. Explain procedure of Bode plot and determination of gain margin and phase margin from Bode plot
4. Procedure for design of lead compensator using Bode plot
5. Explain about feedback characteristics?

L3: Apply

The characteristic polynomial of a system is $s^5+2s^6+3s^5+s^4+5s^3+2s^2+s+7=0$. Determine the location of roots on the S-plane and hence the stability of the system

Construct Nyquist plot for a feedback control system whose open loop transfer function is given by $G(s) H(s) = \frac{1}{s(s-1)}$, comment on stability of open loop and closed loop system

Determine range of K for stability of unit feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s+1)(s+2)}$

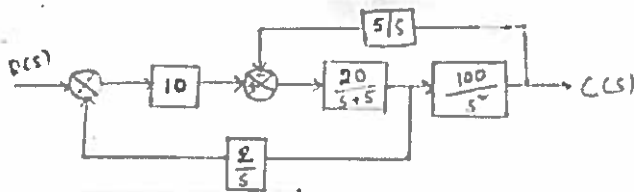
Calculate the angle of asymptotes and the centroid for the system having $G(s) H(s) = \frac{K(s+3)}{s(s+4)(s+2)(s+5)}$

For a system having $G(s) = \frac{25}{s(s+10)}$ and units negative feedback, find its time response specifications

L4: Analyze

1. State the necessary and sufficient conditions for stability for first and second order control systems. Explain why these conditions are necessary but not sufficient for stability of higher order systems
2. Differentiate the advantage and disadvantages of root locus and Bode Plot
3. Justify whether the state space model is controllable or not
4. Outline the state space model in different canonical forms

For the block diagram of the system shown, determine the transfer function using the block diagram reduction technique



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PC 20EE404 Induction Motors and Synchronous Machines

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

Code	Course Outcomes	Mapping with PO's						DoK
		PO1	PO2	PO3	PO12	PSO1	PSO2	
20EE404.1	Analyze the performance of three-phase induction motors and their characteristics	2	3	2	1	3	2	L1,L2,L3
20EE404.2	Summarize the different techniques related to speed control and starting of 3-phase induction motors	3	3	2	1	3	3	L1,L2
20EE404.3	Discuss the operation and design different types of single-phase induction motors	2	2	2	1	3	2	L1,L2
20EE404.4	Outline the different types of alternators and design alternators based on their performance characteristics	2	2	3	1	3	3	L1,L2,L3
20EE404.5	Interpret the performance of synchronous motors based on their applications	2	3	1	1	3	2	L1, L2

1 Weakly Contributing | 2 Moderately Contributing | 3 Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Three Phase Induction Machines.

11+1 Hour

Constructional features, salient pole, non-salient pole, Rotating magnetic field, Principle of operation, Torque and power equations, Torque- slip characteristics, Equivalent circuit, Power flow analysis, losses in the machine – No load and blocked rotor tests Circle diagram, Cogging phenomenon and remedies, Crawling phenomenon and remedies

Production of RMF

Unit II: Starting methods & Speed control of Three Phase Induction Machines

11+1 Hour

Problems in starting of induction motor, Starting of squirrel cage induction motors-I, Starting of squirrel cage induction motors-II, Starting of wound rotor/slip ring induction motors, Speed control of induction motor from stator end – through stator voltage - Pole changer - Frequency control - Speed control of induction motor from rotor end – through rotor resistance control and Cascade connection, Slip power recovery scheme

Losses of three phase induction motor

Unit III: Single Phase Induction Machine

11+1 Hour

Construction of single phase induction motor, Working – Double revolving field theory, Torque-slip characteristics, equivalent circuit, Power flow analysis, No load and blocked rotor tests, determination of equivalent circuit parameters, Split phase motors – Resistance start motors, Capacitor start motors, Capacitor start and capacitor run motors, Permanent split capacitor / single value capacitor motors, Shaded pole motors

BLDC motor and Universal motor

Unit IV: Synchronous Machine I

11+1 Hour

Constructional features of 3 phase alternators, Armature winding, EMF Equation, Winding Coefficients, Equivalent circuit

and phasor diagram, Armature reaction. O. C. & S. C. tests, Voltage regulation using Synchronous Impedance method, MMF method, Potier's Triangle method, Parallel operation of synchronous generators, Two reaction theory, Applications

Synchronizing power and torque, applications of synchronous generator

Unit V: Synchronous Machine II

11+1 Hour

Construction of Synchronous motor, Principle of operation, Starting methods, Effect of varying field current at different loads, V and Λ curves, Synchronous condenser, Applications.

Excitation circle and power circle, comparison of synchronous and induction motors

Textbooks

1. Bhimbra P. S., "Electrical Machinery", 7th edition, Khanna Publishers, colour reprint 2014
2. Nagarath I. J. & Kothari D. P., "Electrical Machines", 5th edition, Tata McGraw Hill Publications, 2017

Reference Books

1. Kothari D. P., Nagarath I. J., "Electrical Machines", 4th edition McGraw Hill Publications, 2017
2. Rajput R.K., "Electrical Machines", 5th Edition, Lakshmi publications, 2016
3. Abijith Chakrabarti and Sudipta Debnath, "Electrical Machinery", 2nd Edition, McGraw Hill education, 2015
4. Stephen J Chapman "Electrical Machinery Fundamentals", 1st Edition, McGraw Hill education, 2010

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the principle of three phase induction motor
2. Mention the types of speed control methods of three phase induction motor
3. State why the single phase induction motor is not self-starting
4. State the need of parallel operation of synchronous generators
5. Define synchronous condenser

L2: Understand

1. Explain the construction of three phase induction motor
2. Describe the operation of single phase induction motor

3. Explain about double cage rotor in three phase induction motor
4. Explain the starting methods of synchronous motor

L3: Apply

1. Construct the circle diagram of three phase induction motor
2. Calculate equivalent circuit parameters of single phase induction motors
3. Derive the EMF equation for three phase alternators

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ES 20EE405 Electro Magnetic Field Theory

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

Code	Course Outcomes	Mapping with PO's					DoK
		PO1	PO2	PO3	PSO1	PSO2	
20EE405.1	Understand the laws of static electric fields	3	1	-	3	3	L1, L2
20EE405.2	Explain the boundary conditions in conductors and dielectrics	3	2	1	3	3	L1, L2
20EE405.3	Apply Biot-Savart's law and Ampere circuit law to static magnetic field	3	2	2	3	2	L1, L2
20EE405.4	Evaluate the energy stored and energy density in electromagnetic fields	3	2	2	3	3	L1, L2
20EE405.5	Summarize Maxwell's equations	3	1	-	3	3	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction Of Fields and Electrostatics

12 Hours

Scalar and vector fields, overview of coordinate system, calculus of scalar and vector fields in Cartesian coordinates; Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, Electric flux density, electric potential – properties of potential function – potential gradient, Maxwell's first and second equation, Gauss's law – Laplace's and Poisson's equations.

Relation between cylindrical and cartesian co-ordinates

Unit II: Conductors – Dielectrics and Capacitance

12 Hours

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Behavior of conductors in an electric field- Conductor- Dielectric and Dielectric – Dielectric Boundary Conditions, Polarization, Capacitance of parallel plates, spherical and coaxial cable, energy stored and energy density in a static electric field, Ohm's law in point form, equation of continuity, properties of materials in electric field.

Conduction and convention current density, Di-electric constants

Unit III: Magneto Statics

12 Hours

Biot-Savart's law, Oester's Experiment, Magnetic Field Intensity (MFI) – MFI due to a straight current carrying filament, MFI due to circular, square and solenoid; relation between magnetic flux, magnetic flux density and MFI, Ampere's circuital law, point form of Ampere's circuital law – applications, Maxwells Third Equation MFI due to an infinite sheet of current and a long filament carrying conductor, Point form of Ampere's Circuital Law – Maxwell's Equation $\text{Curl}(\mathbf{H}) = \mathbf{J}$.

Magnetic Field Intensity at middle of equilateral triangle

Unit IV: Magnetic Force and Inductance

12 Hours

Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment, Torque on a current loop placed in a magnetic field, properties of materials in magnetic field

Scalar and Vector magnetic potential – properties and limitations; Self and Mutual Inductances – Mutual inductance between a straight long wire and square loop wire in the same plane; energy stored and density in a magnetic field.

Self inductance of toroid, Co-axial cable

Unit V: Time varying Fields

12 Hours

Time varying fields: Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, $\text{Curl}(\mathbf{E}) = -\partial\mathbf{B}/\partial t$, statically and dynamically induced EMF.

Modified maxwell equation

Text Books

1. Sadiku, "Principles of Electro Magnetics", 4th Edition, Oxford Publications, 2016
2. William H. Hayt and John. A. Buck, "Engineering Electromagnetics", 9th Edition, McGraw Hill Companies, 2020
3. S.Salivahanan and S.Karthie, "Electromagnetic Fields and Waves", 2nd Edition, McGraw Hill Companies, 2018

Reference Books

1. Griffiths D. J., "Introduction to Electro Dynamics", 4th Edition, Prentice Hall of India Pvt.Ltd., 2020
2. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press, Oxford Higher Education, 2012

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/>
3. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Divergence, Gradient and Curl
2. Define dot and cross product
3. What is vector field and vector potential?
4. State gauss law
5. Define Laplace equation

L2: Understand

1. Derive the expression for electric field intensity due to infinite surface charge
2. Explain the behaviour of conductors in electric field
3. Determine self and mutual inductance
4. Given $V = 5x^3y^2z$ and $\epsilon = 2.25\epsilon_0$, find (i) E at point $P(-3, 1, 2)$ (ii) ρ_v at P
5. Illustrate an expression for capacitance of a parallel plate capacitor

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PC 20EE406 Induction Motors & Synchronous Machines Lab

0 0 3 1.5

At the end of the course, students will be able

Code	Course Outcomes	Mapping with POs					
		PO1	PO2	PO4	PO12	PSO1	PSO2
20EE406.1	To understand the performance of single-phase and three-phase induction motors	3	2	3	1	1	2
20EE406.2	To control the speed of three-phase induction motors	3	2	3	1	2	2
20EE406.3	To analyze the characteristics of V and inverted V curves of synchronous motors	3	2	3	1	3	3
20EE406.4	To determine the efficiency of three-phase alternators	3	2	3	1	1	3
20EE406.5	To determine the regulation of alternator by various methods	3	2	3	1	1	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of Experiments

1. Brake test on three phase induction motor
2. No-Load and Blocked rotor test of three phase induction motor
3. Power factor improvement of single-phase induction motor by using capacitors and load test on single phase induction motor
4. Equivalent circuit of single-phase induction motor
5. Speed control of induction motor by V/F method
6. Brake test on single phase induction motor
7. V and inverted V curves of three phase synchronous motor
8. Determination of X_d and X_q of salient pole synchronous machine
9. Regulation of three phase alternator by synchronous impedance and MMF method
10. Regulation of three phase alternator by Potier triangle method
11. Parallel operation of three phase alternator
12. Determination of efficiency of three phase alternator by loading with three phase induction motor

References

1. Lab Manual for "Induction Motors and Synchronous Machines Lab", Department of Electrical and Electronics Engineering, NSRIT
2. Bimbhra P.S., "Electrical Machines" 7th Edition, Khanna publishers, 2006

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PC 20EE407 Industrial Automation for Electrical & Electronics Engg 0 0 3 1.5

Code	Course Outcomes	Mapping with POs						
		PO1	PO4	PO5	PO10	PO12	PSO1	PSO2
20EE408.1	Draw the ladder logic diagram for Boolean logic and monitor with SCADA	2	3	3	2	1	3	3
20EE408.2	Draw the ladder logic and ladder latching logic diagrams for timers, counters, combinations and monitor with SCADA	2	3	3	2	2	3	3
20EE408.3	Draw the ladder latching logic diagram for counters and timers	2	3	2	2	2	3	3
20EE408.4	Develop ladder logic for traffic signal Control and flash a light once in every one second and monitor with SCADA	1	3	3	2	2	3	3
20EE408.5	Development of ladder logic for various practical applications	1	3	3	2	2	3	3

1 Weakly Contributing | 2 Moderately Contributing | 3 Strongly Contributing for the attainment of respective PO's

List of experiments

1. Switch on light/off light for logic gates *AND, NOR, NAND, NOR, NOT, XOR, HALF, ADDER, FULL ADDER) by using Ladder Logic and SCADA monitoring
2. Develop the ladder logic for the below Boolean logic function before and after simplification

$$Y = \overline{(AB\bar{C}D + ABC\bar{D} + \bar{A}BCD + \bar{A}\bar{B}CD)} + D$$

3. Switch on light/off light with timers (on Delay and Off Delay), counters (up & down) and their combination by using Ladder logic and SCADA monitoring.
4. Switch on light/off with timers and switch on light/off light with counter by using Ladder latching logic and SCADA monitoring.
5. Write small ladder logic programs for traffic signal control and controlled by SCADA.
6. Develop a ladder logic program that will flash a light once every one second and controlled by SCADA
7. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor and the Stop switch will stop it. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor (The Stop switch will be wired as normally closed). And monitoring by SCADA.
8. Develop a ladder logic for the motor which is controlled by two switches. The start switch will start the motor after 10 seconds delay and the Stop switch will stop the motor after 10s delay. If the Stop switch was used to stop the motor, the start switch must be thrown twice to start the motor. When the motor is active a light should be turned on. And monitoring by SCADA
9. Develop a ladder logic for oven started with a Start button that seals in the Auto mode. This can be stopped if the Stop button is pushed. (Remember: Stop buttons are normally closed.) When the Auto goes on initially the TON timer is used to sound the horn for the first 5 seconds to warn that the oven will start, and after that the horn stops and the heating coils start. When the oven is turned off the fan continues to blow for 300s or 10 sec after. And monitoring by SCADA
10. Develop ladder logic for conveyor run by switching on or off a motor. We are positioning parts on the conveyor with an optical detector. When the optical sensor goes on, we want to wait 1.5 seconds, and then stop the conveyor. After a

delay of 2 seconds the conveyor will start again. We need to use a start and stop button - a light should be on when the system is active. And monitoring by SCADA

11. To study the variable frequency drive based 3phase induction motor operation by key pad

References

1. Lab Manual for Industrial Automation for Electrical & Electronics Engg Lab, Department of Electrical and Electronics Engineering, NSRIT
2. FrankpetruzellaD , " programmable logic controllers", 3rd Edition Tata MC Graw Hill, 2010

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PC 20EE408 Control Systems Lab

0 0 3 1.5

Code	Course Outcomes	Mapping with POs					
		PO1	PO4	PO5	PO1 2	PS O1	PSO 2
20EE408.1	Analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchronous motors.	3	2	1	1	2	2
20EE408.2	Design P,PI,PD and PID controller, design lag, lead and lag-lead compensators	3	2	1	1	1	2
20EE408.3	Determine the transfer function of D.C.motor	3	2	1	1	2	1
20EE408.4	Control the temperature using PID controller	3	2	1	1	2	2
20EE408.5	Control the position of D.C servo motor performance	3	2	1	1	1	1

1 Weakly Contributing | 2. Moderately Contributing | 3 Strongly Contributing, for the attainment of respective POs

List of experiments

1. Time response of Second order system
2. Characteristics of Synchro
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor using MATLAB
6. Characteristics of magnetic amplifier
7. Characteristics of AC servo motor
8. Characteristics of AC servo motor
9. Root locus and Bode plot from MATLAB
10. DC position control system
11. Controllability and observability test using MATLAB
12. Temperature controller using PID

References

1. Lab Manual for Control Systems Lab, Department of Electrical and Electronics Engineering, NSRIT
2. Nagarath I.J. and Gopal M, "Control Systems Engineering", 2nd Edition New age International Publications, , 2018
3. Norman S Nise, "Control Systems Engineering", 3rd Edition John Wiley and sons, , 2018

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SC 20EES02PLC

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

Code	Course Outcomes	Mapping with POs						
		PO1	PO4	PO5	PO10	PO12	PSO1	PSO2
20EES01.1	Determine Automation & System Overview, Engineering Software TIA Portal	2	3	3	3	2	2	2
20EES01.2	Distinguish b/w logic Gates, Circuit diagrams, Timers, Counters, FC's, OB's, DB's and PLC Tags	2	3	3	3	2	1	2
20EES01.3	Write Ladder program for various applications	1	3	3	3	2	2	1
20EES01.4	Communicate between PLC's	2	3	3	3	2	2	2
20EES01.5	Understand Control Strategies	1	3	3	3	2	1	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

MODULE 1: Automation Overview, System Overview.

MODULE 2: Digital Fundamentals, Engineering Software TIA Portal, STEP 7 Range of Products

MODULE 3: Devices & Networks, PLC Tags, Program Blocks and Program Editor.

MODULE 4: Binary Operations, Digital Operations, Data Blocks.

MODULE 5: Functions and Function Blocks, Organization Blocks, Troubleshooting

Text Books

1. Madhuchhanda Mitra, Samarjit Sengupta, "Programmable Logic Controllers and Industrial Automation: An Introduction", 2nd Edition, Penram International Publishing (India) Pvt.Ltd., 2017
2. Hackworth, "Programmable Logic Controllers Programming Methods And Applications", 1st Edition, PEARSON INDIA, 2011

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PC 20EC303 Signals and Systems

3 1 0 3

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

Code	Course Outcomes	Mapping with Pos							DoK
		PO1	PO2	PO4	PO5	PO12	PSO1	PSO2	
20EC303.1	Define the mathematical model of continuous discrete time signals and systems	3	2	1	1	1	1	1	L1, L2
20EC303.2	Determine and Analyze the output response of LTI systems	3	3	1	1	1	1	1	L1 - L3
20EC303.3	Derive the frequency domain representation of signals and systems	3	2	1	1	1	1	2	L2 - L4
20EC303.4	Analyse the characteristics of linear time invariant systems	2	3	1	1	1	1	2	L2 - L4
20EC303.5	Determine the output response of continuous time/ discrete time LTI systems	3	3	1	1	1	1	2	L2 - L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction

9+3 Hours

Continuous-time and Discrete-time signals, Basic operations on signals, Signal models: The unit step, The unit impulse, The sinusoid, The complex exponential, Sinc, Rect, Even and odd functions. Continuous-time and Discrete-time systems, System properties: Linearity, Time invariance, Causality, Stability, Response of LTI system: Impulse response, Unit step response.

Orthogonality in complex functions

Unit II: Fourier Series and Fourier Transform

9+3 Hours

Analogy between Vectors and Signals, Orthogonality, Representation of Continuous time periodic signals using Fourier series, Dirichlet's conditions, Trigonometric fourier series and exponential Fourier series, Properties of the fourier series. Fourier transform from fourier series, Dirichlet's conditions, Fourier transform of standard and arbitrary signals, Fourier transform of periodic signals, Properties of the Fourier Transforms. Inverse Fourier Transforms.

Derivation of Fourier Transform from Fourier Series

Unit III: Convolution and Correlation

9+3 Hours

Convolution, Graphical representation of convolution, Convolution properties, Cross correlation and Auto correlation of functions, Properties of correlation function, Energy density spectrum, Power density spectrum, Parseval's theorem, Relation between auto correlation function and energy/power spectral density function, Comparison between ESD and PSD.

Detection of periodic signals in the presence of noise by correlation

Unit IV: Analysis of Linear Systems

9+3 Hours

Continuous time and discrete time Linear shift-invariant (LSI) systems: system impulse response and step response, Transfer function of a LTI system, Properties of LTI system, Causality, Filter characteristics of linear systems - Ideal LPF, HPF and BPF characteristics. Distortionless transmission through a system, Signal bandwidth, System bandwidth, Relationship between bandwidth and rise time, Sampling Theorem. Types of Sampling Techniques.

Reconstruction of signal from its samples, effect of under sampling – Aliasing

Unit V: Laplace Transform and Z-Transforms

9+3 Hours

The Laplace Transform: the region of convergence (roc) for Laplace transforms, The inverse laplace transform, Properties of the laplace transform, Causality and stability.

Introduction, Z- Transform, Distinction between Laplace, Fourier and Z transforms, Region of convergence, Constraints on ROC for various classes of signals, Properties of the z-transforms, Inverse Z Transform.

Distinction between Laplace, Fourier and Z transforms

Textbooks

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and Systems", 2nd Edition, Prentice Hall of India, 1997
2. Bhagawandas P. Lathi, "Linear Signals and Systems", 3rd Edition, Oxford University Press, 2009
3. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley Student Edition, 2002

Reference Books

1. Anand Kumar, "Signals & Systems", Prentice Hall of India, 2nd Edition, 2012
2. Govind Sharma and Michael J. Robert, "Fundamentals of Signals and Systems", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2010
3. K. Raja Rajeswari and B Visweswara Rao, "Signals and Systems", 1st Edition, Prentice Hall of India, 2009
4. Charles L. Phillips, John M. Parr and Eve A. Riskin, "Signals, Systems, and Transforms", 4th Edition, Pearson Publications, 2007

Web Resources

1. https://www.tutorialspoint.com/dip/signals_and_system_introduction
2. <https://web.stanford.edu/~boyd/ee102/>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-notes/>
4. <https://nptel.ac.in/courses/117101055/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	20	20
L4	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define and sketch sinusoidal signal
2. Define Signal and System
3. What are orthogonal functions?
4. Define Hilbert transform of a signal $x(t)$
5. Recall Dirchlet's conditions
6. State differentiation in time domain property of Fourier transforms
7. List any three properties of convolution Integral
8. When is a function $x(t)$ said to be Laplace transformable?

L2: Understand

1. Explain, how Impulse Response and Transfer Function of a LTI system are related?
2. Compare Laplace, Fourier and z- transforms
3. Summarize the properties of ROC of Laplace Transform
4. Relate rise time and Bandwidth
5. Organise the continuous time version of a sinusoidal signal and bring out the relation between sinusoidal and complex exponential signals
6. List the advantages and Limitations of Laplace transform
7. Obtain the Fourier transform of the unit step function
8. Obtain the Laplace transform of the signal $x(t) = e^{-at}u(t) + e^{bt}u(-t)$
9. Interpret the scaling and time shifting properties of Laplace transform

L3: Apply

1. Build the relation between unit step and signum functions
2. Develop Square wave from time shifting property of unit step signal
3. Develop relation between Rise time and Bandwidth
4. Compare one-sided and two sided z-transforms and its region of convergence
5. Solve the Laplace transform and ROC of $x(t) = e^{-5t}[u(t) - u(t-5)]$
6. Make use of Convolution property, develop discrete signals from continuous time signals
7. Develop Fourier transform from Fourier Series
8. Express complex exponential Fourier coefficients in terms of trigonometric Fourier coefficient

L4: Analyze

1. Explain briefly the extraction of a signal from noise by filtering
2. Compare impulse sampling, natural sampling and flat top sampling with relevant diagrams
3. Outline differentiation property of Fourier transform
4. Obtain the Fourier transform of the impulse function $\delta(t)$
5. Explain the aliasing effect using relevant diagrams and suggest remedies to avoid aliasing
6. Analyse the autocorrelation function and energy spectral density function of $x(t) = e^{-at}u(t)$
7. Examine the relationship between autocorrelation function and energy spectral density of an energy signal

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PC 20EE502 Power Electronics

3 1 0 3.0

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

Code	Course Outcomes	Mapping with PO's						DoK
		PO1	PO2	PO3	PO12	PSO1	PSO2	
20EE502.1	Understand the operation and characteristics of various power electronic devices	3	1	1	1	1	2	L2
20EE502.2	Interpret the operation and control of single phase full wave converters	2	2	1	1	2	1	L2
20EE502.3	Analyze the operation and control of three-phase full wave converters	2	3	2	1	2	2	L3
20EE502.4	Understand and design of buck, boost and buck-boost converters	2	2	3	1	1	2	L2
20EE502.5	Outline the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation	1	2	2	1	2	1	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Power Electronic Devices

12 Hours

Basic Theory of Operation - Static Characteristics-Two Transistors analogy -Turn on and Turn off Methods - Methods of SCR Triggering - Dynamic & Gate Characteristics of SCR – Series and Parallel Operation – Snubber circuit - Characteristics of Power MOSFET.

Characteristics of IGBT

Unit II: Single Phase AC-DC Converters

12 Hours

Single Phase half wave controlled rectifiers - R load and RL load with and without freewheeling diode - Single Phase fully controlled bridge converter with R load, RL load - Continuous and Discontinuous conduction - Effect of source inductance in 1-phase fully controlled bridge rectifier with continuous conduction – Expression for output voltages – Single Phase semi Converter with R load, RL load and RLE load – Continuous and Discontinuous conduction - Numerical Problems, applications of single phase AC-DC converters to industries.

Single Phase fully controlled bridge converter with RLE load

Unit III: Three Phase AC-DC Converters & AC – AC Converters

12 Hours

Three Phase half wave Rectifier with R and RL load - Three Phase fully controlled rectifier with R and RL load - Three Phase semi converter with R load - Expression for Output Voltage - - Three Phase Dual Converters - Numerical Problems. AC-AC power control by phase control with R and RL loads - Three Harmonic Analysis phase AC voltage regulator with R load – Numerical Problems, applications of AC-AC converters to industries.

Three Phase semi converter with RL load

Unit IV: DC–DC Converters

12 Hours

Operation of Basic Chopper - Classification - Control Techniques - Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple- Numerical Problems.

Analysis of Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM)

Unit V: DC–AC Converters

12 Hours

Introduction - Harmonic Analysis - Classification - Single Phase half bridge and full bridge inverters with R and RL loads - Unipolar & Bipolar Switching - Quasi-square wave pulse width modulation - Three Phases square wave inverters - 180° conduction mode of operation – PWM inverters - Numerical Problems

Three Phase square wave inverters - 120° conduction mode of operation

Text Books

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore MUndeland, William P Robbins, John Wiley & Sons
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books

1. Elements of Power Electronics–Philip T.Krein,oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradia, A. Joshi and R. K.Sinha, New Age International (P) Limited Publishers, 1996.

Web References

1. <https://nptel.ac.in/courses/108/102/108102145/>
2. <https://nptel.ac.in/courses/108/101/108101126/>
3. <https://www.digimat.in/nptel/courses/video/108101126/L01.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Latching Current
2. List the applications of step up choppers.
3. What is shoot through fault? Explain.
4. Draw the circuit diagram of three phase M-3 controlled converter.


L2: Understand

1. Explain the operation of snubber circuit and also design the parameters of snubber circuit.
2. Draw the two-transistor analogy of a SCR? Explain SCR operation with this analogy
3. Explain the operation of single phase two pulse midpoint converter with relevant voltage and current waveforms and also derive the expression for average output voltage.
4. Explain the working of three-phase half wave uncontrolled rectifier with relevant wave forms for 'R' load.

L3: Apply

1. A single phase semi converter is delivering power to RLE load with $R= 5\Omega$, $L= 10\text{ mH}$ and $E = 80\text{ V}$. The ac source voltage is 230 V , 50 Hz . For continuous conduction, find the average value of output current for a firing angle of 50° . If one of the SCR is damaged and open circuited find the new value of average output current on the assumption to continuous conduction. Also sketch the output voltage and current waveforms?
2. A boost regulator has an input voltage of $V_s = 5\text{ V}$. The average output voltage $V_a = 15\text{ V}$ and the average load current $I_a = 0.5\text{ A}$. The switching frequency is 25 kHz . If $L = 150\text{ }\mu\text{H}$ and $C = 220\text{ }\mu\text{F}$, determine (i) the duty cycle, (ii) the ripple current of inductor ΔI , (iii) the critical values of L and C .

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PC 20EC305 Digital System Design

3 0 0 3

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

Code	Course Outcomes	Mapping with Pos				DoK
		PO1	PO2	PSO1	PSO2	
20EC305.1	Utilise the knowledge of number systems in digital design and evaluate the errors in digital transmission of data using error Codes	3	2	2	2	L1, L2
20EC305.2	Utilise laws of Boolean algebra and minimization techniques to simplify and design logic circuits	3	3	2	2	L2, L3
20EC305.3	Design and analyse the operation of combinational circuits and Programmable Logic Devices from the description of a logical function	3	2	2	2	L2, L3, L4
20EC305.4	Design and analyse the operation of sequential circuits from the description of a logical function	3	2	2	2	L2, L3, L4
20EC305.5	Write HDL Code for the design of digital logic circuits.	1	2	2	2	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT-I: Digital Systems and Number System

13 Hours

Digital systems, Number systems, Counting in radix, Conversion of one radix to other, Complements of numbers, Signed binary numbers, Arithmetic addition and subtraction, 4-bit codes: BCD codes, Excess-3, Gray code, r's and r-1's complement, Error detecting & Error correcting codes, Basic logic gates, Universal gates, Ex-OR, Ex-NOR gates.

Logic families, Characteristics of Logic families: CMOS, TTL, ECL families.

UNIT-II: Concept of Boolean Algebra

12 Hours

Basic Theorems and Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Min-terms and Max-terms, Products of Sum Simplification, Sum of Products Simplification, Gate level Minimization: Map Method, Two-Variable K-Map, Three-Variable K-Map, Four Variable K-Maps, Five Variable K-Maps, Don't – Care Conditions, Quine–McCluskey method, NAND and NOR Implementation, Exclusive-OR function, Code converters.

Six variable K-Map, Hazards

UNIT-III: Combinational Logic Circuits & Programmable Logic Devices

12 Hours

Introduction, Adder, Subtractor, 4-Bit binary adder, 4-Bit binary Subtractor, BCD adder circuit, Carry look-a-head adder circuit, Decoders, Encoders, Multiplexers, Higher order multiplexing, De-Multiplexers, Priority encoder, Magnitude comparator.

Programmable Logic Devices: PROM, PAL, PLA-Basics structures, Realization of boolean function with PLDs, Programming tables of PLDs, merits & demerits of PROM, PAL, PLA comparison, Realization of Boolean functions using PROM, PAL, PLA, Programming tables of PROM, PAL

Parallel Prefix Adders, Binary Multiplier, Vedic Multiplier. Complex Programmable Logic Devices (CPLD), Field Programmable gate arrays (FPGA).

12 Hours

UNIT -IV: Sequential Logic Circuits & Finite State Machines

Introduction to sequential circuits, Storage elements: Latches, Flip-flops, RS- Latch using NAND and NOR Gates, RS, JK, T and D Flip Flops, Master Slave JK flip flop, Excitation tables and Characteristic equations, Conversion of flip flops. Registers, Shift registers, Universal shift register, Asynchronous counters, Synchronous counters, Ring counter, Johnson counter.

Master slave RS flip flop, Master slave D flip flop, Registers and Counters using reversible logic gates, Vending machine controller

UNIT -V Introduction to VHDL

12 Hours

Design flow, Program structure, Levels of abstraction, Elements of VHDL: Data types, Data objects, operators and identifiers. Packages, Libraries and Bindings, Subprograms. VHDL Programming using structural and data flow modelling. HDL implementation of combinational and Sequential Logic Circuits.

Modelling of Combinational ICS Using VHDL, Modelling of Sequential ICS Using VHDL

Textbooks

1. Morris Mano, "Digital Design", 3rd Edition, Prentice Hall of India, 2001
2. Hill and Peterson Mc-Graw Hill, "Switching Theory and Logic Design", 1st Edition, Tata McGraw-Hill, 2016
3. John F.Wakerly, "Digital Design", 4th Edition, Pearson Prentice Hall, 2008
4. A. Anand Kumar, "Switching theory and logic design", 3rd Edition, Prentice Hall of India, 2016

Reference Books

1. Zvi Kohavi, "Switching & Finite Automata theory", 2nd Edition, Tata McGraw-Hill, 2008
2. R P Jain, "Modern Digital Electronics", 3rd Edition, Tata McGraw-Hill, 2003
3. Charles H. Roth Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers, 1992

Web Resources

1. <https://nptel.ac.in/courses/117/105/117105080/>
2. <https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/>
3. http://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/15CS20

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	15	-
L2	40	40
L3	30	30
L4	15	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Find the decimal number equivalent of fractional octal number
2. List any two postulates of Boolean algebra
3. What you mean by non-weighted code?

L2: Understand

1. Explain how combinational logic circuit 4:1 multiplexer works
2. Represent the following Boolean expression to min-terms and max-terms $AB+BC'+ABD'+ACD$
3. Represent a T flip flop using JK flip flop

L3: Apply

1. Build the Boolean function $F(x, y, z) = \sum m(0, 1, 2, 4, 5, 7)$ by using 4 to 1 Multiplexer
2. Develop a full adder using half adder
3. Construct a 16:1 multiplexer using 8:1 multiplexer

L4: Analyze

1. Distinguish combinational logic circuits and sequential logic circuits.
2. Compare mealy and Moore machine
3. Classify the counters

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PE 20EE001 Advanced Power Electronics**3 0 0 3**

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

Code	Course Outcomes	Mapping with Pos			DoK
		PO1	PO2	PSO1	
20EE001.1	Evaluate different dc-dc voltage regulators	2	2	1	L1-L2
20EE001.2	Explain resonant converters	2	2	1	L1-L2
20EE001.3	Understand phase shifting converter for a multi-level converter	2	2	1	L1-L3
20EE001.4	Explain phase shifting converter for a multi-pulse converter	2	2	1	L1-L2
20EE001.5	Understand various multi-level inverter configurations	2	2	1	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Switching Voltage Regulators**12 Hours**

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuck converter, Sepic Converter; Design criteria for SMPS;

*Multi-output switch mode regulator***Unit II: Resonant Converters****12 Hours**

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero-voltage switching dc-dc converters, zero current switching dc-dc converters,

*clamped voltage topologies***12 Hours****Unit III: Multi-level converters**

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications,

*carrier based PWM technique for multi-level converters***Unit IV: Multi pulse Converters****12 Hours**

Concept of multi-pulse, Configurations for m-pulse (m=12,18,24) converters, Different phase shifting transformer (Y-Y1, Y-Y2, Y-Z1 and Y-Z2) configurations for multi-pulse converters

*Applications of multi pulse converters***Unit V: HVDC Transmission****12 Hours**

Introduction, Operation of 12-pulse converter as receiving and sending terminals of HVDC system, Equipment required for HVDC System and their significance, Comparison of AC and DC transmission

*Control of HVDC transmission***Textbooks**

1. Ned Mohan, Tore M. Undeland and William P, "Power Electronics – Converters, Applications and Design" 5th edition ,Robbins John Willey & sons,2015
2. Drives Bin Wu John "High Power Converters and AC" 4th edition, John Willey & sons Inc,2013
3. Clean Power Derek, "Power Electronic Converter Harmonics – Multipulse Methods", 3rd edition, IEEEPress

Reference Books

1. P.C.Sen "Modern Power Electronics" 3rd edition S. Chand and Co. Ltd.,2012
2. L. Umanand Wiley " Power Electronics Essentials and Applications" 3rd edition, India Pvt Ltd 2009
3. Vijay K. Sood Kluwer "HVDC and FACTS Controllers Applications of Static Converters in Power System, 5th edition, Academic Publishers, 2008

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ee28/preview
2. <http://ieeexplore.ieee.org/document/6493452/>
3. <https://www.nature.com/articles/s41467-020-16262-0>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	40	40
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the need of resonant converters?
4. State important advantages, disadvantages and applications of SMPS.
5. Give comparison of HVAC and HVDC transmission.
6. Discuss need of multilevel inverter.

L2: Understand

1. Explain in brief Static VAR Compensator (SVC). Compare it with STATCOM.
2. Explain concept of multilevel inverter.
3. Discuss principle of series compensation. Explain operation of static synchronous series compensator (SSSC).
4. Draw block diagram of HVDC transmission system. Mention equipment required for HVDC system.

L3:Apply

1. Compare 12 pulse and 18 pulse converter based on its harmonic analysis.
2. Discuss principle of shunt compensation. Explain operation of fixed capacitor- thyristors controlled reactor.

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PE 20EE002 Digital Control Systems

3 0 0 3.0

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

Code	Course Outcomes	Mapping with PO's						DoK
		PO1	PO2	PO3	PO12	PSO1	PSO2	
20EE002.1	Understand the concept of sample and hold operation and apply Z-transforms to Digital systems	2	2	3	1	1	2	L1 - L2
20EE002.2	Apply the theory of z-transformations and application for the mathematical analysis of digital control systems.	2	3	3	1	2	1	L1 - L2
20EE002.3	Analyze the stability of digital control systems	2	3	3	1	3	2	L1 - L3
20EE002.4	Evaluate the concept of state space to test the performance of digital control systems	3	3	2	1	1	2	L1 - L3
20EE002.5	Interpret the design of state feedback control by "the pole placement method.	2	3	3	1	2	3	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Introduction and Signal processing

12 Hours

Introduction to analog and digital control systems – Advantages of digital systems sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal, A/D and D/A conversion, applications of A/D and D/A conversion

Frequency domain characteristics of zero order hold.

Unit II: Review of Z-transforms

12 Hours

Z-Transform method for solving difference equations; Pulse transfer function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane: Primary strips

Complementary Strips.

Unit III: Stability analysis

12 Hours

Mapping between the s-Plane and the z-Plane – Primary strips and Complementary strips – Stability criterion – Modified Routh's stability criterion and Jury's stability test

Stability analysis using Liapunov theorems.

Unit IV: State space representation

12 Hours

State Space Representation of discrete time systems, solving discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations. Concepts of Controllability and Observability, Tests for controllability and Observability

Duality between Controllability and Observability

Unit V: State feedback controllers

12 Hours

Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula. Applications of state feedback controllers

Advanced feedback controllers.

Text Books

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition
2. B.C. Kuo, "DigitalControlSystems", 2 nd Edition, Oxford University Press, Feb 2012. (Units - 2, 3)
3. M. Gopal, "Digital Control Engineering", 2 nd Edition-New Age International Publications, 2014.

Reference Books

1. Karl J Astrom& B. Wittenmark, "Computer controlled systems, Theory and & Design", 3 rd Edition, Prentice Hall Information Sciences & System sciences series,1997.
2. M.Gopal, "Digital Control and State Variable Methods", 4 th Edition, TMH, April-2012.

Web References

1. <http://mtc-m18.sid.inpe.br/col/sid.inpe.br/mtc-m18@80/2008/03.17.15.17.24/doc/mirrorget.cgi?languagebutton=pt-BR&metadatarepository=sid.inpe.br/mtc-m18@80/2009/02.09.14.45.33&index=0&choice=full>
2. http://portal.acm.org/author_page.cfm?id=81100182444&coll=GUIDE&dl=GUIDE&trk=0&CFID=27536832&CFTOKEN=71744014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What State Transition Matrix?
2. Write about Discretization of continuous time state – space equations?
3. Define stability of digital control systems
4. What is meant by sampling and hold operations?
5. What are digital compensators?
6. State the sampling theorem

L2: Understand

1. Write about a) State Transition Matrix b) Pulse Transfer Function Matrix c) Discretization of continuous time state – space equations.
2. Explain the shifting and scaling operator with suitable examples.
3. Describe the linear time invariant and casual systems.
4. What is State transition matrix? state its Properties. Also explain any two methods for Computation of State Transition Matrix.
5. Discuss the design procedure of state feedback controller through pole placement technique.

L3: Apply

1. Prove that the discrete-time control system defined by $x[(k+1)T] = G x(kT)$, $y(kT) = C x(kT)$ is complete observable.

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PE 20EE003 Utilization Of Electrical Energy**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's			DoK
		PO1	PO2	PO3	
20EE003.1	Identify a suitable motor for electric drives and industrial applications	3	1	2	L1-L2
20EE003.2	Identify most appropriate heating or welding techniques for suitable applications	3	1	2	L1-L2
20EE003.3	Understand various levels of illuminosity produced by different illuminating sources.	3	1	2	L1-L3
20EE003.4	Design different lighting systems by taking inputs and constraints in view for different layouts.	3	1	2	L1-L3
20EE003.5	Understand the speed/time characteristics of different types of traction motors.	3	1	2	L1-L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I:**12 Hours****Illumination fundamentals**

Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light

Various Illumination Methods

Discharge lamps, MV and SV lamps–Basic principles of light control–Types and design of Indoor lighting and Outdoor lighting–LED lighting, Energy conservation.

*Comparison between tungsten filament lamps and LED lamps***Unit II:****12 Hours****Electric Heating**

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding

Electric welding–Resistance and arc welding–Electric welding equipment

*Comparison between AC and DC Welding, Applications of Electric Heating and Electric Welding***Unit III: Selection of Motor****12 Hours**

Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.

*Applications of electric drives***Unit IV: Electric Traction - I****12 Hours**

System of electric traction and track electrification–Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

*Review of existing electric traction systems in India***Unit V: Electric Traction - II****12 Hours**

Calculations of tractive effort–power–Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking retardation adhesive weight and coefficient of adhesion

*Principles of energy efficient motors***Text Books**

1. Partab, "Art & Science of Utilization of electrical Energy", 5th edition, Dhanpat Rai & Sons, 2014.

2. C.L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy" 2nd Edition, New Age International (P) Limited, Publishers, 1997

Reference Books

1. N V Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric Traction", 2nd edition New age International (P) Limited, publishers, 1996.

Web References

1. <https://nptel.ac.in/courses/108/105/108105060/>
2. <https://youtu.be/ft5QB91LDw>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are different types of Motor control?
2. What is Adhesive weight:
3. List out the electrical characteristics of DC Shunt motors.

L2: Understand

1. Explain the Operating Characteristics of a DC series motor using the Curves.
2. Explain the operation of Ajax Wyatt Furnace.
3. Discuss about the Speed-Time curves in Traction

L3: Apply

1. For a three-phase induction motor, maximum torque is thrice the full-load torque and starting torque is 1.9 times the full-load torque. In order to get a full-load slip of 6%, calculate the percentage reduction in rotor circuit resistance neglect stator impedance.
2. The rotor of a six-pole, 50-Hz, and 3- ϕ induction motor has a resistance of 0.3 Ω per phase and runs at 960 rpm. If the load torque remains unchanged, calculate the additional rotor resistance that will reduce the speed by 20%.
3. A 4.5-kW, 200-V, and 1- ϕ resistance oven is to have nichrome wire heating elements. If the wire temperature is to be 1,000°C and that of the charge 500°C. Estimate the diameter and length of the wire. The resistivity of the nichrome alloy is 42.5 $\mu\Omega$ -m. Assume the radiating efficiency and the emissivity of the element as 1.0 and 0.9, respectively.

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PE 20EE004 Machine Modelling and Analysis**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO3	PSO 1	
20EE004.1	Explain the basic concepts of AC/ DC machine modeling.	2	1	L1 - L2
20EE004.2	Understand the dynamic modeling and phase transformation	2	1	L1 - L2
20EE004.3	Explain various methodologies in small signal machine modeling.	2	1	L1 - L2
20EE004.4	Understand the modeling of synchronous machine modeling	2	1	L1 - L2
20EE004.5	Explain the performance and dynamic modeling of synchronous machines	2	1	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Basic concepts of Modelling**12 Hours**

Basic Two - pole Machine representation of Commutator machines, 3 phase synchronous machine with and without damper bars and 3 - phase induction machine. DC Machine modeling: Mathematical model of separately excited D.C motor –Steady State analysis - Transient State analysis - Sudden application of Inertia Load - Transfer function of Separately excited D.C Motor - Mathematical model of D.C Series motor, Shunt motor - Linearization Techniques for small perturbations

*Theory of DC Machines***Unit II: Reference Frame Theory****12 Hours**

Reference frame theory Real time model of a two phase induction machine-Transformation to obtain constant matrices - three phase to two phase transformation - Power equivalence. Dynamic modeling of three phase Induction Machine Generalized model in arbitrary reference frame - Electromagnetic torque - Derivation of commonly used Induction machine models - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model - Equations in flux linkages - per unit model

*Theory of Induction Machines***Unit III: Small Signal Modeling****12 Hours**

Small Signal Modeling of Three Phase Induction Machine Small signal equations of Induction machine – derivation - DQ flux linkage model derivation - control principle of Induction machine. Single phase induction motor - Cross field theory of single - phase induction machine.

*Single phase induction motor***Unit IV: Modeling of Synchronous Machine****12 Hours**

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine- modeling of PM Synchronous motor.

*Theory of synchronous Machines***Unit V: Dynamic analysis of Synchronous Machine****12 Hours**

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque

characteristics, Equal area criteria.

Synchronous machine torque equation

Text Books

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & control", First edition, Pearson Publications, 2002.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", Second Edition, IEEE Press.
3. Dynamic Simulation of Electric Machinery using MATLAB by ONG, Chee-Mun - Prentice Hall PTR

Reference Books

1. P.S.Bimbra, "Generalized Theory of Electrical Machines", Fifth edition, Khanna publications, - 1995.
2. Chee Mun Ong –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications.

Web References

1. <http://nptel.ac.in/courses/108106023/>
2. <https://nptel.ac.in/courses/108/106/108106023/#>
3. <http://www.infocobuild.com/education/audio-video-courses/electronics/AnalysisOfElectricMachines-IIT-Madras/lecture-09.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Why damper bars are used?
2. What are the commonly used induction machine models?
3. What meant by reference frame theory?
4. State electro magnetic torque in induction motor
5. Define and write relation for stored magnetic energy

L2: Understand

1. Draw the basic circuit model for a 3-phase induction motor for stator as well as rotor currents
2. Derive the dynamic model of a 3-phase induction motor in synchronizing rotating reference frame
3. Discuss in detail about phase transformation and active transformation
4. Explain the generalized mathematical model of the series motor. List out the assumptions pertaining to the use of generalized mathematical model of dc machines.
5. Explain the transfer function analysis of a separately excited DC motor.

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PE 20EE005 Sensors and Transducers**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO1	PO5	
20EE005.1	Understand basic operation of sensors.	2	2	L1 - L2
20EE005.2	Explain different types of sensors	2	2	L1 - L2
20EE005.3	Understand basic operation of transducer	2	2	L1 - L2
20EE005.4	Explain different types of amplifiers	2	2	L1 - L2
20EE005.5	Explain various types of electric quantities	2	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Sensors**12 Hours**

Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics.

Stretched diaphragm type: microphone, response characteristics

Unit II: Thermal and Magnetic Sensors**12 Hours**

Material expansion type: solid, liquid, gas & vapor. Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type. Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.

Wiedemann effect for yoke coil sensors, Thomson effect.

Unit III: Introduction to Transducers**12 Hours**

Strain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers.

Induction Potentiometers, Micro Electromechanical Systems

Unit IV: Signal Condition**12 Hours**

Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Electrical and electronic Amplifiers.

Data Acquisition Systems and Conversion: Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems,.

Optical Amplifiers, Data Conversion

Unit V: Data Transmission and Telemetry**12 Hours**

Data/Signal Transmission, Telemetry. Measurement of Non – Electrical Quantities: Pressure Measurement.

Modified maxwell equation

Text Books

1. Patranabis D, "Sensors and Transducers", 5th Edition, Prentice Hall India Learning Private Limited, 2003
2. Murty D.V.S, "Transducers and Instrumentation", 2nd Edition, Prentice Hall India Learning Private Limited, 2008
3. Ian Sinclair, "Sensors And Transducers", 2nd Edition, Elsevier, 2011

Reference Books

1. S. Vijayachitra., "Transducers Engineering", 4th Edition, Prentice Hall of India Pvt. Ltd., 2010

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/>
3. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. What is principle of transduction?
2. What is the functions of Signal Conditioning Equipment?
3. What is proximity sensor?
4. What is the tactile sensor?
5. What are the configurations of Data Acquisition System?

L2: Understand

1. Explain the basic parameters that are to be possessed by a sensor.
2. Differentiate between Electrical and electronic Amplifiers.
3. Determine the objectives of Data Acquisition System.
4. Explain Variable Differential Transformer.
5. Explain the characterisitcs of Fiber Optic Transducers.

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OE 20EE001 Introduction to Renewable Energy Sources 3 0 0 3.0

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO1	PO7	
20EE001.1	Understand the significance of solar energy	2	2	L1, L2
20EE001.2	Provide the importance of Wind Energy	2	2	L1, L2
20EE001.3	Understand the role of ocean energy in the Energy Generation	3	2	L1, L2
20EE001.4	Explain the utilization of Biogas plants and geothermal energy	2	2	L1, L2
20EE001.5	Explain the concept of energy Conservation	2	2	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Solar Energy

12 Hours

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

Thermal analysis of flat plate collectors

Unit II: Wind Energy

12 Hours

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy

12 Hours

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

Open and closed OTEC Cycle

Unit IV: Bio Mass

12 Hours

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation

12 Hours

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Hydro Thermal, Geo-pressured, Hot dry rocks

Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd.,2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P.& Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill , 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

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1. <https://nptel.ac.in/courses/121/106/121106014/>
2. <https://www.edx.org/learn/renewable-energy>
3. <https://www.coursera.org/learn/renewable-energy-resources-and-technologies>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	30
L2	60	70
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H₂ - O₂ fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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PC 20EC308 Digital System Design Lab

0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs					
		PO1	PO2	PO5	PO9	PSO1	PSO2
20EC308.1	Analyze basic logic gates and simplify complex logical expression to implement efficient gate-level circuits	1	1	2	3	2	2
20EC308.2	Design and test combinational logic blocks such as adders, subtractors, deCoders, multiplexers, Code converters, and comparators	1	1	2	3	2	2
20EC308.3	Implement ,verify, and analyze sequential circuits such as counters and registers	1	1	2	3	2	2
20EC308.4	Implement sequential logic using FSM design methodologies for both Melay and Moore machines	1	1	2	3	2	2
20EC308.5	Integrate multiple functional blocks into a cohesive digital system and apply systematic troubleshooting methods to diagnose and correct errors	1	1	2	3	2	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Design of Logic Gates
2. Design of Adders and Sub-tractor
3. Design of Binary to Gray and Gray to Binary
4. Design of 3 to 8 Decoder
5. Design of 4-bit Comparator
6. Design of 4-bit multiplier
7. Design of 8 x 1 Multiplexer
8. Design of Decade counter
9. Design of 4-bit Ring and John Son Counter
10. Design of Universal shift registers
11. Design of Mealy and Moore machine

References

1. Lab Manual for Digital System Design Lab, Department of Electronics and Communication Engineering, NSRIT

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PC 20EE507 Power Electronics Lab

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Code	Course Outcomes	Mapping with POs				
		PO1	PO4	PO12	PSO1	PSO2
20EE507.1	Study the characteristics of various power electronic devices.	3	3	1	1	2
20EE507.2	Analyze the performance of single-phase and three-phase full-wave bridge converters with both resistive and inductive loads.	2	3	1	2	1
20EE507.3	Determine the operation of single-phase AC voltage regulator with resistive and inductive loads	2	3	1	2	2
20EE507.4	Evaluate the working of Buck converter, Boost converter	2	3	1	1	2
20EE507.5	Examine the working of single-phase square wave inverter and PWM inverter	1	3	1	2	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of experiments

1. Characteristics of Thyristor, MOSFET & IGBT
2. Single -Phase semi converter with R & RL loads.
3. Single -Phase full converter with R & RL loads.
4. Three- Phase full converter with R & RL loads.
5. Single -Phase AC Voltage Regulator with R & RL Loads
6. Single Phase step down Cyclo-converter with R & RL Loads
7. Single Phase dual converter in circulating current & non circulating current mode of operation.
8. Boost converter in Continuous Conduction Mode operation.
9. Buck converter in Continuous Conduction Mode operation.
10. Single -Phase square wave bridge inverter with R & RL Loads.
11. Single - Phase PWM inverter

References

1. Lab Manual for Power Electronics Lab, Department of Electrical and Electronics Engineering, NSRIT.
2. P S Bimbhra, "Power Electronics", 2nd Edition Khanna Publishers, 2021.
3. Norman S Nise, "Control Systems Engineering", 3rd Edition John Wiley and sons, 2018.

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AC Technical Paper Writing

0 0 2 0

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

Course Code	Statement	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2
C306.1	Develop searching latest relevant literature pertaining to the topic of interest	2	1	-	2	3	-	-	-	-	2	-	2	2	1
C306.2	Develop self-learning ability to become a lifelong independent learner	2	1	-	2	3	-	-	-	-	2	-	2	2	1
C306.3	Develop the habit of writing technical manuscript as per the requirement	2	1	-	2	3	-	-	-	-	2	-	2	2	1
C306.4	Develop presentation skills and speak with appropriate technical phrases	2	1	-	2	3	-	-	-	-	2	-	2	2	1
C306.5	Explore the research topics and develop research interests	2	1	-	2	3	-	-	-	-	2	-	2	2	1
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes															

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MC 20MCX03 Intellectual Property Rights and Patents

2 0 0 0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20MCX03.1	Acquire knowledge on intellectual property rights	-	-	L1,L2
20MCX03.2	Know about the acquisition of trademarks.	-	-	L1,L2
20MCX03.3	Identify the importance of copyrights,patents and Transfer of Ownership.	-	-	L1, L2
20MCX03.4	Reciprocate to new developments of intellectual property rights	-	-	L1, L2
20MCX03.5	International overview of IPR	-	-	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Intellectual property: 4 Hours

Concepts, types of intellectual property,international organizations, agencies and importance of intellectual propertyrights.IndustrialProperty,technologicalResearch,InventionsandInnovations – Important examples of IPR.,IPR in India and Abroad

Unit II: Introduction toTrade Marks: 4 Hours

Purpose and function of trademarks, acquisition of trade markrights,selecting and evaluating trademark ,trademark registration processes.Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights 4 Hours

Fundamentals of copy right law,rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyrightregistration, international copyright laws.

Law of patents: Foundation of patent law, patent searching process, ownership rights andtransfer.

Unit IV: Latest development of intellectual property Rights 4 Hours

New developments in trademark law; copy right law, patent law, intellectual property audits. Infringementof IPRs,Enforcement Measures,Emerging issues–

Unit V:Enforcement Of IPRs 4 Hours

International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law.

Text Books

1. Intellectualpropertyright,Deborah,E. Bouchoux,cengagelearning.
2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli,TataMcGraw Hill PublishingCompanyLtd.
3. Cornish,WilliamRodolph&Llewelyn,David.Intellectualproperty:patents,copyright,trademarks andallied rights. Sweet& Maxwell,8/e,2013.

Reference Books

1. Cornish, William Rodolph. Cases and materials on intellectual property. Sweet & Maxwell, 5/e, 2006.
2. Lo, Jack and Pressman, David. How to make patent drawings: a patent it yourself companion. Nolo, 5/e 2007.

Web References

1. <https://www.investopedia.com/terms/i/intellectualproperty.asp>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/>
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment	Internal Assessment #2
	#1 (%)	(%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfer of trade marks.

L2: Understand

1. Explain the role trade secrets in company law.
2. Explain the concept ownership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copy right registration.

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IN Summer Internship #1

0 0 0 1.5

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

Course Code	Statement	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O1	PS O2
C308.1	Demonstrate the theoretical learning outcomes	2	3	1	3	2	2	1	1	1	2	1	1	1	1
C308.2	Integrate theory and practical during graduation	2	3	1	3	2	2	1	1	1	2	1	1	1	1
C308.3	Comprehend the industry practices in the relevant and allied field of study	2	3	1	3	2	2	1	1	1	2	1	1	1	1
C308.4	Develop communication skills in terms of oral, written, and graphical communications	2	3	1	3	2	2	1	1	1	2	1	1	1	1
C308.5	Develop problem solving skills	2	3	1	3	2	2	1	1	1	2	1	1	1	1
C308.6	Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation	2	3	1	3	2	2	1	1	1	2	1	1	1	1

Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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10 10 10 10 10
10 10 10 10 10

PC 20EC603 Microprocessors and Microcontrollers

3 1 0 3

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

Code	Course Outcomes	Mapping with POs									
		PO 1	P O2	P O 3	P O 4	PO5	PO7	PO 12	PS O1	PSO 2	DoK
20EC603.1	Explain the features and internal architecture of 8086 Microprocessor and the modes of operation.	3	1	3	1	1	1	3	1	2	L1, L2
20EC603.2	Classify different instructions, addressing modes and write assembly programs.	2	1	2	1	1	1	3	1	2	L1, L2, L3
20EC603.3	Design and implement interfacing of basic digital devices like LEDs, switches, and keypads with microprocessors.	3	2	3	1	2	1	3	1	2	L1, L2, L3
20EC603.4	Describe the concepts of 8051 microcontroller's architecture, addressing modes, and interfacing and programs.	2	2	2	1	2	1	3	1	2	L1, L2
20EC603.5	Differentiate the various ARM processor architectures, functions and interfaces	1	2	3	1	1	1	3	1	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Introduction to 8086 Microprocessor

11+1Hours

Basic Microprocessor architecture, with examples, Microprocessor Unit and Microcontroller Unit, Main features, pin diagram/description, 8086 microprocessor family, internal architecture, Bus interfacing unit, Execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configurations *Diode switching times, PN diode clipping circuits.*

Address bus, Databus, ALE, Interrupts

UNIT II: 8086 Programming

11+1Hours

Instruction set, addressing modes, Assembler directives, writing simple programs with an assembler, assembly language program development tools, Program development steps.

Assembler Directives, Instruction set

UNIT III: 8086 Interfacing

11+1 Hours

Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Interfacing, Interrupt priority, Direct Memory Access

UNIT IV: 8051 Microcontrollers

11+1 Hours

Architecture, Signal Description, Input/output ports and circuits, Memory Organization, Counters/Timers, serial Communication, Interrupts. Assembly language programming: Instructions, addressing modes, simple programs.

Interfacing to 8051: Memory (RAM, ROM), Stepper motor interface, Keyboard, LCD Interfacing A/D and D/A Converters.

Counters, Timers, Data Transfer through Serial Communication

UNIT V: ARM Processors

11+1 Hours

ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, functions and Interfaces. Modes of operation and execution, Instruction set summary, System address map, write buffer, bit-banding, processor core register summary, exceptions.

ARM Features, Modes of operation

Textbooks

1. Douglas V. Hall, Rao S. S. S. P., "Microprocessors and Interfacing – Programming and Hardware ", Tata McGraw Hill Education Private Limited, 3rdEdition, 1994
2. Prof Bhurchandi K. M., and Prof Ray A. K., "Advanced Microprocessors and Peripherals: With ARM and an Introduction to Microcontrollers and Interfacing", 3rdEdition, 2010
3. Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontrollers and Embedded systems Using Assembly and C", 2nd Edition, Pearson Publications, 2011
4. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors", 3rdEdition, Newnes, 2013

Reference Books

1. Kenneth J. Ayala, "The 8051 Microcontroller", 4thEdition, Tata McGraw Hill Education Private Limited, 1994
2. Dr. Alexander G. Dean, "Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English", Arm Education Media, 2017

Web Resources

1. https://www.youtube.com/watch?v=GapjO_8Kuk
2. https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.html
3. <https://www.javatpoint.com/8086-microprocessor>
4. <http://www.digimat.in/nptel/courses/video/108105102/L31.html>
5. <https://nptel.ac.in/courses/117/106/117106111/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	40
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Microprocessor
2. Define Bus in Microprocessor
3. What is an Interrupt in Microprocessor?
4. Specify the function of ALE Signal
5. Define Pipeline processing
6. List out any four features of 8086 Microprocessor
7. List out any four features of 8051 Microcontroller
8. Write any four Applications of A/D Converters

L2: Understand

1. Illustrate different operations in Stack
2. Explain the functions of BIU and Execution unit
3. Discuss the addressing modes of 8086 Microprocessor with examples
4. Illustrate different instructions of 8086 Microprocessor
5. Discuss the minimum mode of configuration of 8086 Microprocessor
6. Discuss the memory Segmentation of 8086 Microprocessor
7. Discuss the Register Organization of 8051 Microcontroller
8. Explain Timers and Counters in 8051 Microcontroller

9. Describe the Features of ARM Microprocessors

L3: Apply

1. How to Write simple Assembly level programs?
2. Discuss the procedure of Interfacing A/D Converters to 8086 Microprocessor
3. How to interface stepper motor to 8051 Microcontroller?
4. How to Generate square wave forms using Timer Mode Programming?
5. How to generate quarter second delay in 8051 Microcontroller?

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PC 20EE602 Electrical Measurements and Instrumentation 3 0 0 3.0

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

Code	Course Outcomes	Mapping with PO's				DoK
		PO 1	PO 2	PO12	PSO 1	
20EE602.1	Understand the construction and working principle of various analog meters	3	2	1	1	L1 - L2
20EE602.2	Illustrate the working of different meters for measurement of Power and Power Factor	3	2	1	2	L1 - L2
20EE602.3	Calculate the values of unknown resistance, inductance and capacitance using bridge	2	3	1	1	L1 - L3
20EE602.4	Demonstrate the working of different Transducers	2	1	2	1	L1 - L2
20EE602.5	Understand the construction and working principle of various analogy meters	3	2	2	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Measuring Instruments

12 Hours

Classification of measuring instruments, Ammeters and Voltmeters – Basics, range extensions, PMMC Moving Iron type instruments – expression for the deflecting torque and control torque – errors and compensations, extension of instrument range, Current Transformer construction, theory, ratio and phase angle errors

Potential Transformer construction, theory, ratio and phase angle errors.

Unit II: Analog Wattmeters and Power Factor Meters

12 Hours

Electrodynamometer type wattmeter (LPF and UPF), Power factor meters: Dynamometer and M.I type (Single phase and Three phase), construction, theory, torque equation, advantages and disadvantages -Numerical Problems.

Construction, theory, torque equation of M.C. type

Unit III: DC and AC Bridges

12 Hours

Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge, Kelvin's double bridge, Megger – measurement of earth resistance - Numerical Problems

Measurement of inductance – quality factor, Maxwell's bridge, Anderson's bridge, measurement of capacitance and loss angle, Schering Bridge, Wien's bridge, Measurement of Permittivity, Quality factor- Numerical Problems

Hay's bridge, Desauty's bridge

Unit IV: Transducers

12 Hours

Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers.

Digital shaft encoders, Hall effect sensors

Unit V: Digital Meters

12 Hours

Digital Voltmeter–Successive approximation, ramp and integrating type - Digital frequency meter–Digital multimeter–Digital Tachometer. Digital energy meter, Measurement of phase difference – Frequency.

Hysteresis loop using lissajous patterns in CRO

Text Books

1. A.K.Sawhney, "Electrical & Electronic Measurement & Instruments", 5th Edition, Dhanpat Rai & Co. Publications, 2021

2. R.K.Rajput, "Electrical and Electronic Measurements and instrumentation", 4th Edition, S.Chand, 2015
3. G.N.Srinivas and S. Narasimha, "Electrical and Electronic Measurements and Instrumentation", 2nd Edition, B S Publications, 2018.

Reference Books

1. E.W. Golding and F. C. Widdis, "Electrical Measurements and Measuring Instruments", 5th Edition, Wheeler Publishers, 2012.
2. W.D. Coopers and Helfrick, "Modern Electronic instrumentation and Measurements Techniques", Pearson / Prentice Hall of India P. Ltd.2003

Web References

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. https://www.udemy.com/course/complete-course-in-electrical-measurement-instrumentation/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_Catchall_Ja.EN_cc.IN.DIA&utm_content=deal4584&utm_term=._ag_rp1MsBIToN2H4nODEy1jzOZtQ5UZ5ZUQIPk2MiFYm1ACDEaAtyfEALw_wcB

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the errors usually occur in PMMC instruments?
2. What is the basic principle used in potentiometer?
3. What are the advantages and disadvantages of a Maxwell bridge?
4. Write about spring control of an instrument.
5. How are Instrumental Errors different from gross Errors?

L2: Understand

1. Discuss any 2 essential features of indicating instruments.
2. Explain with the help of a neat sketch the construction and operation of a D'Arsonval galvanometer.
3. Explain the working of Successive - approximation type Digital voltmeter with a neat block diagram.
4. Derive the expression for torque equation of a moving iron instrument.
5. Explain the procedure for measuring a low resistance with the help of kelvin's double bridge.

L3: Apply

1. The four arms of an A.C. bridge network are as follows: Arm AB: an unknown capacitance; Arm BC: a standard capacitor C 3 of 1000pF; Arm CD: a non inductive resistor R4 of 100 in parallel with a capacitor C4 of 0.01μF; Arm DA: a non – inductive resistor R2 of 1000 . The A.C. supply is connected across terminals B, D and the supply frequency is 50 Hz. If the bridge is balanced with the above values, determine the components of the unknown impedance, while deriving the balanced conditions.

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PC 20EE603 Power System Analysis

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

Code	Course Outcomes	Mapping with PO's							DoK
		PO1	PO2	PO3	PO4	PO 12	PSO 1	PSO 2	
20EE603.1	Illustrate the per-unit representation for given power system network	2	2	1	1	1	2	3	L2
20EE603.2	Solve load flow equations using Gauss-Seidel method and Newton-Raphson's method.	2	2	3	2	1	2	3	L2
20EE603.3	Analyze power system stability..	1	2	2	1	1	1	3	L3
20EE603.4	Study the concept of the Z bus building algorithm	2	2	2	2	2	2	3	L2
20EE603.5	Understand the excitation control.	2	2	2	1	1	1	3	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Circuit Topology & Per-unit Representation

12 Hours

Graph theory – definition, Per-unit System representation of a given power system network, Per-unit equivalent reactance diagram Symmetrical fault Analysis: Symmetrical Component Theory: Symmetrical Component Transformation, power in symmetrical components, Sequence Networks. Unsymmetrical Fault Analysis: LG, LL, LLG faults without fault impedance

symmetrical Fault Analysis: LG, LL, LLG faults with fault impedance

Unit II: Power Flow studies

12 Hours

Power flow problem – significance, classification of buses, Formation of Ybus using direct inspection method, Derivation of Static load flow equations, Load flow solutions using Gauss Seidel Method, Acceleration Factor, Newton Raphson Method in Rectangular and Polar Co-ordinates, Comparison of different load flow methods. (Only derivative approach) problems on 3-bus systems only.

Decoupled and Fast decoupled load flow method

Unit III: Power system stability

12 Hours

Elementary Concepts of Steady State, Dynamic and Transient Stabilities - Description of: Steady State Stability Power Limit, Transfer Reactance, Synchronizing Power Coefficient, derivation of swing equation, Power Angle Curve and Determination of Steady State Stability

Methods to Improve Steady State Stability.

Unit IV: Z-Bus Algorithm & Symmetrical Fault Analysis:

12 Hours

Formation of Zbus: Algorithm for the Modification of Zbus Matrix (without mutual impedance).

Symmetrical Fault Analysis: Reactances of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems.

Algorithm for the Modification of Zbus Matrix (with mutual impedance).

Unit V: Excitation voltage and control

12 Hours

Excitation System Control in synchronous generators, Automatic Voltage Regulators. Series and Shunt Compensators.

Facts devices

Text Books

1. C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 7th Edition, 2017.
2. P.Kundur, "Power System Stability and Control", McGraw Hill Inc, 2nd Edition, 2005
3. Allen J Wood, Bruce F Wollenberg, Gerald B Sheble, "Power Generation, Operation and Control", Wiley India, 3rd Edition, 2013.
4. John J Grainger, William D Stevenson Jr. "Power system analysis" Tata McGraw-Hill, 2th Edition, 2012.(Unit-I,II,III,IV)

Reference Books

1. I.J. Nagrath & D.P. Kothari, "Modern Power System Analysis", Tata McGraw-Hill, 4th Edition, 2013.
2. M. A. Pai "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company, 2nd Edition, 2006.

Web References

1. <https://www.youtube.com/watch?v=tb3gCr9m0LU&list=PLtcRclUOKppXWUMEVXGwwULXgzEBygOK->
2. https://www.youtube.com/watch?v=fBm1dr_gRBk&list=PL36A60B630E8C7B56

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the disadvantages of per unit quantities?
2. What are the merits and demerits of Gauss-Seidel method?
3. What are the causes for large disturbances in the power system?
4. What are the methods considered for improving steady state stability?
5. What is the need of slack bus?

L2: Understand

1. How the Zbus is modified when a new branch Zb is added from a new bus P to reference bus 'O'.
2. How do you get the short circuit MVA from per unit impedance?
3. Explain the sequence networks of three phase transformer..
4. Explain the selection of reactors.
5. Describe the latest methods for improving the transient stability

L3: Apply

1. Determine the ZBus using building algorithm for a power system whose element data is given in the following table: Element No. Connected between bus Nos. Self reactance (p.u)
- | Ele.no. | busno. | Self reactance(p.u) |
|---------|--------|---------------------|
| 1 | 1-2 | 0.3 |

2	1-3	0.1
3	2-3	0.2
4	1-2	0.1

2. A transformer rated at 75 MVA and having a short circuit reactance of 0.02 p.u is connected to the bus bar of a generating station which is supplied through two 12.6 kV feeders each having an impedance of $(1.5+j 4) \Omega$. One of the feeder is connected to the generating station using generator capacity of 50 MVA connected to its bus bars having a short circuit reactance of 0.2 p.u and other feeder to a generator with 25MVA and having a reactance of 0.35 p.u. Calculate the MVA supplied to the fault in the event of a short circuit occurring between the secondary terminals of the transformer.

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PE 20EE006 Solid State Electric Drives

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

Code	Course Outcomes	Mapping with PO's						DoK
		PO 1	PO 2	PO 3	PO 12	PSO1	PSO2	
20EE006.1	Understand the fundamentals of electric drive	3	2	1	1	2	2	L1 - L2
20EE006.2	Outline the operation of controlled converter dc motors and four quadrant operation of dc motors using dual converters.	2	2	1	1	3	1	L1 – L3
20EE006.3	Apply speed control technique using AC voltage controllers and voltage source inverters for an induction motor.	3	2	2	1	2	2	L1 – L2
20EE006.4	Analyze the speed control of an induction motor by using various slip power recovery schemes.	2	2	3	1	2	1	L1 - L2
20EE006.5	Analyze the speed control mechanism of synchronous motors	2	1	3	1	1	1	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Fundamentals of Electric Drives

12 Hours

Electric drive – Block diagram of electric drive- Dynamics of electric Drive - Equivalent Drive Parameters– Load torque components — Steady state stability – Load equalization.

Nature and classification of load torques Active load and passive loads

Unit II: Multi Quadrant & Dual converter operation of DC drives

Four quadrant operation of drive (hoist control) -Braking methods: Dynamic braking – Plugging braking methods. Principle of operation of 1-phase half and fully controlled converter fed DC motor drive- Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

Regenerative braking method

Unit III: Control of DC Motor Drives

12 Hours

1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics.

Single quadrant – Two quadrant and four quadrant chopper fed separately excited and series excited motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics

Four quadrant operations

Unit IV: Stator side control of 3-phase Induction motor Drive:

12 Hours

Stator voltage control using 3-phase AC voltage regulators – Waveforms– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

–Speed torque characteristics of 3-phase Induction motor

Unit V: Rotor side control of 3-phase Induction motor Drive

12 Hours

Rotor side control of 3-phase Induction motor Drive - Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

- Introduction to permanent magnet synchronous motors - principal of operatin and types of Control techniques of PMSM –block diagram of Cloased loop control of PMSM Drive.

Advantages –Applications of Slip power recovery schemes

Text Books

1. Fundamentals of Electric Drives – by G K Dubey Narosa Publications
2. Power Semiconductor Drives, by S.B. Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.
3. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

Reference Books

1. Electric Motors and Drives Fundamentals, Types and Applications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H. Rashid, PHI.

Web References

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. https://www.youtube.com/watch?v=g8l3Ckx4AlQ&list=PLQLdKyBqWCjpHeitTB8UlkuYsmhbRnb2V&ab_chann el=ElectricalandElectronicsEngineering

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the converters used for the speed control of induction motor below the rated frequency?
2. What are the disadvantages of rotor resistance control?
3. Draw the schematic diagram of two quadrant chopper
4. How the variable frequency control is used for synchronous motor speed control?

L2: Understand

1. Explain the different types of load torques and enlist different motors to suit these torques.
2. Explain the operation of a dc series motor supplied from single phase full converter with free-wheeling diode.
3. Describe type-D chopper fed two-quadrant drive operation with necessary equivalent circuits and waveforms.
4. Describe the closed loop self control of synchronous motor with VSI.

L3: Apply

1. A three phase, 440 V, 4-pole 50 Hz induction motor is driving a constant torque load of 80 Nm. The parameters of the motor are: $r_1 = 0.4 \Omega$, $r_2 = 0.1 \Omega$, $x_{eq} = 4 \Omega$ and $N_1/N_2 = 2$. Calculate the magnitude of the injected voltage that would reduce the motor speed to 1000 rpm. Also calculate the power received by the source of the injected voltage.
2. A three phase, 480 V, 4-pole 60 Hz Y-connected induction motor has inductive reactance of 4Ω and stator resistance of 0.6Ω , the rotor resistance referred to stator is 0.8Ω . The motor is driving constant load torque of 60 Nm at a speed of 3500 rpm. Calculate motor speed and starting current if the frequency is reduced to 50 Hz

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PE 20EE007 Advanced Control Systems**3 0 0 3**

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

Code	Course Outcomes	Mapping with Po's		DoK
		PO3	PSO1	
20ESX03.1	State space representation of control system and formulation of different state models are reviewed.	-	3	L1 – L3
20ESX03.2	Understand the design of control system using the pole placement technique.	-	3	L1 – L3
20ESX03.3	Analyze nonlinear systems using the describing function technique	2	1	L1 - L3
20ESX03.4	Understand the stability analysis using phase plane analysis.	3	1	L1 – L3
20ESX03.5	Understand the stability analysis using Lyapunov method.	3	3	L1 – L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: State space analysis**12 Hours**

State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Jordan Canonical Form.

The concept of state – State Equations for Dynamic systems

Unit II: Controllability, observability and design of pole placement**12 Hours**

Controllability, observability and design of pole placement

Tests for controllability and observability for continuous time systems – Time varying case –Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

Controllable Companion Form, Observable Companion Form (For Siso and MIMO Systems)

Unit III: Non-Linear Systems**12 Hours**

Introduction – Non-Linear Systems – Types of Non – Linearities – Saturation – Dead Zone – Backlash – Jump Phenomenon etc; - Singular Points – Introduction to Linearization of nonlinear systems, properties of Non-Linear Systems – Describing function – describing function analysis of nonlinear systems.

Applications of frequency response analysis, transfer function

Unit IV: Stability of Non-Linear Systems**12 Hours**

Stability analysis of Non-Linear systems through describing functions Introduction to phase – plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.

Graphical Representation of Stability, Optimum Switching Curve and applications

Unit V: Stability Analysis**12 Hours**

Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems – Stability Analysis of the Linear Continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasovskii's method.

Asymptotic Stability and Instability; Sign-Definiteness of Scalar Function

Textbooks

1. Nagarath I.J. and .Gopal M, "Control Systems Engineering", 2nd Edition, New age International Publications,2018.
2. Benjamin C.Kuo, "Automatic control systems", 8th Edition, John Wiley and sons, 2014.
3. Norman S Nise, "Control Systems Engineering", 3rd Edition, John Wiley and sons, 2018.

Reference Books

1. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd. , 2015.
2. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.

Web References

1. https://www.youtube.com/watch?v=W2jzxNeEAPU&list=PLooDK0dmOTDb-9czkkO_b13evBJqE9BaL
2. <https://www.youtube.com/watch?v=bbm79UcNN0&list=PLbMVogVj5nJTNkhtkCEKQHhPOR2bpS3za>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Define state
2. Define state variable
3. Define controllability
4. Define observability
5. What is saturation?

L2: Understand

1. Explain the concept of state? Write the observable canonical form?
2. Describe the controllability tests for continuous time systems.
3. State and explain the Lyapunov's instability theorem

L3: Apply

1. Convert the following state model into the Jordan canonical form and there from comment on controllability and observability

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -4 & -3 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & 1 \end{bmatrix} u(t), \quad y(t) = \begin{bmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \end{bmatrix} x(t)$$

2. Draw a phase plane portrait of the following system

$$\ddot{\theta} + \dot{\theta} + \sin\theta = 0.$$

3. Find a Lyapunov's function for the following system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

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PE 20EE008 Reactive Power Compensation and Management**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO3	PSO 1	
20EE008.1	Understand objectives specifications of load compensation	2	1	L1 - L2
20EE008.2	Understand steady state reactive power compensation in transmission system	2	1	L1 - L2
20EE008.3	Understand reactive power coordination	2	1	L1 - L2
20EE008.4	Understand importance of user reactive power management	2	1	L1 - L2
20EE008.5	Understand power management in electric traction systems and arc furnaces	2	1	L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Load Compensation**12 Hours**

Objectives and specification: Reactive power characteristics, inductive and capacitive approximate biasing, load compensator as a voltage regulator, phase balancing and power factor correction of unsymmetrical loads examples.

Reactive power, Voltage regulator, power factor

Unit II: Steadystate Reactive Power Compensation In Transmission System**12 Hours**

Uncompensated line: Types of compensation, passive shunt and series and dynamic shunt compensation, examples
transient state reactive power compensation in transmission systems: Characteristic time periods, passive shunt compensation, static compensations, series capacitor compensation, compensation using synchronous condensers, examples.

Types of compensation, Synchronous condensers

Unit III: Reactive Power Coordination**12 Hours**

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady -state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences

Quality of power supply, Harmonics.

Unit IV: User Side Reactive Power Management**12 Hours**

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations

KVAR, Basics of capacitors.

Unit V: Reactive Power Management in electric traction systems and arc furnaces**12 Hours**

Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace.

Traction systems, Arc furnace.

Text Books

1. D M Tagare, "Reactive power Management", 1st Edition, Tata McGraw Hill, , 2004
2. TJE Miller, "Reactive power control in Electric power systems", 1st Edition, Wiely Publication, 1982.

Reference Books

1. Wolfgang Hofmann, Jurgen Schlabach, Wolfgang Just "Reactive Power Compensation: A Practical Guide", Wiely publication, 4th Edition, 2012.

Web References

1. <https://www.accessscience.com/content/reactive-power-compensation-technologies/YB084380>
2. <http://een.iust.ac.ir/profs/Arabkhabouri/Electrical%20Drives/Books/>
3. <https://ktu.edu.in/eu/at/attachments.htm?download=file&id=156232>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	60
L2	50	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. what are different methods of load shaping
2. Define reactive power control?
3. What are the different Types of compensation?
4. State shunt compensation?
5. What are the objectives of reactive power planning

L2: Understand

1. Describe Reactive Power Management
2. Draw the reactive power characteristics and also explain with neat figures and circuit diagrams
3. Discuss how Reactive Power Management or Planning is found by means of mathematical modelling
4. How power factor correction and voltage regulation can be achieved by means of compensation
5. Discuss how a Load Compensator works as a voltage regulator

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PE 20EE009 Basic Industrial Automation**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO3	PSO 1	
20EE009.1	Understand different types of amplifiers and their characteristics	2	3	2	L1,L2
20EE009.2	Analyzing the performance of Electronic Controlled DC motors	2	3	2	L4
20EE009.3	Distinguish between various types of Industrial Heating methods	2	3	2	L4
20EE009.4	Illustrate the understanding of various industrial timing circuits	3	3	2	L1,L2
20EE009.5	Understand PLC functions to timing and counting applications	3	3	2	L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Analysis And Design of Small Signal Low Frequency BJT Amplifiers **12 hours**

Review of transistor biasing, Classification of Amplifiers – Distortion in amplifiers, Analysis of CE, CC, and CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Design of single stage RC coupled amplifier Different coupling schemes used in amplifiers, Analysis of Cascaded RC Coupled amplifiers,.

*Cascode amplifier, Darlington pair***Unit II: Regulators For Voltage And Motor Speed** **12 hours**

Voltage compensator – Solid state DC voltage regulation – DC shunt motor – Armature control and field control of motor speed – Electronic control of DC motor – Speed regulator action – Full wave motor speed regulation by one SCR.

*Switched Mode voltage regulator***Unit III: Industrial Heating** **12 hours**

Induction heating – Principles- Theory – Merits – Applications – High frequency power source for induction heating, Dielectric heating –Theory – Electrodes used in dielectric heating – Method of coupling of electrodes to RF generator – Thermal losses in dielectric heating.

*Electrical Heating***Unit IV: Industrial Timing Circuits** **12 hours**

Constituents of industrial timing circuits – Timers – Classification of timers – Thermal timers –Electromechanical timers – Electronic timers – Classification of electronic timers – Digital timing element –Digital counters – SCR delay timer – IC electronic timer

*Fridge Timer***Unit V: Programmable Logic Controllers** **12 hours**

Number system and codes – Basics of PLC programming – Timer and counter instructions – Data manipulation instructions.

Shift register and sequence instructions

Text Books

1. Frank D. Petruzella, Industrial Electronics , McGraw Hill International Editions, 1996.
2. G.K. Mithal, Ravi Mithal, Industrial Electronics, Khanna Publishers, Delhi, 1995
3. Gopal. K. Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, 28th edition, 2011.

Reference Books

1. M. H. Rashid, " Power Electronics: Circuits, Devices and Applications" , Prentice Hall of India 3rd Edition, 2014.
2. Ned Mohan, Tore M. Undeland, " Power Electronics – Converters, Applications and Design ",Wiley India Edition, 3rd Edition, 2012.
3. Biswanath Paul " Industrial Electronics and Control " by PHI publications, 3rd Edition, 2014.
4. John W. Webb & Ronald A.Reiss," Programmable Logic Controllers-Principles and Applications ", 5th Edition, PHI, 2009.

Web References

1. <https://nptel.ac.in/courses/108/108/108108077/>
2. <https://www.youtube.com/watch?v=ViIOMXnoEC0&t=10s>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	45
L2	30	45
L4	40	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Explain VI characteristics of SCR.
2. Explain about triggering of TRIAC in different modes.
3. Write about the 3-terminal IC voltage regulators

L2: Understand

1. Discuss the principle and operation of ARC welding with neat sketch.
2. Draw the circuit diagram and waveforms of input current and output voltage of a single phase full wave ac voltage controller with resistive load.
3. Understanding the behaviour, turn on and turn off methods of SCR

L4: Analyze

1. Evaluate the characteristics of TRIAC circuit.
2. Evaluate the speed regulation of motor by SCR.
3. Classify the different types Industrial Timing Circuits

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PE 20EE010 Process Instrumentation**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO3	
20EE010.1	Understand the instrumentation for heat exchangers and dryers	3	1	2	L1-L2
20EE010.2	Explain instrumentation for evaporators & crystallizer	3	1	2	L1-L2
20EE010.3	Examine the instrumentation for distillation columns.	3	1	2	L1-L2
20EE010.4	Analyze the operation of Boiler Instrumentation	3	1	2	L1-L2
20EE010.5	Describe the instrumentation for pumps and compressors.	3	1	2	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Instrumentation for heat exchangers and dryers**12 Hour**

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers. Selection of devices required in instrumentation.

Types and operation of dryers

Unit II: Instrumentation for evaporators & crystallizer**12 Hour**

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, controlled and manipulated variables in crystallizer control problem, instrumentation for control of various types of crystallizers. Selection of devices required in instrumentation.

Types and operation of crystallizers

Unit III: Instrumentation for distillation columns**12 Hour**

Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, reflux ratio control, pressure control schemes. Material and energy balance of distillation column.

Top and bottom composition control

Unit IV: Boiler Instrumentation**12 Hour**

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, operation and types of reactors, instrumentation for temperature, pressure control in CSTRs. Continuous / regulatory functions related to batch processes.

Air to fuel ratio controls

Unit V: Instrumentation for pumps and compressors**12 Hour**

Types and operation of pumps, manipulated and controlled variables in pump control problem, pump control methods and instrumentation for pump control, capacity control methods of compressors, instrumentation for control of different

variables in centrifugal, rotary and reciprocating compressors including surge and anti-surge control. Methods to increase performance of pump and compressor.

Types and operation of compressors

Textbooks:

1. "Chemical Process Control", Stephanopoulos George, Prentice Hall of India.
2. "Boiler Control System", D. Lindsey, McGraw Hill Publishing Company.

Reference Books:

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine McGraw Hill Publishing company.

Web References:

1. <https://nptel.ac.in/courses/108/105/108105064/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out the types of dryers.
2. List out cascade control strategies for evaporators.
3. Define Feed – forward control.

L2: Understand

1. Explain the pump control methods and instrumentation for pump control.
2. Discuss about the cascade control strategies for evaporators.
3. Describe the Operation of distillation column.

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OE 20EEO02 Electrical Safety and Management**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO3	PSO 1	
20EEO02.1	Understand the Indian electricity rules and their significance	2	1	L1, L2
20EEO02.2	Explain the safety standard in residential, commercial, and agricultural	2	1	L1, L2
20EEO02.3	Learn about electrical safety installation, testing and commission	2	1	L1, L2
20EEO02.4	Understand about electrical safety in distribution system	2	1	L1, L2
20EEO02.5	Explain flash-overs and corona discharge	2	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Indian Electricity Regulations and Acts and their Significance**12 Hours**

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act 2003 (Part 1, 2, 3, 4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations**12 Hours**

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance**12 Hours**

Preliminary preparations – safe sequence – risk of plant and equipment – safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas**12 Hours**

Hazardous zones – class 0, 1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention**12 Hours**

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

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1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/>
3. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	40
L2	70	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.

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PC 20EC606 Microprocessors and Microcontrollers Lab

0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs						PSO2
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 9	
20EC606.1	Develop assembly language programs to perform arithmetic, logical operations, string operations using TASM and 8086 Microprocessor boards	3	1	2	3	3	2	2
20EC606.2	Design interfacing circuits using 8086 Microprocessor	2	1	2	2	3	3	2
20EC606.3	Construct different waveforms using 8086 Microprocessor and 8051 Microcontroller	3	1	2	3	3	3	2
20EC606.4	Develop and implement assembly language programs to perform real time interfacing using 8051Microcontrollers	3	1	2	3	3	3	2
20EC606.5	Implement assembly language programs to perform arithmetic operations using ARM Processors	3	1	2	3	3	3	2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Programs for 16 -bit arithmetic operations using 8086 programs
2. Perform BCD Addition
3. Write an assembly program for finding factorial of a given number
4. Program for sorting anarray
5. Interfacing ADC to 8086
6. Interfacing DAC to8086
7. Interfacing stepper motor to8086
8. Finding number of 1's and number of 0's in a given 8-bit number
9. Program to find Average of n-numbers
10. Interfacing Traffic Light Controller to8051
11. Timer Mode Programming
12. Write an assembly program to multiply of 2 16-bit binarynumbers
13. Write an assembly program to find the sum of first 10 integersnumbers
14. Write a program to toggle LED every second using timerinterrupt

References

1. Lab Manual for Microprocessors and Microcontrollers of Electronics and Communication Engineering, NSRIT

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PC 20EE607 Electrical Measurements and Instrumentation Lab 0 0 3 1.5

Code	Course Outcomes	Mapping with POs					
		PO1	PO4	PO5	PO12	PSO1	PSO2
20EE607.1	Understand various measurement techniques used in electrical engineering	3	3	1	1	2	1
20EE607.2	Determine the calibration of DC and AC Potentiometers.	3	3	1	1	1	1
20EE607.3	Demonstrate the use of sensors and transducers in electrical and nonelectrical measurements.	3	3	1	1	2	1
20EE607.4	Apply knowledge of virtual instruments in measurement of analysis of electrical parameters	3	3	1	1	2	1
20EE607.5	Understand and the characteristics of Thermo couples, LVDT.	3	3	1	1	2	1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective PO's

List of experiments

1. Calibration of dynamometer wattmeter using phantom loading.
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter.
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance.
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
8. Thermocouple – characteristics.
9. LVDT – characteristics.
10. Capacitive transducers characteristics.
11. Piezoelectric transducer characteristics.

References

1. Lab Manual for Control Systems Lab, Department of Electrical and Electronics Engineering, NSRIT
2. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002.
3. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.

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SC 20EES04 P-SPICE

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

Code	Course Outcomes	Mapping with POs						
		PO1	PO4	PO5	PO10	PO12	PSO1	PSO2
20EES04.1	Understand the P-SPICE software	3	3	3	2	2	3	3
20EES04.2	Design the circuits for various types of loads	3	3	3	2	2	3	3
20EES04.3	Demonstrate the control of AC voltage using a voltage controller.	3	3	3	2	2	3	3
20EES04.4	Demonstrate the working of Buck and Boost converter	3	3	3	2	2	3	3
20EES04.5	Understand the working of single-phase inverter	3	3	3	2	2	3	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Po's

List of Experiments

1. Introduction to PSPICE software
2. PSPICE Simulation of Series RLC Circuits for Step, Pulse & Sinusoidal Inputs
3. Study VI characteristics of a diode using PSPICE
4. PSPICE Analysis of Single-Phase Full Converter with RL & RLE Loads
5. Single phase AC voltage controller using RL loads
6. PSPICE Simulation of Integrator
7. PSPICE Simulation of Differentiator
8. Introduction to PSPICE modelling
9. Simulation of Boost Converters
10. Simulation of Buck Converters
11. Single Phase Inverter with PWM Control

Text Books

1. Susan A. Riedel, James W. Nilsson, "Introduction to PSpice for Electric Circuits", 6th Edition, Pearson, 2007
2. Franz J. Monssen, "OrCAD PSpice with Circuit Analysis", 4th Edition, Pearson, 2000.

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MCQ 20MCX04 Indian Traditional Knowledge

2 0 0 0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	PO7	PO12	
20MCX04.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX04.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX04.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX04.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX04.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT 1: Introduction to traditional knowledge

6 hours

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT 2: Protection of traditional knowledge

6 hours

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT 3: Legal framework and TK

6 hours

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT 4: Traditional knowledge and intellectual property

6 hours

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT 5: Traditional Knowledge in Different Sectors

6 hours

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Amit Jha, "Traditional Knowledge System in India", 2009.

Reference Books:

1. Amit Jha, "Traditional Knowledge System in India", 2002
2. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", CBSE, 2012

Web Links:

1. <https://www.youtube.com/watch?v=LZP1StpYEPM>
2. <http://nptel.ac.in/courses/121106003/>

OE 20CEO01 Urban Environment and Health

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO01.1	Identify urban – health relationships		L1, L2
20CEO01.2	Demonstrates the connection between urban built form and health outcomes		L1, L2
20CEO01.3	Discuss the distribution of health risks of urban transportation grid		L1, L2
20CEO01.4	Assess and plan for community needs in health-care infrastructure		L1, L2
20CEO01.5	Identify preliminary opportunities for advancing urban health outcomes		L1, L2

1: Weakly Contributing | 2: Moderately Contributing | 3: Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning

9 Hours

Introduction: The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health

9 Hours

Renewing the Health-Urban Link, the Urban Form, the Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems

9 Hours

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrians Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services

9 Hours

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behavior, Access and Mortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities

9 Hours

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Palaki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" *Frontiers in Ecology and the Environment*, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

Web References

1. <https://www.oecd.org/health/health-systems/32006565.pdf>
2. <https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. How is natural environment different from urban environment?
 2. How does the urban environment affect health and well-being?
 3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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OE 20CSO01 Data Structures and Algorithms 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Data Structures & Algorithms

9 hours

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions. Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists

9 hours

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List. Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue

9 hours

Unit III: Trees and Graphs

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I

9 hours

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II

9 hours

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis , "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

Web References

1. <https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/>
2. <https://www.geeksforgeeks.org/data-structures/>
3. <https://www.programiz.com/dsa>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures


L2: Understand

1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion

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Board of Studies (CSE)

OE 20AIO01 Machine Learning for Engineers

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learning's		L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms		L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to learning

9 hours

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

Examples of regression

Unit II: Linear Models

9 hours

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models

9 hours

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models

9 hours

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic Algorithms – Genetic Offspring: – Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models

9 hours

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

Tracking Methods

Text Books

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014

3. Ethem Alpaydm, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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Sr. Inv. Vis. Prof. Dr. M. Ramani

0E 20DSO01 Introduction to Database Management Systems**3 0 0 3**

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

Code	Course Outcomes	Mapping withPos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models	L1,L2	
20DSO01.2	Apply Constrains on relations	L2,L2,L3	
20DSO01.3	Apply SQL commands on relations	L1,L3	
20DSO01.4	Understand PL/SQL operations	L1,L2,L3	
20DSO01.5	Understand the principles of database normalization and Transaction management system.	L1,L2	

1 Weakly Contributing | 2 Moderately Contributing | 3 Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction to Databases**9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

*History of DBMS***Unit II: Relational Model, Relational Algebra and Relational calculus****9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

*Expressive Power of Algebra and Calculus***Unit III: Structured Query Language****9 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL, Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

*Compare all Database Languages***Unit IV: Schema Refinement and Normalization****9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

*Compare all Normal Forms***Unit V: Normalization****9 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5N.

Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

Concurrency Control without Locking

Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date C.J, Kannan A. Swamynathan S, "An Introduction to Database Systems", 6th Edition, Pearson Education, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition Pearson Education, 2013

Web References

1. <https://www.javatpoint.com/dbms-tutorial>
2. <https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
(1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A → B, BC → E, and ED → A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchid, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializability concept

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OE 20ECO01 Architectures and Algorithms of IoT

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT		L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Event analysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Things and its Architecture		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing. for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: The IoT Landscape

09 Hours

What is IoT?, Applications, Architectures, Wireless Networks, Devices, Security and Privacy, Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures

09 Hours

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetry Transport (MQTT)

Unit III: IoT Devices

09 Hours

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption.

Platform Design

Unit IV: Event-Driven System Analysis

09 Hours

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things

09 Hours

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", Universities Press, 2015

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Data bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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Chairman
Board of Studies (ECE)

OE 20MEO01 Nano Technology

3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20MEO01.1	Describe the fundamental science of nano materials		L2
20MEO01.2	Demonstrate the preparation of nano materials		L1,L2
20MEO01.3	Explain of the challenges on safe nano technology		L1,L2
20MEO01.4	Develop knowledge in characteristic nano material		L1,L2,L3
20MEO01.5	Apply Nano science for industrial applications		L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction

09 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

Introduction to properties and motivation for study (qualitative only)

Unit II: General Methods Of Preparation

09 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOCVD

Unit III: Nano materials

09 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO₂, MgO, ZrO₂, NiO, nanoalumina, CaO, AgTiO₂, Ferrites, Nanoclays- functionalization and applications-Quantum wires.

Quantum dots-preparation, properties and applications

Unit IV: Characterization Techniques

09 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

SIMS-Nano-indentation

Unit V: Applications

09 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobe in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS:

1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley- VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Edition, Springer Publications.2013
4. Louis Homyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1st Edition, Tailor Francis CRC Press,2008

REFERENCE BOOKS:

1. Timp G, 'Nanotechnology', AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, 'The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations'.Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1. <http://www.nano.gov>
2. <http://mrsec.wisc.edu/edetc/IPSE/links.html>
3. <http://nptel.ac.in/courses/112105182/9>
4. IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	20
L2	60	40
L3		40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What is Nano technology?
2. How does Nano Technology Works?
3. What are Nano Materials?
4. Who is Developing Nano technology?

L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Nol Developing Nanotech (In Health Care, Environmental Protection, And Economic Development)?

L 3: Applying

1. How are safety tests carried out in nano tech?
2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?
3. Discuss about targeted drug delivery using nanoparticles.

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OE 20CE002 Ecology, Environment and Resource Management

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CE002.1	Discuss the role that humans play in affecting the characteristics of the environment		L1, L2
20CE002.2	Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments		L1, L2
20CE002.3	Distinguish between economic growth and economic development and outline the nature of a sustainable economy		L1, L2
20CE002.4	Identify the environmental attributes to be considered for the EIA study		L1, L2
20CE002.5	Develop a thorough understanding of Environmental Policies and legislations practiced in India		L1, L2

1: Weekly Contributing | 2: Moderately Contributing | 3: Strongly Contributing for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction

9 Hours

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structure and Function, Flow of material, Ecological Succession, Tropic levels, Food chain, Food web, Ecological pyramids.

Adaptation, Environmental Zones

Unit II: Ecosystem and its relevance to Environment

9 Hours

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

Energy Conservation

Unit III: Resource Management and Sustainable Development

9 Hours

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

Planning for environmentally sensitive areas

Unit IV: Environmental Impact Assessment

9 Hours

Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

EIA Case Studies

Unit V: Environmental Policies and Legislations in India

9 Hours

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India - Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

Five year plans in relation to environmental aspects

Text Books

1. Erach Bhanucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van Nostrand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. <http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf>
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is Ecology?
 2. List any three ways in which humans directly influence environmental conditions
 3. What is the goal of sustainable development?
 4. List the three sequential phases of EIA
 5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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 Sr. Assistant Professor
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 Chairman
 Board of Studies

OE 20CSO02 Designing the Internet of Things**3 0 0 3.0**

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO02.1	Illustrate the IoT in different contexts		L1, L2
20CSO02.2	Outline the Design Principles for Connected Devices		L1, L2
20CSO02.3	Explain the Internet Principles & Application Layer Protocols		L1, L2
20CSO02.4	Apply the Prototyping concepts in IoT		L1, L2
20CSO02.5	Analyse the Prototyping Embedded Devices		L1, L2

1 Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1 Remember | L2: Understand | L3: Apply | L4 Analyze | L5 Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Overview of Internet of Things**9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

*Applications of IoT***Unit II: : Design Principles for Connected Devices****9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

*Examples of Connected Devices***Unit III: : Internet Principles****9 hours**

Internet Communications-IP, TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

*HTTPS: Encrypted HTTP***Unit IV: Thinking About Prototyping****9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

*Embedded Platforms***Unit V: Prototyping Embedded Devices****9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

*Arduino Components***Textbooks**

1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Eloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann, 2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. <https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/>
2. <https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything>
3. <https://www.javatpoint.com/iot-internet-of-things>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understanding

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping

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Chairman
Board of Studies (CSE)

OE 20AI002 Fundamentals of Deep Learning

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AI002.1	Describe the fundamental concept of artificial neural networks		L1, L2
20AI002.2	Describe the function of different deep neural networks		L1, L2
20AI002.3	Explain different deep learning algorithms		L1, L2
20AI002.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AI002.5	Choose appropriate deep neural network for given application		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Deep Learning

9 hours

Basics: Biological Neuron, Idea of computational units, McCulloch– Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

Unit 2: Feedforward Networks

9 hours

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

Unit 3: Convolution Networks

9 hours

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

Unit 4: Recurrent Neural Networks

9 hours

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

Unit 5: Applications of Deep Neural Networks

9 hours

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books

1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

1. <https://www.coursera.org/specializations/deep-learning>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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Board of Studies (BOS)

OE 20DSO02 Introduction to Data Science

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20DSO02.1	Understand Fundamentals of Data Science Terminology.		L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.		L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK Depth of Knowledge

Unit I: Introduction to Data Science**9 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the ThreeVs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

Unit II: Computing for Data Science - 1**9 Hours**

Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

Unit III: Computing for Data Science - 2**9 Hours**

Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

Unit IV Machine Learning, Probability and Statistical Modelling**9 Hours**

Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science**9 Hours**

Data Science in Journalism, Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growth

Text Books

1. Lillian Pierson and Jake Porway, "Data Science For Dummies", 2nd Edition, For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources

1. <https://www.simplilearn.com/tutorials/data-science-tutorial/>
2. <https://www.w3schools.com/datascience/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. What is data science? Identify three areas or domains in which data science is being used
 2. Give three examples of structured data formats
 3. Name three measures of centrality and describe how they differ
 4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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OE 20ECO02 IoT for Smart Grids

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid		L1, L2
20ECO02.2	Explain the Energy Management system functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions	-	L1, L2
20ECO02.4	Explain the Advanced metering infrastructure and AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks for Smart Grid applications		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid

09 Hours

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

Unit II: Energy Management System

09 Hours

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

Unit III: Distribution Management System

09 Hours

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

Unit IV: Smart Meters

09 Hours

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

Unit V: Communication Networks & IoT

09 Hours

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 2012

Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. <https://books.google.co.in/books?isbn=1119969093>
2. <https://books.google.co.in/books?isbn=135123093X>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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OE 20ME002 Fundamentals of Automobile Engineering

3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.		L1, L2
20ME302.2	Classify and identify the steering system		L2, L3
20ME302.3	Classify and identify the Transmission system		L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.		L2, L4
20ME302.5	Identify and Interpret the specifications and safety precautions..		L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction**09 Hours**

Components of four wheeler automobile – chassis and body – power unit – types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – Types – wheels and tyres. Safety Introduction, safety systems – seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

Unit II: TRANSMISSION SYSTEM**09 Hours**

Power transmission – rear wheel drive, front wheel drive, 4 wheel drive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

Unit III: STEERING SYSTEM**09 Hours**

Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering, types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears, – types
steering linkages.

Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM**09 Hours**

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.
BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylinder tandem master cylinder requirement of brake fluid
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism, solenoid switch, lighting systems, horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

pneumatic and vacuum brakes.

Unit V: ENGINE SPECIFICATION AND MAINTENANCE**09 Hours**

Introduction – engine specifications with regard to power, speed, torque, no. of cylinders and arrangement, lubrication and cooling etc. engine service, reboring, decarburization, Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly – precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling – engine modification, exhaust gas treatment – thermal and catalytic converters – use of alternative fuels for emission control

National and International pollution standards.

Text Books

1. AutomotiveMechanics–Vol. 1&Vol. 2/KirpalSingh/standardpublishers
2. AutomobileEngineering/WilliamCrouse/TMHDistributors
3. AutomobileEngineering/P.SGill/S.K.Kataria&Sons/NewDelhi.
4. AutomobileEngineering/CSrinivasan/McGrawHill

Reference Books

1. Automotive EnginesTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr./Pearsoneducationinc.
2. Automotive Engineering/KNewton,W.Steeds&TKGarrett/SAE
3. Automotive Mechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References

1. <https://nptel.ac.in/noc>

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L2	40	30
L3	40	30
L4	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

L2: Understand

1. Describe the Atkinson cycle.
2. Explain the flywheel with neat sketch
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?

L3: Classify

1. Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of 1.5Mpa ,the gas expands according to the process. Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston

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HO 20EEH01 SMART GRID

4 0 0 4

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

Code	Course Outcomes	Mapping with PO's			DoK
		PO1	PO2	PO3	
20EEH01.1	Get acquainted with different smart devices and smart meters	3	1	2	L1-L2
20EE H01.2	Describe how modern power distribution system functions	3	1	2	L1-L2
20EE H01.3	Identify suitable communication networks for Smart Grid applications	3	1	2	L1-L2
20EE H01.4	Identify suitable smart meters for Smart Grid applications	3	1	2	L1-L2
20EE H01.5	Describe basics of Communication Networks & IOT	3	1	2	L1-L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid

12 Hours

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Technology Drivers

Difference between conventional & Smart Grid

Unit II: Energy Management System

12 Hours

Energy Management System (EMS) - Smart substations - Substation Automation - Feeder Automation, SCADA – Remote Terminal Unit – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources – Energy Storage.

Intelligent Electronic Devices

Unit III: Distribution Management System

12 Hours

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Network Reconfiguration, Outage management System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Customer Information System

Unit IV: SMART METERS

12 Hours

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use,

Real Time Pricing, Peak Time Pricing.

Unit V: Communication Networks & IOT

12 Hours

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing,

Cyber Security for Smart Grid.

Textbooks:

1. Stuart Borlase, "Smart Grid: Infrastructure", Technology and Solutions, CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid Technology and Applications", Wiley, 2012.

Reference Books:

1. Mini S. Thomas, John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande, Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014.

Web References:

1. <https://nptel.ac.in/courses/108/107/108107113/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define smart grid concept and explain its necessity.
2. Compare micro grid and smart grid.
3. Compare conventional metering and smart metering.

L2: Understand

1. Explain IED application for monitoring and protection.
2. Explain how the automatic meter reading can make the system smarter.
3. Explain the smart substation.

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HO 20EEH02 Advanced Smart Power Grids

4 0 0 4.0

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO 2	PSO 1	
20EEH02.1	Understand smart grids and analyze the smart grid policies and developments in smart grids.	2	2	L1 - L2
20EEH02.2	Develop concepts of smart grid technologies in hybrid electrical vehicles	2	2	L1 - L2
20EEH02.3	Understand smart substations, feeder automation, GIS.	3	2	L1 - L3
20EEH02.4	Analyze micro grids and distributed generation systems	2	2	L1 - L2
20EEH02.5	Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.	3	2	L1 - L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to Smart Grid

12 Hours

Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid.

Present development & International policies on Smart Grid

Unit II: Smart Grid Technologies Part 1

12 Hours

Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors,

Home & Building Automation, Phase Shifting Transformers.

Unit III: Smart Grid Technologies Part 2

12 Hours

Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage.

Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Unit IV: Micro grids and Distributed Energy Resources

12 Hours

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines.

Captive power plants, Integration of renewable energy sources

Unit V: Power Quality Management in Smart Grid:

12 Hours

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN).

Wide Area Network (WAN).

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 DemandResponse", CRC Press
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010

Reference Books

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akhiko Yokoyama, "Smart Grid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
4. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
5. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving

Web References

1. https://www.google.com/ack?sa=l&ai=DChcSEwi965uQ7-r1AhXEwJYKHJCJDkQYABAAGgJ0bA&ae=2&sig=AOD64_0RNc3a64DXk7r07Vbp47On1IZgCA&q&nis=1&adurl&ved=2ahUKEwjA7pKQ7-r1AhWgsYBHUwNCqAQ0Qx6BAgDEAM
2. https://www.smartgrid.gov/the_smart_grid/smart_grid.html
3. <https://nptel.ac.in/courses/108/107/108107113/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	50	50
L3	10	10
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define smart grid concept
2. Compare micro grid and smart grid.
3. State the issues of interconnecting the micro grid with the utility grid.
4. What is power quality control technologies?
5. How the power quality can be improved in smart grid
- 6.

L2: Understand

1. Explain the role of HAN in smart grid
2. Draw the flow chart of procedure for monitoring power quality and issues of power quality monitoring
3. Explain Bluetooth, Wi-Fi and GPS
4. Explain Wi-Max based communication and wireless mesh network.

L3: Apply

1. Explain the power quality issues in power grid related to renewable energy sources
2. Describe the significance of electromagnetic compatibility in power system with power grid

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Chairman
Board of Studies (EEE)

HO 20EEH03 Electric Power Quality

4 0 0 4

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

Code	Course Outcomes	Mapping with Po's			DoK
		PO1	PO6	PSO1	
20EEH03.1	Differentiate different types of power quality problems.	3	2	1	L1-L2
20EEH03.2	Explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages in a power system.	3	2	1	L1-L2
20EEH03.3	Explain the principle of voltage regulation and power factor improvement methods.	3	2	1	L1-L3
20EEH03.4	Explain the harmonics in a power system.	3	2	1	L1-L2
20EEH03.5	Demonstrate the relationship between distributed generation and power quality.	3	2	1	L1-L2

1 Weakly Contributing | 2 Moderately Contributing | 3 Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction

12 Hours

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long-duration voltage variations –Short-duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

Understanding of transmission lines, Different types of losses and conditions

Unit II: Voltage imperfections in power systems

12 Hours

Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

Causes and Effects of Transient Voltages

Unit III: Voltage Regulation and power factor improvement

12 Hours

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End-user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

Capacitor Banks, Synchronous Condenser, Phase Advancers.

Unit IV: Harmonic distortion and solutions

12 Hours

Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems

The Effects of Harmonics on Power Quality and Energy Efficiency

Unit V: Distributed Generation, Power Quality and Monitoring

12 Hours

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks. Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

various real time monitoring of power quality

Textbooks

1. Dugan R.C., McGranaghan M.F., Santoso S., and Beaty H.W., "Electrical Power Systems Quality", Second Edition, McGraw-Hill, 2012, 3rd edition.
2. Bollen M.H.J., "Electric power quality problems", IEEE series-Wiley India publications,2011.

Reference Books

1. Primer, Kennedy B.W., "Power Quality", First Edition, McGraw-Hill, 2000.
2. Bollen M.H.J., "Understanding Power Quality Problems: Voltage Sags and Interruptions", First Edition, IEEE Press; 2000.
3. Arrillaga J. and Watson N.R., "Power System Harmonics", Second Edition, John Wiley & Sons, 2003.
4. Kazibwe W.E. and Sendaula M.H., Van Nostrand Reinhold, "Electric Power Quality control Techniques", New York.

Web References

1. http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/electrical_power_system_s_quality.pdf
2. http://nptel.ac.in/courses/108106025/Power%20quality_in_power_distribution_systems.pdf
3. <https://www.accessengineeringlibrary.com/browse/power-quality-in-electrical-systems#>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the causes for interruptions?
2. Write the remedies to improve power quality?
3. Distinguish power quality and voltage quality
4. Write different types of DG technologies
5. Write standards of power quality monitoring
6. Write different types of non linear loads

L2: Understand

1. Explain different types of transients
2. Explain about various solutions for over voltage protection
3. Explain about long duration and short duration voltage variations

L3: Apply

1. Draw block diagram of advanced power quality monitoring systems and explain
2. Explain impact of DG on low voltage distribution networks
3. Explain Static VAR compensation for power factor improvement

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20CEM01 Air Pollution

3 0 0 3

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

Code	Course Outcomes	Mapping withPOs	DoK
20CEM01.1	Identify different types of pollution and their sources		L1,L2
20CEM01.2	Identify the meteorological components		L1,L2
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation		L1,L2
20CEM01.4	Explain various types of air pollution control equipment and their working principles		L1,L2
20CEM01.5	Understand sampling methods and monitoring of air pollution		L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction

9 H Hours

Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants, Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology

9 Hours

General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles and stack plume patterns

Unit III: Effects of Air Pollution

9 Hours

Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion, heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control

9 Hours

Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring

9 Hours

Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

- Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
- Rao M. N., Rao H. V. N., "Air Pollution", 1st Edition, Mc Graw Hill, 2004

Reference Books

- Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
- Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
- Rao C. S., "Environmental Pollution Control Engineering," Wiley Eastern Limited, New Delhi, 1992
- Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

- <http://www.epa.gov>
- <http://www.indiaenvironmentportal.org.in>
- <http://nptel.iitm.ac.in>
- <http://www.filtersource.com>
- <https://dgserver.dgsnd.gov>

Internal Assessment Pattern

Cognitive Level Internal Assessment #1 (%) Internal Assessment #2 (%)

L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Mention various sources of air pollution.
2. Define Atmospheric stability
3. Write a note on Ozone depletion
4. What are Filters & Electrostatic precipitators?

L2: Understand

1. What are Primary and secondary air pollutants?
2. Write the effect of effect of meteorology on Plume dispersion
3. Explain briefly about effects of air pollution on human beings, plants and animals and properties

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M 20CSM01 E-Commerce

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

Code	Course Outcomes	Mapping withPOs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce		L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System		L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK. Depth of Knowledge

Unit I: Introduction

9 hours

Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security

9 hours

Client-Server Network security, World Wide Web(WWW) as the architecture, Web background: Hypertext Publishing, Technology behind the web, Security and the web

Emerging Client-Server Security Threats

Unit III: E-Payment Systems

9 hours

Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E-Payment systems.

Designing E-Payment Systems

Unit IV: EDI Implementation and Intraorganizational E-Commerce

9 hours

Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E -Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet

9 hours

Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing-Information based marketing, Advertising on Internet, online marketing process, market research.

Charting the Online Marketing Process

Text Books

1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education 2011
2. Jaiswal S., " E-Commerce", Second Edition, Galgolia, 2010

Reference Books

1. Dave Chaffey, "E-business & E-commerce management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008

Web References

1. <https://www.techopedia.com/definition/18226/corporate-data-warehouse-cdw>
2. <http://ecmrce.blogspot.com>
3. <http://data.conferenceworld.in>

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Write any four important E-Commerce organization Applications
 2. Write about any four requirements of EDI
 3. Write short notes on Risks in E-Payment systems
 4. Write short notes on Market research
 5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perceptive
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards

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M| 20MEM01 Biomaterials

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

Code	Course Outcomes	Mapping withPOs	DoK
20MEM01.1	Classify various biomaterials		L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials	-	L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Introduction

09 Hours

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials

09 Hours

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials

09 Hours

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials

09 Hours

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials

09 Hours

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.

Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. Academic Press, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural integrity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karthalo, Elsevier Academic Press, 2003.

Reference Text books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define Importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1. Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions

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MI 20EEM01 Basic Control Systems

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

Code	Course Outcomes	Mapping with PO's			DoK
		PO1	PO2	PO3	
20EEM01.1	Determine time response specifications of second order systems	3	1	2	L1-L2
20EEM01.2	Determine error Constants for different types of input signals	3	1	2	L1-L2
20EEM01.3	Understand various levels of illuminosity produced by different illuminating sources.	3	1	2	L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.	3	1	2	L1-L3
20EEM01.5	Understand the speed/time characteristics of different types of traction motors.	3	1	2	L1-L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Control Systems

12 Hours

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis

12 Hours

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability

12 Hours

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response

12 Hours

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis

12 Hours

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014

Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. <https://nptel.ac.in/courses/107/106/107106081/>
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1	Internal Assessment #2
	(%)	(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the various standard test signals?
2. Define concept of observability.
3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

L3: Apply

1. The characteristic polynomial of a system is $s^5+2s^6+3s^5+s^4+5s^3+2s^2+s+7=0$. Determine the the stability of the system using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is $G(s) = K/s(s+1)(s+2)$.
3. For a system having $G(s) = 25/s(s+10)$ and units negative feedback, find its time response specifications.

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MI 20ECM01 Semiconductor Devices and Circuits

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams		L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers		L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3 Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5 Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Semiconductor Physics 09 Hours

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

Fermi Level, Charge Densities in Semiconductors

Unit II: Semiconductor Diodes and Special Diodes 09 Hours

Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

Diode Switching times, Varactor diode, Tunnel Diode

Unit III: Rectifiers and Filters 09 Hours

Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

LC filter, Multi section π filter

Unit IV: Transistors and Biasing Techniques 09 Hours

Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in V_{BE} , I_c , and β , Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.

Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability

Unit V: Small Signal Low Frequency Transistor Amplifier Models 09 Hours

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response

Textbooks

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications, 2009

Reference Books

1. Salivahanan S. Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khanna Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. <http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html>
3. <http://nptel.ac.in/courses/117103063/11>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels**L1: Remember**

1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier

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20AIM01 Fundamentals of Neural Networks

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks		L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit 1: Introduction to Neural Networks 9 hours

Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN 9 hours

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN - Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks 9 hours

Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and Continuous Perceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks 9 hours

Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks 9 hours

Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Companies, 2006
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley Publishing Company

Reference Books

1. B. YagnaNarayana, "Artificial Neural Networks", Prentice Hall India, 2013
2. Satish Kumar, "Neural Networks: A classroom approach", Tata McGraw Hill; 2004.
3. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100


Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand

4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories


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MI 20DSO03 Introduction to R Programming

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

Code	Course Outcomes	Mapping withPOs	DoK
20DSO03.1	Understand the basic concepts of R programming		L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2, L3
20DSO03.5	Implement Functions in R programming		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK Depth of Knowledge

Unit I: Introduction**9 Hours**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

*Variable Scope & Default Arguments***Unit II: Control Structures And Vectors****9 Hours**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

*Higher-Dimensional Arrays***Unit III: Lists****9 Hours**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

*Merging Data Frames***Unit IV: Factors and Tables****9 Hours**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

*Aggregate () Function, Set Operations***Unit V: Functions****9 Hours**

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Borders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

Text Books

1. Norman Matloff, "The Art of R Programming- A Tour of Statistical Software Design", 2011
2. Roger D. Peng, "R Programming for Data Science", 2012

Reference Books

1. Garrett Golemund, Hadley Wickham, "Hands-On Programming with R. Write Your Own Functions and Simulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. <https://data-flair.training/blogs/object-oriented-programming-in-r/>
3. <http://www.r-tutor.com/elementary-statistics>
4. <https://www.tutorialspoint.com/r/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

- L1: Remember**
1. Write about vectors in R
 2. Write any three type conversions in R
 3. What is a data structure in R?
 4. Write any two Boolean operators in R
 5. Write any two linear vector algebra operations

L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else command

$$f(x) = \begin{cases} x & \text{if } x < 1/2 \\ (1-x) & \text{if } 1/2 < x < 1 \\ 0 & \text{otherwise} \end{cases}$$

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Handwritten text at the bottom of the page, possibly bleed-through from the reverse side. The text is mirrored and difficult to decipher but appears to contain a list of items or a set of instructions.

PE 20EE011 Switchgear Protection

3 0 0 3

Pre – Requisite: Power Generation and Transmission, Power Distribution and Distributed Generation

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE011.1	Describe the basic principles of arc interruption, circuit breaking principles, operation of various types of circuit breakers		L3
20EE011.2	Explain the classification, operation, construction and application of different types of electromagnetic protective relays		L3
20EE011.3	Illustrate the characteristics of distance relays and the principles and operations of different types of static and Digital relays.		L3
20EE011.4	Describe different protection schemes for protecting generators, transformers, feeders and bus bars.		L3
20EE011.5	Summarize various types of over voltages in a power system and principles of different protective Schemes for insulation coordination.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Circuit Breakers

9 Hours

Principle of operation – RRRV – Current chopping- Resistance Switching-Circuit Breaker ratings and specifications, Testing of Circuit Breakers. Constructional features and selection of LT breakers (Miniature circuit breakers/Metal clad circuit breakers/Earth leakage circuit breaker) and HT breakers (Air Blast Circuit Breaker-Oil circuit breakers-SF6 CB-Vacuum Circuit Breakers), Auto reclosing.

Difference between a Fuse, an Isolator and a Circuit breaker

Unit II: Protective Relays-I

9 Hours

Principle of Operation and Construction of Attracted armature, Balanced Beam, induction Disc and Induction Cup relays. Relays Classification - Instantaneous, DMT and IDMT types - Application of relays - Over current, under voltage, Directional, Differential and Percentage Differential relay

Fundamental requirements of protective relays

Unit III: Protective Relays-II

9 Hours

Electromagnetic Protection - Universal Torque Equation - Distance relays - Impedance, Reactance and Mho and Off-Set Mho relays, Characteristics of Distance Relays and Comparison - Static and digital Relays –Static relay components-Static Relays versus Electromagnetic Relays - Microprocessor Based digital relays - impedance, directional, reactance, Mho & offset Mho and mathematical expression for distance relay

Types of protection

Unit IV: Protection of Generator, Transformer, Feeders and Busbars

9 Hours

Generator Protection: Protection of Generators against Stator faults, Rotor faults, and Abnormal Conditions - Restricted Earth and inter turn Fault Protection - Numerical Problems on % Winding Unprotected. Transformer Protection: Percentage Differential Protection of transformers - Design of CT's Ratio - Buchholz relay protection - Numerical Problems. Feeder and Busbar Protection: Protection of lines - Over Current, Three-zone Distance Relay using Impedance Relays and Carrier Current Protection - Protection of Busbars – Differential protection.

Static relays versus electromagnetic relays

Unit V: Grounding Techniques and Over Voltage Protection

9 Hours

Grounded and Ungrounded Neutral Systems- Effects of Ungrounded Neutral on system performance Methods of Neutral Grounding –Solid, Resistance, Reactance- Arcing Grounds and Grounding Practices. Protection against Over Voltages- Generation of over voltages in power System-Protection against lightning over voltages- Valve type and Zinc-Oxide Lightning Arresters - Insulation Coordination-BIL, Impulse Ratio, Standard Impulse Test Wave - Volt-Time Characteristics

Voltage surge, lightning

Text Books

1. Badri Ram, Vishwakarma. D.N, "Power System Protection and Switchgear", MGH Publications, 2nd Edition 2011
2. T.S.Madhava Rao , "Power system protection- Static Relays with microprocessor applications", 2nd Edition, TMH, 2008

Reference Books

1. Paithankar and S.R.Bhide, "Fundamentals of Power System Protection ",PHI, 2nd Edition 2010
2. C R Mason, "Art & Science of Protective Relaying", 2nd edition,1966, Wiley Eastern Ltd.
3. Bhavesh Bhalja, " Protection and Switch Gear", 3rd edition,2011, oxford. Web References

Web References

1. <https://nptel.ac.in/courses/108107167>
2. <https://www.electrical4u.com/electrical-switchgear-protection/>
3. <https://www.electricalpaathshala.com/2019/02/switchgear-and-protection/>
4. <https://www.youtube.com/watch?v=CdVnBLQDmoA> (Elementary principles of arc interruption)
5. <https://www.youtube.com/watch?v=GKl2mn3zp44> (oil circuit breakers)
6. <https://www.youtube.com/watch?v=ngbMkLKpgTw> (SF6 circuit breakers)
7. <https://www.youtube.com/watch?v=2247gMbc5Lk> (Differential relays)

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Label the circuit diagram of relay
2. List the advantages of vacuum circuit breaker
3. Define arc voltage
4. List any three problems associated with differential relay

L2: Understand

1. Formulate the expression for restriking voltage
2. Illustrate the SF6 circuit breaker with neat diagram
3. Explain any three types of lightning arresters
4. Classify voltage balance differential relay and translay relay
5. Explain the working principle of restricted earth fault relay for the protection of stator winding of alternator

L3: Apply

1. For 132kV system the reactance and capacitance up to location of circuit breaker is 3ohms, and 0.015 μ F, respectively. Find i) frequency of transient oscillation, ii) maximum value of restriking voltage iii) RRRV

2. A star connected 3-phase, 10MVA, 7.5 kV alternator has a per phase reactance of 10%. It is protected by Merz-Price circulating current principle which is set to operate for fault currents not less than 200A. Find the value of earthing resistance to be protected in order to ensure that only 10% of the alternator winding remains unprotected.
3. Find the time of operation of a 5 amp 3 second over current relay having current setting of 95% and time setting multiplier of 0.6 connected to supply circuit through a 400/5 current transformer when the circuit carries a fault current of 4000A. Use the following table

Operating Time	2	4	6	8	10	9
PSM	2	2.5	3	3.5	4	4.5

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PE 20EE012 Digital Signal Processing

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Pre – Requisite : Linear Algebra and Differential Equations, Signals & Systems

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

Code	Course Outcomes	Mapping with POs	DoK
20EE012.1	Apply the difference equations concept for analyzation of Discrete time systems		L3
20EE012.2	Apply the FFT algorithm for solving the DFT of a given signal		L3
20EE012.3	Design and realize the IIR Digital filter from the given specifications		L3
20EE012.4	Design and realize the IIR Digital filter from the given specifications		L3
20EE012.5	Apply the signal processing concepts on DSP Processor		L3
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction

12 Hours

Introduction to Digital Signal Processing: Discrete-time signals & sequences, Classification of discrete-time systems, stability and causality of LTI systems, Response of LTI systems to arbitrary inputs. Solution of linear constant coefficient difference equations. Frequency domain representation of discrete-time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.

Discrete time Fourier transform

Unit II: Discrete Fourier Transform

12 Hours

Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT)-Radix-2 decimation-in-time and decimation-in-frequency FFT Algorithms, Inverse FFT.

Discrete Fourier Series, DFS Properties

Unit III: Design of IIR Digital Filters & Realizations

12 Hours

Analog filter approximations – Butterworth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

Lattice structures of IIR systems

Unit IV: Design of FIR Digital Filters & Realizations

12 Hours

Characteristics of FIR Digital Filters, Frequency response. Design of FIR Digital Filters using Window technique and Frequency Sampling technique, Comparison of IIR & FIR filters. Basic structures of FIR systems.

Lattice structures, Lattice-ladder structures

Unit V: Introduction to DSP Processors

12 Hours

Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS320C5X, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers.

Some flags in the status registers

Textbooks

1. John G. Proakis and Dimitris G. Manolakis, " Digital Signal Processing, Principles, Algorithms, and Applications", 4th Edition, Pearson Education / Prentice Hall of India, 2009.
2. Oppenheim A V. and Schaffer R W., " Discrete Time Signal Processing", 3rd Edition, Prentice Hall of India

3. Venkataramani B. and Bhaskar M., "Digital Signal Processors – Architecture, Programming and Applications", TATA McGraw Hill, 2002

Reference Books

1. Ramesh Babu P., "Digital Signal Processing", 7th Edition, Scitech Publications, 2018
2. Robert J. Schilling and Sandra L. Harris, "Fundamentals of Digital Signal Processing using MATLAB" Thomson, 2007
3. Alan V. Oppenheim and Ronald W. Schaffer, "Digital Signal Processing", Prentice Hall of India, 2006
4. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2014

Web Resources

1. <https://nptel.ac.in/courses/117/102/117102060/>
2. <https://nptel.ac.in/courses/117/105/117105134/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	30	30
L3	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the condition for stability of an LTI system?
2. What are the limitations of DSP?
3. Define DFT and IDFT
4. How FFT is more efficient to determine DFT of sequence?
5. Why IIR filters do not have linear phase?
6. What is meant by frequency warping effect?
7. Write two advantages of Kaiser widow
8. List the on-chip peripherals
9. List the special feature of DSP architecture

L2: Understand

1. What are the basic elements of a DSP system? Explain
2. Find the linearity, invariance and causality of the following systems
 $y(n) = x(-n+2)$ ii) $y(n) = x(n^2) + x(-n)$
3. State and prove the periodicity and time shifting property in DFS
4. Prove that the convolution in time-domain leads to multiplication in frequency domain for discrete time signals
5. Establish the relation between DFT and Z-transform
6. Compare bilinear transformation and impulse invariant mapping
7. Distinguish between FIR and IIR filters
8. Explain the need for the use of window sequence in the design of FIR filter
9. With neat block diagram, explain about the pipelining
10. What are the special addressing modes of DSP? Explain

L3: Apply

1. Find the impulse response $h[n]$ of the system described by the difference equation $8y(n) + 6y(n-1) = x[n]$
2. Determine the unit step response for the system given by the difference equation $Y(n) + 3y(n-1) + 2y(n-2) = 2x(n) - x(n-1)$
3. Compute the DFT of the three point sequence $x(n) = \{2, 1, 2\}$; Using the same sequence, compute the 6 point DFT and compare the two DFTs
4. Compute the DFT for the sequence $\{1, 2, 0, 0, 0, 2, 1, 1\}$ using radix-2 DIF FFT and radix-2 DIT- FFT algorithm
5. Find the circular convolution of the sequences $x[n] = \{1, 4, 0, 9, -1\}$ and $h[n] = \{-3, -4, 0, 7\}$

6. Determine the system function $H(z)$ of the lowest order Chebyshev digital filter with the following specification
 - (i) 3dB ripple in pass band $0 \leq \omega \leq 0.25\pi$
 - (ii) 30 dB attenuation in stop band $0.35\pi \leq \omega \leq \pi$
7. Design a digital IIR low pass filter using Butterworth approximation with Pass band edge at 1000 Hz, Stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a Passband ripple of 0.5 dB and Stop band ripple below 30 dB
8. Obtain the direct form I, direct form II and Cascade form realization of the following system function
 $Y(n) = 0.1 y(n-1) + 0.2 y(n-2) + 3x(n) + 3.6 x(n-1) + 0.6 x(n-2)$
9. Design an FIR digital low pass filter with cut off frequency 1.2 radian and length $N = 7$. Use frequency sampling method
10. Design an ideal high pass filter with a frequency response
 $H_d(e^{j\omega}) = 1$ for $\pi/4 \leq |\omega| \leq \pi$
 $= 0$ for $|\omega| \leq \pi/4$ Find the values of $h(n)$ for $N = 11$ using Hamming window. Find $H(z)$ and determine the magnitude response

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PE 20EE013 HVDC & FACTS

3 0 0 3

Pre – Requisite : Power Electronics

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

Code	Course Outcomes	Mapping with POs										DoK
		PO1	PO2	PO3	PO5	PO6	PO7	PO12	PS01	PSO2		
20EE013.1	Compare AC and DC systems, Describe the Types of HVDC Links and FACTS devices and explain various parameters in HVDC.	3	2	1	3	1	-	1	2	1	L2	
20EE013.2	Analyze the Graetz circuit with various conditions.	3	2	3	3	-	1	1	1	2	L2	
20EE013.3	Describe various control schemes, Analyze the harmonics and design the Filters in HVDC.	2	1	2	3	-	-	1	2	2	L2	
20EE013.4	Understand the Operation of various Shunt devices and their control.	3	1	2	3	-	-	1	2	3	L2	
20EE013.5	Understand the Operation of various Series devices and their control.	3	1	2	3	-	-	1	2	2	L2	

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to HVDC and FACTS

9 Hours

Introduction, Comparison of AC and DC Transmission (Economics of power transmission, technical performance and Reliability), Description of DC transmission system (Types of DC links and Converter Station), Modern trends in HVDC technology.

FACTS Concepts

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, Benefits from FACTS controllers.

Application of DC transmission systems

Unit II: ANALYSIS OF HVDC CONVERTERS

9 Hours

Introduction, Analysis of Graetz circuit –with grid control but no overlap-with grid control and overlap less than 60°, relationship between AC and DC quantities-equivalent circuit of rectifier, Inversion- equation of average direct current and voltage in terms of β and γ – equivalent circuit of inverter, 12 Pulse converters-relations between AC and DC quantities.

Graetz circuit

Unit III: HVDC System Control & Harmonics and Filters:

9 Hours

Basic means of control-desired features of control-actual control characteristics-constant minimum ignition angle control-constant current control-constant extinction angle control-tap changer control-power control and current limits, System control hierarchy, firing angle control- IPC-EPC.

Introduction, Design of DC and AC filters (design and types of filters)

Generation of harmonics (Characteristics and Non characteristics harmonics)

Unit IV: Static Shunt Compensation:

9 Hours

Objectives of Shunt Compensation, midpoint voltage regulation voltage Instability prevention, Improvement of Transient Stability, Methods of controllable VAR generation – Variable Impedance type only.

Power Oscillation Damping

Unit V: Static Series Compensators:

9 Hours

Concept of series capacitive compensation, Sub Synchronous Oscillation Damping. Functional requirements of GTO Thyristor Controlled Series Capacitor (GCSC), control schemes of Thyristor Switched Series Capacitor (TSSC), and Thyristor Controlled Series Capacitor (TCSC) control schemes for GCSC, TSSC and TCSC.

Improvement of Transient Stability, Power Oscillation Damping

Textbooks:

1. K. R.Padiyar, "HVDC Transmission Systems", 2nd edition (in Two Colour), New Age International publishers, 2012.
2. N. G. Hingorani and, L.Gyugui, "Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems", B.S. Publications, Indian Reprint 2000.

Reference Books:

1. E. Uhlmann, "Power Transmission by Direct Current", Springer 1st edition, 2012.
2. Vijay K. Sood, "HVDC and FACTS Controller: Application of Static Converters in power systems", IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, First edition January 2004.
3. E.W. Kimbark, "Direct Current Transmission", Wiley Inter Science-New York, 1971.
4. R. Mohan Mathur, Rajiv K Varma, "Thyristor based FACTS Controller for Electrical Power Systems", John Wiley Sons, 2011.
5. X. P. Zhang, C. Rehtanz, B.Pal, "Flexible AC Transmission System Modeling and Control", Springer, 2006.

Web References:

1. <https://nptel.ac.in/courses/108104013>
2. <https://nptel.ac.in/courses/108107114>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	60
L2	60	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out any 3 advantages of HVDC.
2. What are the different loading capability limits?
3. List any 2 advantages of FACTS controllers.
4. What is power oscillation damping?
5. What is System control hierarchy?

L2: Understand

1. Explain dynamic stability considerations of a system.
2. Explain mid-point voltage regulation
3. Explain power oscillation damping

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PE 20EE014 Programmable Control Devices and Applications

3 0 0 3

Pre-Requisite : Digital System Design

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE014.1	Introduction to basic PLC modules		L2
20EE014.2	Explain about different PLC operations		L2
20EE014.3	Discuss different PLC registers		L2
20EE014.4	Describe various data handling functions		L2
20EE014.5	Discuss different applications of PLC		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction to PLC

9 Hours

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams.

Devices connected to I/O modules

Unit II: PLC Programming and Operations

9 Hours

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction.

Flow chart for spray process system

Unit III: PLC Registers

9 Hours

Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions,.

Number conversion functions

Unit IV: Data handling functions

9 Hours

SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

Changing a bit shift register

Unit V: Applications of PLC's

9 Hours

Object counter, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, PID Controller, Study of Boolean Gates, Timers and counters

Calculation of space to mounting height ratio

Text Books

1. Job Dan Otter, "Programmable Logic Controller", P.H. International, Inc, USA, 2009
2. Gary Dunning, "Introduction to PLCs", 4th Edition, McGraw Hill, 2019
3. Gurpreet Kaur and SK Sahdev, "Programmable Logic Controller and Microcontrollers", 2nd Edition, Uneek Publications, Jalandhar, 2013.

Reference Books

1. John R. Hackworth, "Programmable Logic Controllers: Programming Methods and Applications", 5th Edition, Pearson, 2013.

2. Parr and E A, "Programmable Controllers: An Engineer's Guide", Elsevier Science, 3rd Edition, 2018.

Web References

1. <https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada>
2. <https://www.ambitautomation.in/courses/industrial-automation/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is I/O module?
2. What are different operational procedures?
3. What are output registers?
4. What is matrix function?
5. What is object counter?

L2: Understand

1. Explain construction of PLC ladder diagrams.
2. Explain ladder diagram construction.
3. Explain architecture functions.
4. Explain Characteristics of Registers.
5. Explain master control relay jump.

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PE 20EE015 Virtual Instrumentation

3 0 0 3

Pre – Requisite: Instrumentation

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEH08.1	Define virtual instrumentation concepts.		L2
20EEH08.2	Describe acquisition methodologies		L2
20EEH08.3	Compare traditional and virtual instrumentation.		L2
20EEH08.4	Discuss operating systems required for virtual instrumentation		L2
20EEH08.5	Illustrate implementation methods for instrumentation		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

UNIT I: INTRODUCTION

9 Hours

Virtual Instrumentation - Definition and Flexibility - Block diagram and Architecture for Virtual Instruments versus Traditional Instruments Instrumentation -VI Programming techniques - VI, sub VI, Loop and Charts, Arrays, Clusters and Graphs, Case and Sequence Structures, Formula nodes, String and File Input / Output

Virtual Instrumentation, VI programming techniques

UNIT II: DATA ACQUISITION IN VI

9 Hours

A/D and D/A converters, Plug-in Analog Input / Output cards – Digital Input and Output Cards, Organization of the DAQ VI system – Opto isolation – Performing analog input and analog output – Scanning multiple analog channels – Issues involved in selection of Data acquisition cards – Data acquisition modules with serial communication – Design of digital voltmeter with transducer input –Timers and Counters.

DAQ VI System, Timers, Counters.

UNIT-III: COMMUNICATION NETWORKED MODULES

9 Hours

Introduction to PC Buses – Local buses: - ISA, PCI, RS232, RS422 and RS485 – Interface Buses: - USB, PCMCIA, VXI, SCXI and PXI –Instrumentation Buses:- Modbus and GPIB – Networked busses – ISO/OSI Reference model, Ethernet and TCP/ IP Protocols.

Interface Buses, Instrumentation Buses

UNIT-IV: REAL TIME CONTROL IN VI

9 Hours

Designs using VI Software - ON/OFF controller – Proportional controller – Modeling and basic control of level and reactor processes – Case studies on development of HMI, SCADA in VI

Proportional controller, SCADA IN VI

UNIT-V: OPERATING SYSTEM AND HARDWARE OVERVIEW

9 Hours

PC architecture, current trends, operating system requirements, PC based instrumentation, analog and digital interfaces, PXI and SCXI main frame - modular instruments – Transducers – power, speed and timing considerations.

Analog and digital interfaces, Transducers

Text Books

1. Gary W. Johnson, Richard Jennings, " LabVIEW Graphical Programming", 3rd edition, McGraw-Hill Professional Publishing, 2019

2. Lisa K Wells, "Lab view for Everyone", 3rd edition, Prentice Hall of India, 2020.

Reference Books

1. Barry Paton, "Sensor, transducers and Lab view", Prentice Hall of India 2020.
2. Buchanan,W. "Computer buses", CRC Press 2020.

Web References

1. <https://www.ni.com/>
2. <https://www.halvorsen.blog/documents/programming/labview/labview.php>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Virtual Instrumentation.?
2. Mention the role of hardware's in V?
3. What is Transducers?
4. What are VI Programming techniques?
5. What is Opto-isolation?

L2: Understand

1. Draw and explain the graphical and VI models with design flow.
2. Explain SCADA in VI.
3. Explain PC based instrumentation
4. Explain Instrumentation Buses.
5. Explain TCP/ IP Protocols.

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PE 20EE016 ANALYSIS OF POWER CONVERTERS 3 0 0 3

Pre – Requisite: Power Electronics

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE016.1	Understand basic concepts of Single Phase rectifiers		L2
20EE016.2	Explain operation of three phase rectifiers with different loads		L2
20EE016.3	Operation and application of Converters		L3
20EE016.4	Explain principle of operation of inverters		L2
20EE016.5	Knowledge of AC Voltage Controllers		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Over view of switching devices and Single Phase AC-DC Converters 9 Hours

Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices. Single phase Half and fully controlled converters with R, RL load – Evaluation of input power factor and harmonic factor, output voltage, ripple and distortion -Continuous and Discontinuous load current - effect of source impedance and overlap – Numerical Problems

half controlled and fully controlled converters with R-L-E load

Unit II: Three Phase AC-DC Converters 9 Hours

Three phase half wave controlled converter with R, RL load, Three phase half controlled bridge converter with R, RL load, Three phase fully controlled bridge converter with R, RL load – Evaluation of input power factor and harmonic factor, output voltage, ripple and distortion -Continuous and Discontinuous load current - effect of source impedance and overlap – Numerical Problems.

Semi and fully controlled converter with R-L-E load

Unit III: DC-DC Converters and Power Factor Correction Converters 9 Hours

Analysis of buck-boost converters, CUK converter – Numerical problems, Full bridge converter – Resonant and quasi – resonant converters. Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state-analysis, three phase boost PFC converter

Analysis of buck and boost converter

Unit IV: DC-AC Inverters 9 Hours

Principle of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM – 60° PWM – Third Harmonic PWM – Space Vector Modulation- Comparison of PWM Techniques – Voltage source and Current source inverters –Variable dc link inverter.

Single PWM and multiple PWM Techniques

Unit V: AC Voltage Controllers and Cycloconverters 9 Hours

Static Characteristics of TRIAC- Principle of phase control: single phase and three phase AC voltage controllers with R Load– various configurations – evaluation of output voltage and current expressions. Single phase and three phase cyclo-converters – power factor Control – Introduction to matrix converters.

Single Phase and Three phase AC voltage controllers with R-L load

Text Books

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Pierson Prentice HallIndia, New Delhi, 2004.
2. P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.
3. Ned Mohan, T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and design" John Wiley and sons Wiley India edition, 2006.

Reference Books

1. Cyril W.Lander, "power electronics", Third Edition McGraw hill-1993
2. P.C Sen., " Modern Power Electronics ", Wheeler publishing Co, First Edition, New Delhi-1998.
3. Power Electronics by Vedam Subramanyam, New Age International publishers, New DelhiSecond Edition, 2006

Web References

1. <https://nptel.ac.in/courses/117103148>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is difference between Mosfet and IGBT?
2. What is firing angle?
3. What are limits for inverter operation?
4. What is VSI and CSI?
5. What are the V-I characteristics of TRIAC?

L2: Understand

1. Explain free wheeling diode operation.
2. Explain in detail about fully controlled converter with R and RL load.
3. Explain the design of boost converter.
4. Explain PWM techniques for inverter operation.
5. Explain power conversion using single phase AC Voltage Controller with R load.

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PE 20EE017 Multivariable Control System

3 0 0 3

Pre – Requisite: Control System

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE017.1	Introduction of multivariable control		L2
20EE017.2	Explain the types of linear system models		L2
20EE017.3	Explain different conditions of a linear system		L2
20EE017.4	Describe the types of feedback control		L2
20EE017.5	Explain various types of system control		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction to Multivariable Control

9 Hours

Introduction, Process and Instrumentation, Process Variables, The Process Behavior, Control Aims, Modes of Operation, The Need for Feedback, Model-free vs. Model-based Control, The Importance of Considering Modeling Errors

Multivariable Systems, Implementation and Structural Issues

Unit II: Linear System Representation: Models and Equivalence

9 Hours

Introduction: Objectives of Modeling, Types of Models, First-principle Models: Components, Internal Representation: State Variables, Linear Models and Linearization, Input/output Representations, Systems and Subsystems: Interconnection, Discretised Models.

Equivalence of Representations, Disturbance Models

Unit III: Linear Systems Analysis

9 Hours

Introduction, Linear System Time-response, Stability Conditions, Discretisation, Gain, Frequency response, System Internal Structure, Block System Structure (Kalman Form).

Hierarchical Control

Unit IV: Solutions to the Control Problem

9 Hours

The Control Design Problem, Control Goals, Variables Selection, Control Structures, Feedback Control, Feed forward Control, Two Degree of Freedom Controller

changing a bit shift register

Unit V: Decentralized and Decoupled Control

9 Hours

Introduction: Plant Decomposition, Grouping of Variables, Multi-loop Control, Pairing Selection, Decoupling, Enhancing SISO Loops with MIMO Techniques: Cascade Control, Other Possibilities, Sequential.

Hierarchical Design and Tuning

Text Books

1. Albertos Pedro, "Multivariable Control Systems", 4th Edition, Springer, 2019
2. Katsuhiko Ogata, "Modern Control Engineering", 3rd Edition, Prentice Hall of India Pvt. Ltd, , 2015.
3. Nagoorkani A, "Control Systems", 3rd Edition, RBA publications, 2017.

Reference Books

1. Skogestad S, "Multivariable Feedback Control", 2th Edition, Wiley, 2018.

2. Nagarath I.J. and Gopal M, "Control Systems Engineering", 2nd Edition, New age International Publications, 2018

Web References

1. <https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada>
2. <https://www.ambitautomation.in/courses/industrial-automation/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is I/O module?
2. What are different operational procedures?
3. What are output registers?
4. What is matrix function?
5. What is object counter?

L2: Understand

1. Explain construction of PLC ladder diagrams.
2. Explain ladder diagram construction.
3. Explain architecture functions.
4. Explain Characteristics of Registers.
5. Explain master control relay jump.

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PE 20EE018 Power System Operation and Control

3 0 0 3

Pre – Requisite: Power Generation and Transmission, Power Distribution and Distributed Generation

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

Code	Course Outcomes	Mapping with PO's							DoK
		PO-1	PO 2	PO 3	PO 7	P012	PSO1	PS-02	
20EE018.1	Outline the economic operation of thermal power plants	3	3	1	1	1	2	1	L2
20EE018.2	Summarize hydro-thermal scheduling	3	3	2	1	1	1	2	L3
20EE018.3	Examine the behavior of single area power system for change in load demand	2	2	1	-	1	2	2	L3
20EE018.4	Demonstrate the behavior of two area power system for various operating scenarios	2	2	1	-	1	1	2	L3
20EE018.5	Explain reactive power and voltage control in power system	3	2	1	-	1	2	1	L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Economic Operation of Power Systems

9 Hours

Optimal operation of Generators in Thermal power stations, Heat rate curve, Cost Curve, Incremental fuel and Production costs, Input, output characteristics – Optimum generation allocation with line losses neglected, Optimum generation allocation including the effect of transmission line losses, Loss Coefficients, General transmission line loss formula.

Lambda -Iteration methods

Unit II: Hydro Thermal Scheduling

9 Hours

Optimal scheduling of Hydrothermal System: Mathematical Formulation, Solution Technique. Optimal unit commitment problem, Need for unit commitment, Constraints in unit commitment, Cost function fomulation, Solution methods, Priority ordering.

Dynamic programming

Unit III: Load Frequency Control-I

9 Hours

Modeling of steam turbine, Generator, Mathematical modeling of speed governing system, Transfer function – Necessity of keeping frequency constant, Definitions of Control area, Single area control system, Block diagram representation of an isolated power system, Steady state analysis, Dynamic response, Uncontrolled case.

Proportional plus Integral control of single area and its block diagram representation

Unit IV: Load Frequency Control-II

9 Hours

Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

Performance Index and optimal load frequency control

Unit V: Reactive Power and Voltage Control

9 Hours

Production and absorption of reactive power, Methods of voltage control-shunt reactor, shunt capacitors series capacitors, synchronous condensers. Static-VAR-systems. Principles of transmission system compensation, Modelling of reactive compensating devices. Application of tap-changing transformers to transmission systems, Distribution system voltage regulation. Modelling of transformer ULTC control system.

Need of FACTS controllers

Text Books

1. I.J.Nagrath&D.P.Kothari, "Modern Power System Analysis", Tata McGraw–Hill Publishing Company Ltd, 4th Edition, 2011

2. P.Kundur, "Power System Stability and Control", McGraw Hill Inc, 2nd Edition, 2005

Reference Books

1. John J.Grainger, William D.Stevenson,Gary W. Chang, "Power System Analysis" Tata McGraw Hill,2nd edition, 2016.
2. O.I.Elgerd, "Electric Energy systems Theory" Tata McGraw-hill Publishing Company Ltd., 2nd edition, 2005
3. S.S.Vadhera, "Power System analysis & Stability", Khanna Publishers, 3rd edition, 2005

Web References

1. <https://npti.gov.in/power-system-operation>
2. <https://www.udemy.com/course/power-system-analysis-part-3-power-flow-and-short-circuit>
3. <https://www.coursera.org/learn/power-system-operation-and-control>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	30
L2	40	30
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define optimal operation.
2. Define Incremental fuel cost.
3. Define control area.
4. Define regulation.
5. List the factors affecting power system security.

L2: Understand

1. Develop an algorithm for determination of optimal operation by neglecting line losses.
2. Develop the solution for long term hydro-thermal scheduling.
3. Describe the Economic dispatch control and Load frequency control.
4. Demonstrate operation of two area load frequency control.
5. Demonstrate the application of tap-changing transformers to transmission systems

L3: Apply

1. Explain Input-Output characteristics of power plants
2. Explain short term hydro-thermal scheduling.
3. Explain the significance of Economic dispatch control and Load frequency control.
4. Demonstrate operation of two area load frequency control.
5. Demonstrate the application of tap-changing transformers to transmission systems

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PE 20EE019 Automotive Electrical Engineering 3 0 0 3

Pre – Requisite: Power Electronics, Instrumentation

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO 1	PO 3	
20EE019.1	Understand the construction of different accessories	3	2	L2
20EE019.2	Explain the principle and construction of various starting systems	3	2	L2
20EE019.3	Discuss various types of charging systems	3	2	L2
20EE019.4	Understand the fundamentals of automotive electronics	2	2	L2
20EE019.5	Explain various types of sensors and activators	2	2	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Batteries And Accessories

9 Hours

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

Principle of lead acid battery, various tests on batteries, LED lighting system.

Unit II: Starting System

9 Hours

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

Illumination at horizontal and vertical plane from point source

Unit III: Charging System

9 Hours

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers, new developments.

Selection of utilisation factor, reflection factor and maintenance factor

Unit IV: Fundamentals Of Automotive Electronics

9 Hours

Current trends in automotive electronic engine management system, electro magnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

Calculation of illumination level available on road

Unit V: Sensors And Activators

9 Hours

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

Recommended method for aiming of lamp

Text Books

1. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press- 1999.
2. William B.Riddens "Understanding Automotive Electronics", 5th edition - Butter worth Heinemann Wobum, 1998.

Reference Books

1. Bechhold "Understanding Automotive Electronics", SAE, 1998.
2. Crouse, W.H "Automobile Electrical Equipment", McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.
3. Judge A.W "Modern Electrical Equipment of Automobiles", Chapman & Hall, London, 1992.
4. Kholi.P.L "Automotive Electrical Equipment", Tata McGraw-Hill Co., Ltd., New Delhi, 1975.
5. Robert Bosch "Automotive Hand Book", SAE (5th Edition), 2000.

6. Ganesan V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., New Delhi, 2003.

Web References

1. <https://nptel.ac.in/courses/108/105/108105060/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What head light dazzling?
2. What is crankshaft position,?
3. What Uniformity ratio?
4. What is coolant temperature?
5. What is manifold pressure?

L2: Understand

1. Explain construction of lead acid battery.
2. Explain behaviour of starter at the time of starting.
3. Explain electro magnetic interference suppression.
4. Explain onboard diagnostic system.
5. Explain air mass flow in a engine.

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PE 20EE020 Wireless Sensor and Instrument Networks

3 0 0 3

Pre – Requisite: Instrumentation

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE020.1	Explain the basic technology of wireless sensor		L2
20EE020.2	Explain different wireless communication technology		L2
20EE020.3	Discuss different protocols and data transfer techniques		L2
20EE020.4	Understand the architecture of different wireless sensors and networks		L2
20EE020.5	Explain various applications of wireless sensors and networks		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK.Depth of Knowledge

Unit I: Instruments and Instrumentation

9 Hours

Introduction, measurements, Instrument architecture ,Digital instrument hardware and software, Sensor technology, advanced sensor's, instrument and sensor communication and networks, industrial instrumentation systems, noise and ditortion

Noise in electronic systems, noise in digital systems

Unit II: Wireless Communication

9 Hours

Introduction, Wireless Communication principles, electromagnetic wave propogation, RF components, Analog modulation and multiplexing, Analog modulation and multiplexing, frequency spreading, multiple access techniques

Carrier sense multiple access, space division multiple access

Unit III: Data transfer, Networks, Protocols, and Standards

9 Hours

Introduction, data transfer, security in data flow, network essentials and topologies, protocols, standards, wireless networks, PANs, LANs, and WLANs, Network, Data and Information management

Industrial sensor buses and networks

Unit IV: Wireless Sensor and Instrument Networks

9 Hours

Wireless sensor architecture, network design of wireless sensors, wireless instrument architecture, wireless sensor and instrument network design, wireless integrated network sensors, plug and play sensors and networks

Industrial wireless sensors and networks

Unit V: Wireless Sensor and Instrument Application

9 Hours

Commercial wireless sensors and instruments, wireless instruments in research and development, sensor networks in research and development, Industrial wireless sensor and instrument networks

Radio frequency identification

Text Books

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", 4th Edition, John Wiley, 2019
2. Jagannathan Sarangapani, "Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control", 3rd Edition, CRC Press, 2015.

Reference Books

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Web References

1. <https://www.nielit.gov.in/calicut/content/online-course-industrial-automation-plc-scada>
2. <https://www.ambitautomation.in/courses/industrial-automation/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is sensor networks ?
2. What is Personal area networks (PANs)?
3. What is MAC protocol?

L2: Understand

1. Explain Technologies for Wireless Sensor Networks.
2. Explain hidden node and exposed node problem.
3. Explain Based MAC Protocols with Scheduling Mechanisms
4. Explain the Demand Routing Protocols.
5. Explain Wireless fidelity systems.

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OE 20CEO03 Disaster Risk Mitigation and Management

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO03.1	Identify various types of disasters, their causes, effects & mitigation measures		L1, L2
20CEO03.2	Understand various phases of disaster management cycle and create vulnerability and risk maps		L1, L2
20CEO03.3	Understand the approaches of risk and vulnerability		L1, L2
20CEO03.4	Explain the concept of disaster management and emerging approaches		L1, L2
20CEO03.5	Understand the mitigation measures		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UNIT I: Natural Disasters

9 Hours

Natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation.

Ozone Depletion

Unit II: Disaster Management Principles

9 Hours

Evolution of disaster risk management concept Disaster management cycle – Prevention, Preparedness, Mitigation, Rescue and Recovery Integrated and Comprehensive disaster risk reduction approach, Strategies and Policies.

Disaster management cycle

Unit III: Risk and vulnerability

9 Hours

Hazard, risk and vulnerability: Physical, social and economic dimensions, Vulnerability in changing climate, Climate change and Disasters, Risk Analysis Techniques, Risk: Identification, reduction and transfer, Approaches to mapping social vulnerability, Participatory disaster risk assessment, Action plans, Strategy for survival.

Vulnerability in changing climate

UNIT IV: Disaster Management

9 Hours

Preparedness through (IEC) Information, education & communication, pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community-based organizations and media.

National disaster management framework

UNIT-V: Risk Mitigation

9 Hours

Definition, Concept, Importance, Guiding Principles, Tools, Approaches, Strategies Sustainable Development, Sustainable Land Use Planning, Technology and the Environment. Emerging Technologies in Disaster Mitigation, Remote Sensing, GIS, Disaster Mapping, Aerial Photography, Land Use Zoning

Emerging technologies in disaster mitigation

Text Books

1. Khanna, B. K., "Disasters: All you wanted to know about", New India Publishing Agency, New Delhi, 2005
2. Edwards, B., "Natural Hazards", Cambridge University Press, U.K., 2005
3. Chakraborty, S. C., "Natural Hazards and Disaster Management", Pargatishil Prokashak, Kolkata, 2007

Reference Books

1. Sahni, P., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, NewDelhi, 2002
2. Prashant K. Srivastava, Sudhir Kumar Singh, Mohanty, U. C., Tad Murty, "Techniques for Disaster Risk Management and Mitigation", 2020

Web References

1. <https://books.google.com>
2. <http://cbseacademic.nic.in>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define climatic change
2. List any four effects of natural disasters
3. Define disaster Management

L2: Understand

1. Explain about risk assessment
2. Outline the principles of disaster management
3. Differentiate between hazard, risk and vulnerability

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OE 20CS404 Operating Systems

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CS404.1	Describe the structure, components and functionalities of operating system		L1, L2
20CS404.2	Describe the process management activities of operating system		L1, L2
20CS404.3	Illustrate the use of process synchronization tools		L1, L2
20CS404.4	Describe the various memory management and allocation techniques		L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Operating System Concepts

9 Hours

What Operating System Do, Operating System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating Systems Services, System Call, Types of System Call, Operating System Generation, System Boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management

9 Hours

Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Operations on Processes, Inter Process Communication, Multithread Programming: Overview, Benefits, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization

9 Hours

Background, The Critical-section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization, Monitors, Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management

9 Hours

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Background, Demand paging, Page replacement, Thrashing, Mass-Storage Structure: Overview of Mass-Storage Structure, Harddisk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface

9 Hours

File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection, Implementing File Systems: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

Consistency Checking, Malware, Denial of service

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGraw Hill

Education, 2001

3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGraw Hill Higher Education, 2017

Web Resources

1. <http://nptel.ac.in/downloads/106108101/>
2. <https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems>
3. <https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/>
4. <https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf>
5. <https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
{ (P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) }. Using preemptive SJF scheduling: (i) Draw Gantt chart
(ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded buffer problem with semaphores
9. Explain the steps involved in handling a page fault with a neat sketch

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OE 20AIO03 Fundamentals of AI

3 1 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO03.1	Describe the foundational principles of artificial intelligence		L1, L2
20AIO03.2	Formalise the given problem using different AI methods		L1, L2
20AIO03.3	Explain different concepts of logic		L1, L2
20AIO03.4	Describe the different methods of knowledge representation		L1, L2
20AIO03.5	Explain the principles and applications of expert systems		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit 1: Introduction to Artificial Intelligence

9+3 Hours

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Unit II: Problem Solving

9+3 Hours

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques - Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing - Alphabeta pruning - Two-player perfect information games

Unit III: Logic concepts

9+3 Hours

Introduction -Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Unit IV: Knowledge Representation

9+3 Hours

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyctheory - Case grammars

Unit V: Expert Systems

9+3 Hours

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

Text Books

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

Reference Books

1. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
2. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
3. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web Resources

1. <https://nptel.ac.in>

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OE 20DS003 Introduction to Big Data

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20DS003.1	Identify the Knowledge of Big Data		L1, L2
20DS003.2	Demonstrate Hadoop Framework for handling Big Data		L1, L2
20DS003.3	Illustrate the Architectural Concepts of HDFS in Hadoop Ecosystem	-	L1, L2
20DS003.4	Illustrate MapReduce Framework		L1, L2
20DS003.5	Explain Spark & RDD		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Big Data

9 Hours

What is Big Data, Evolution of Big Data, Types of Big Data, Sources of Big Data, 5Vs of Big Data, Big Data Analytics, Big Data Applications, Google File System

Uses of Big Data in Retail Industry

Unit II: Introduction to Hadoop

9 Hours

Introducing Hadoop, Hadoop History, Hadoop-definition, Comparing SQL Databases and Hadoop, Hadoop Cluster, Hadoop Modes, Hadoop Features, The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, Job Tracker, Task Tracker

Hadoop Cluster

Unit III: Hadoop Ecosystem & HDFS

9 Hours

Hadoop and its Ecosystem, Hadoop Ecosystem Components, Hadoop Ecosystems Tools, Hadoop Distributed File System, Concept of Block in HDFS Architecture, Features of HDFS, HDFS Read and Write Mechanism, Rack awareness in HDFS, Introducing HBase, Hive, Pig

HDFS Read/Write

Unit IV: Introduction to MapReduce

9 Hours

Hadoop MapReduce Framework, Architecture, Phases, Mapreduce Job Types, Uses of MapReduce, Techniques to Optimize MapReduce Jobs, Limitations of MapReduce.

MapReduce Phases

Unit V: Introduction to Spark and RDD

9 Hours

Introduction to Spark, Dataframes - Dataframes role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

Dataframes

Text Books

1. DT Editorial Services, "Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Black Book, DreamTech Press, 2019.
2. Sridhar Alla, "Big Data Analytics with Hadoop 3" - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia, "Learning Spark" O'reilly Publications, 2015.

Reference Books

1. Chuck Lam, "Hadoop in Action", 1st Edition, MANNING Publications, 2016.
2. Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture" 1st Edition, Wiley Publications, 2021.
3. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers & Techniques", 1st Edition, Pearson Publications, 2016.

Web Resources

1. <https://hadoop.apache.org/>
2. <https://spark.apache.org/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Big Data.
2. List the characteristics of Big Data.
3. Define Hadoop.
4. What are Hadoop components?
5. What are RDD operations?

L2: Understand

1. Explain HDFS Read & Write mechanism.
2. Explain Rack awareness in HDFS.
3. Explain MapReduce workflow in detail.
4. Describe the working with Key/value pairs in RDDs.

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OE 20ECO03 Privacy and Security in IoT

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO03.1	Understand the basic knowledge of cryptography, networking and web security		L1, L2, L3
20ECO03.2	Explain Architecture of IoT and its Applications		L1, L2, L3
20ECO03.3	Understand the Attacks against IoT system		L1, L2, L3
20ECO03.4	Explain Secure Bootstrapping for IoT System		L1, L2, L3
20ECO03.5	Understand the IoT system security and Trust zone		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Cryptography and Network Securitys

9 Hours

Cryptography, networking, Web Security: Secure socket layer and transport layer security, System Security: Intruders, Viruses and related threads, trusted systems.

Secure Shell (SSH)

Unit II: Introduction to IoT

9 Hours

Internet of Things (IoT), Need of IoT, Applications, Architecture, Enabling technologies, IoT security and privacy.

IoT protocols

Unit III: Attacks against IoT

9 Hours

Attacks against IoT system (hardware + software), Attacks against IoT network protocols, Attacks against industry IoT

Attacks against Web systems

Unit IV: Secure Bootstrapping for secure IoT system

9 Hours

Trusted boot, Secure boot, TPM and its usages, Remote attestation, tamper resistant-proof-response hardware and its usage

Bootstrapping for IoT

Unit V: IoT System Security and TrustZone

9 Hours

System security, TrustZone hardware architecture, TrustZone software architectures.

Web security

Text Books

1. Syed Rameem Zahra, Mohammad Ahsan Chishti, "Security and Privacy in the Internet of Things" 1st Edition, Chapman & Hall, 2020
2. Fei Hu, "Security and Privacy in Internet of Things (IoT)s Models, Algorithms, and Implementations", 1st Edition CRC Press

Reference Books

1. Ravi Ramakrishnan, Loveleen Gaur "Internet of Things Approach and Applicability in Manufacturing", 1st Edition, Chapman & Hall, 2019
2. Vijay Madiseti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press, 2015

Web Resources

1. <https://lss.at.ufl.edu/help.shtml>
2. <http://cms.uflib.ufl.edu/ask>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is cryptography ?
2. List the applications of IoT
3. What is Attacks against IoT system ?

L2: Understand

1. Explain about networking
2. Explain Enabling technologies of IoT
3. Explain Aattacks against IoT network protocols

L3: Apply

1. Discus about web security
2. Write about Architecture of IoT
3. Explain Attacks against industry IoT

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OE 20EE003 Low Cost Automation

3 0 0 3.0

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

Code	Course Outcomes	Mapping with PO's	DoK
20EE003.1	Understanding automation of assembly lines		L2
20EE003.2	Automation Using Hydraulic Systems		L2
20EE003.3	Describe Automation Using Pneumatic Systems		L2
20EE003.4	Explain Automation Using Electronic Systems		L2
20EE003.5	Explain Assembly Automation		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

UNIT I :Automation Of Assembly Lines

9 Hours

Concept of automation-mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms -Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

Transfer line-monitoring system (TLMS) using Line Status ,Line efficiency

UNIT II: Automation Using Hydraulic Systems

9 Hours

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT-III: Automation Using Pneumatic Systems

9 Hours

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Low cost automation - Robotic circuits.

UNIT-IV :Automation Using Electronic Systems

9 Hours

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT-V:Assembly Automation

9 Hours

Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

Product design for automated assembly.


Text Books

1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover-"Automation, Production System and Computer IntegratedManufacturing", Prentice Hall Publications, 2007

Reference Books

1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.

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OE 20MEO03 Industrial Automation

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20MEO03.1	Identify various concepts of automation and work part transport mechanisms.	-	L2
20MEO03.2	Illustrate the assembly systems and their applications.	-	L3
20MEO03.3	Describe the importance of handling systems and identification systems.	-	L3
20MEO03.4	Apply the concepts of part families and machine cells into various production systems	-	L2
20MEO03.5	Recognize the importance of automated inspection and to distinguish the various control systems	-	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Manufacturing and Automation-Over View

9 Hours

Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, Information processing in Manufacturing plant layout, production facilities, Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers. Automation for machining operations.

Unit II: Assembly Systems and Line Balancing

9 Hours

Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. Automated Assembly Systems – Design for automated assembly-Types of automated assembly systems-Parts feeding devices

Unit III: Automated Material Handling Systems

9 Hours

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID

Unit IV: Manufacturing Cells

9 Hours

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications, Transfer lines

Unit V: Control Systems

9 Hours

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control.

Text Books

1. Milkell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

Reference Books

1. C. Roy, "Robots and Manufacturing Automation", Asfahl John Wiley & Sons. 2. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd edition, 2010

Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com

Internal Assessment Pattern

Cognitive Level	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	40	30
L2	40	30
L3	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is industrial automation?
2. What are the different costs included in industry in designing the particular product ?
3. What is production volume?
4. List the categorization of production system.
5. What are the types of automation?
6. What are the features of Flexible Automation?
7. What is factory type of Integral automation?
8. Define process.
9. What are process variables?
10. What is meant by control system in automation?

L2: Understand

1. Explain Automation principles and strategies
2. Compare Manual assembly line, automated assembly system
3. Illustrate Material handling, equipment, Storage systems, performance and location strategies
4. Demonstrate components of a manufacturing system
5. Compare Continuous Control Systems, Discrete Control Systems

L3: Apply

1. Apply the basic elements of an automated system for industrial automation
2. Apply different types of automated assembly systems for moderate plants
3. Apply the Barcode technology, RFID for industrial automation
4. Discuss Automated production lines, Applications, Transfer lines
5. Design the capabilities of computer control systems

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OE 20SHO02 Design Thinking

3 0 0 3

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

Code	Course Outcomes	DoK
20SHO02.1	Explain the fundamentals of Design Thinking and innovation	L2
20SHO02.2	Empathize and analyse model action plan	L2
20SHO02.3	Describe the principles of innovation and idea generation for product design	L2
20SHO02.4	Apply design thinking techniques for given tasks	L2
20SHO02.5	Apply the design thinking techniques for solving problems in various sectors	L3
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge		
1. Weakly Contributing 2. Moderately Contributing 3. Strongly Contributing. for the attainment of respective Pos		
L1: Remember L2: Understand L3: Apply L4: Analyze L5: Evaluate L6: Create. DoK: Depth of Knowledge		

Unit I: Introduction to Design Thinking

9 Hours

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

Unit II: Design Thinking

9 Hours

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Unit III: Innovation

9 Hours

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications

Unit IV: Design Thinking for Strategic Innovation

9 Hours

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Start-ups

Unit V: Design thinking in Various Sectors

9 Hours

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results

Case study learning outcomes:

1. Make use of practical design thinking methods in every stage of problem with the help of method templates
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions
3. Empathize with end user and initiate a new working culture based on user-centric approach
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem

Text Books

1. Tim Brown, Harper Bollins, Change by Design, 2009
2. David Lee, Design Thinking in the Class Room, Ulysses Press

Reference Books

1. Design the Future, Shrutin N Shetty, Norton Press
2. William Lidwell, Kritina Holden, Jill Butter, Universal Principles of Design
3. Chesbrough H., The Era of Open Innovation
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall

Web References

1. <https://nptel.ac.in/courses/110106124>
2. https://onlinecourses.nptel.ac.in/hoc19_mg60/preview
3. www.tutor2u.net/business/presentations/productlifecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/E11087_01.pdf
5. www.bizfilings.com › Home › Marketing › Product Development
6. <https://www.mindtools.com/brainstrm.html>
7. <https://www.quicksprout.com/how-to-reverse-engineer-your-competit>
8. www.vertabelo.com/blog/documentation/reverse-engineering <https://support.microsoft.com/en-us/kb/273814>
9. <https://support.google.com/docs/answer/179740?hl=en>
10. <https://www.youtube.com/watch?v=2mjSDiBaUJM>
11. thevirtualinstructor.com/foreshortening.html
12. <https://dschool.stanford.edu/designresources/ModeGuideBOOTCAMP2010L.pdf>
13. <https://dschool.stanford.edu/use-our-methods/6>
14. <https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process> 7.
15. <https://www.nngroup.com/articles/design-thinking/> 9.
16. <https://designthinkingforeducators.com/design-thinking/> 10.
17. www.designthinkingformobility.org/wp-content/uploads/2010/NapkinPitch_Worksheet.pdf

Activity Based Learning (Suggested Activities in Class) / Practical Based learning

<http://dschool.stanford.edu/dqift/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment # 1 (%)	Internal Assessment # 2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by design thinking?
2. How design thinking works within a product development process

L2: Understand

1. Explain the elements and principles of design
2. Differentiate between creativity and innovation

L3: Apply

1. How design thinking helped financial sector to gain the consumer 'trust'?

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HS 20HSX04 Professional Ethics

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

Code	Course Outcomes	Mapping with POs		DoK
		PO8	PO12	
20HSX04.1	Understand the ethics and Apply ethics in society	3	1	L1,L2,L3
20HSX04.2	Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.	3	1	L1,L2,L3
20HSX04.3	Know the code of ethics and industrial standreds	3	1	L1,L2,L3
20HSX04.4	Understand the rights and responciabilitys of an employee at work place	3	1	L1,L2,L3
20HSX04.5	Understand environmental ethics and CSR of companies	3	1	L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit: Introduction to Ethics

10 Hours

Need and importance of ethics, objectives , morals, values and ethics – integrity – work ethic – service learning – civic virtue – respect for others – living peacefully –honesty – courage – valuing time – cooperation – commitment – empathy – self-confidence..

Unit II :Engineering Ethics

10 Hours

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – consensus and controversy – models of professional roles – self-interest – self respect-customs and religion.

Unit III : Engineering As Social Experimentation

10 Hours

Engineering as experimentation – engineers as responsible experimenters– codes of ethics –industrial standards -- a balanced outlook on law.

Unit IV:Safety, Responsibilities And Rights

10 Hours

Safetyand Risk – Assessment of Safety and Risk – Risk Benefit Analysis - Safety lessons from Challenge- Collective Bargaining – Confidentiality – Conflicts of Interest – OccupationalCrime–ProfessionalRights–EmployeeRights.

UnitV:Global issues

10 Hours

MultinationalCorporations–EnvironmentalEthics–ComputerEthics –WeaponsDevelopment- Engineersas Managers–ConsultingEngineers–MoralLeadership–CodeofConduct– CorporateSocialResponsibility.

Text Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "EngineeringEthics", Prentice Hall of India, New Delhi, 2004.

Reference Books

1. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt. Ltd., New Delhi 2013 Web References
2. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011

3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.

Web reference:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List the human values and explain
2. Give an overview of Engineering Ethics
3. What is meant by Professional Responsibility?
4. What are the safety lessons one can learn in the *Challenger* case?
5. Discuss in detail about the employee rights.
6. Discuss on the engineer's role in weapon development.

L2: Understand

1. Illustrate the ethical aspect principle of caring or sharing, with an example.
2. Explain various actions of an engineer leading to dishonesty.
3. Justify the safety and other obligations of professional engineers.
4. Discuss the problems with law in engineering practice.
5. Explain in detail about the effect of information on risk assessments
6. Explain the role of engineers as 'expert witness' and 'advisors'.

Dr. V. BALA, M.B.A, Ph.D
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HO 20EES05 ECAD

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO10	PSO2	
20EES05.1	Draw symbolic representation of electrical components manually.	3	1	1	L3
20EES05.2	Draw free hand sketches, isometric and orthographic views of electrical machines and components.	3	1	1	L3
20EES05.3	Use CAD tools to draw simple electrical components and machines	3	1	1	L3
20EES05.4	Use CAD to create electrical circuits with components.	3	1	1	L3
20EES05.5	Edit electrical line drawings and control panel layouts in CAD.	3	1	1	L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

List of Experiments:

1. Sketch the symbols of the given type of electric lamps, electric wiring accessories.
2. Interpret orthographic Projection of the given Electrical Machine parts or electrical components.
3. Interpret the isometric Projections of the given Electrical Machine parts or electrical components.
4. Absolute Coordinate Method: Commands: LIMITS, UNITS, LINE and ARC.
5. Relative coordinate Method: Commands: LIMITS, UNITS, LINE and ARC.
6. Relative polar coordinate method: Commands: LIMITS, UNITS, LINE and ARC.
7. 2D figures: Commands: LINE, CIRCLE, OIT'SE'I, TRIM, FILLET, ARC, POLYGON, ELLIPSE, COPY, MIRROR, TRIM, ROTATE and CHAMFER
8. Isometric drawings: commands: LIMITS, UNITS, ZOOM, GID, SNAP, LINE, COPY, ISOPLANE, ELLIPSE, TRIM, ERASE, PROPERTIES and SAVE.
9. Draw cable layout diagrams.
10. Draw layouts of substations.
11. Draw layouts of earthing systems.

Textbooks:

1. Gaurav Verma, Matt Weber, "AutoCAD Electrical 2022 Black Book", CAD/CAM/CAE works, USA., 2021.
2. Prof. Sham Tickoo, "AutoCAD Electrical 2021 for Electrical Control Designers", CAD/CIM Technologies, USA, 2020.

Web References:

1. www.mycadsite.com/tutorials/level_3/isometric-drawing-in-autocad-3-2.htm accessed on 27th June, 2016
2. www.cadlearning.com/courses/autocad-mechanical-training-tutorials/. accessed on 27th June, 2016
3. <http://www.staff.city.ac.uk/~ra600/MEI105/Tutorials/CAD-I/Tutorial%20CAD-Ia.pdf>, accessed on 28th June, 2016
4. www.youtube.com/watch?v=Nv8skZZcUlw , accessed on 29th June, 2016

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HO 20EEH04 Electric Vehicle Technologies

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEH04.1	Outline various electric and hybrid vehicle architectures		L2
20EEH04.2	Understand about drives and control.		L2
20EEH04.3	Select battery, battery indication system for EV applications		L3
20EEH04.4	Analyse battery charger for an EV		L4
20EEH04.5	Demonstrate different configurations of electric vehicles and its components		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Introduction to Electric and Hybrid Electric Vehicles **12 Hours**
Sustainable transportation, Brief history of electric vehicles (EV's), Hybrid electric vehicles, Fuel cell vehicles, Architectures of EV, Series HEV, Parallel HEVs, Diesel HEVs, PHEV & FCEV, Hybridization ratio, Interdisciplinary Nature of HEVs, Challenges and key technology of HEVs.

Unit II: Electric Machines and Drives in HEVs **12 Hours**
Introduction to induction motor drives and control Principle of operation and analysis of BLDC motor Drive, PMSM drive and SRM drive.

Unit III: Power Factor and energy instruments **12 Hours**
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, Hybridization of different energy storage devices. Sizing the drive system, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle

Unit IV: Energy Management System **12 Hours**
Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business- E-mobility business, electrification challenges

Unit V: Mobility and Connectors **12 Hours**
Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards

Text Books

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
2. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.
3. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003

Reference Books

1. Larminie, James, and John Lowry, "Electric Vehicle Technology Explained" John Wiley and Sons, 2012.
2. Tariq Muneer and Irene Illescas Garcia, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
3. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013

Web References

1. <https://nptel.ac.in/courses/108/106/108106170/>
2. <https://www.youtube.com/watch?v=3E1SXG7VvQk&list=PLHRG-unM84XgZd9HKQAmKdE12-1eRSe>

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HO 20EEH05 Energy Audit Conversation and Management

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEH05.1	To understand energy efficiency, scope, conservation and technologies.		L2
20EEH05.2	To design energy efficient lighting systems.		L2
20EEH05.3	To estimate/calculate power factor of systems and propose suitable compensation techniques		L2
20EEH05.4	To understand energy conservation in HVAC systems		L2
20EEH05.5	To calculate life cycle costing analysis and return on investment on energy efficient technologies.		L1

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Basic Principles of Energy Audit and management

12 Hours

Energy audit – Definitions – Concept – Types of audit – Energy index – Cost index – Pie charts –Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential – Numerical problems – Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions – Language – Questionnaire – Check list for top management.

Unit II: Lighting

12 Hours

Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units – Luminous efficiency – Polar curve – Calculation of illumination level – Illumination of inclined surface to beam – Luminance or brightness – Types of lamps – Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservation measures.

Unit III: Power Factor and energy instruments

12 Hours

Power factor – Methods of improvement – Location of capacitors – Power factor with non linear loads – Effect of harmonics on Power factor – Numerical problems. Energy Instruments – Watt-hour meter – Data loggers – Thermocouples – Pyrometers – Lux meters – Tong testers – Power analyzer.

Unit IV: Space Heating and Ventilation

12 Hours

Ventilation – Air-Conditioning (HVAC) and Water Heating: Introduction – Heating of buildings – Transfer of Heat-Space heating methods – Ventilation and air-conditioning –Insulation–Cooling load – Electric water heating systems – Energy conservation methods.

Unit V: Economic Aspects and Financial Analysis

12 Hours

Understanding energy cost - Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis.

Need of investment, appraisal and criteria - Calculation of simple payback period–Return on investment – Net present value – Internal rate of return – numerical examples – Applications of life cycle costing analysis – Return on investment – Numerical examples.

Text Books

1. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill
2. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd–2nd edition, 1995
3. Energy management and conservation –k v Sharma and P.venkatasessaiah-I K International Publishing House pvt.ltd,2011.

Reference Books

1. Energy management by W.R. Murphy & G. McKay Butter worth, Elsevier publications. 2012
2. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
3. Energy management by Paul o' Callaghan, Mc-Graw Hill Book company-1st edition, 1998.
4. Energy management hand book by W.C.Turner, John wiley and sons.

Web References

1. <https://nptel.ac.in/courses/108/104/108104087/>
2. <https://www.edx.org/course/electricity-and-magnetism-maxwells-equations>
3. <https://www.udemy.com/course/energy-audit/>

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HO 20EEH06 Electrical Load Estimation

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEH05.1	Understand the basic concepts of Estimation		L2
20EEH05.2	Explain estimation and costing of residential and commercial buildings		L2
20EEH05.3	Explain estimation of industrial installations		L2
20EEH05.4	Condition monitoring and Testing of various electrical equipment		L2
20EEH05.5	Learn Distribution systems, its types and substations		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: General Principles of Estimation

12 Hours

Introduction to estimation & costing, Electrical Schedule, Catalogues, Market Survey and source selection, Recording of estimates, Determination of required quantity of material, Labor conditions, Determination of cost material and labour, Contingencies, Overhead charges, Profit, Purchase system, Purchase enquiry and selection of appropriate purchase mode, Comparative statement, Purchase orders, Payment of bills, Tender form, General idea about IE rule, Indian Electricity Act and major applicable I.E rules.

Unit II: Estimation of Domestic Installations

12 Hours

Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate

Unit III: Estimation of Industrial Installations

12 Hours

Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single phase, 3-phase motor load and the light load (3-phase supply system) ,Service line connections estimate for domestic and Industrial loads (over-head and Under- ground connections) from pole to energy meter.

Unit IV: Estimation of Over Head Transmission & Distribution Lines

12 Hours

Introduction, Typical AC electrical power system, Main components of overhead lines, Factors governing height of pole, Determination of size of conductor for overhead transmission line, Points to be considered at the time of erection of overhead lines, Positioning of conductors and attachment to insulators, Jumpers, Tee-offs, Earthing of transmission lines, Clearances of conductor from ground, Spacing between conductors, Testing and commissioning of overhead distribution lines, Some important specifications.I.C

Unit V: Estimation of Substations

12 Hours

Introduction, Classification of substation, Indoor substations, Outdoor substations, Selection and location of site for substation, Main Electrical Connections, Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram, Key diagram of typical substations, Equipment for substation and switchgear installations

Text Books

1. J.B Gupta, S.K Kataria and Sons "A Course in Electrical Installation, Estimating and Costing" 2nd edition, 2013
2. Raina & Battacharya, Wiley Eastern "Electrical Design: Estimation & Costing" 2nd edition, 2009

Reference Books

1. Surjeet Singh, Dhanpat Rai & Co. "Estimating and Costing" 2nd edition, 2003.
2. S.L Uppal, "Estimating and Costing", 2nd edition, Khanna Publishers, 2004.
3. N Alagappan and B Ekambaram, "Electrical Estimating and Costing" 2nd edition, Tata Mcgraw Hill, 2006.

Web References

1. <http://www.electricaltechnology.org/2015/05/earthing-and-electrical-grounding-types-of-earthing.html>
2. http://mptransco.nic.in/tender_files/volume-v.pdf (Transmission Line Materials and Installation work)
3. https://www.ergon.com.au/_data/assets/pdf_file/0004/146839/NI000401R121-Subs-Design-Manual.pdf

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HO 20EEH07 Challenges and Impact of Electric Vehicles on Smart Grid 4 0 0 4.0

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEH07.1	Describe vehicle electrification and impact of charging strategies.		L2
20EEH07.2	Describe the influence of EVs on power system		L2
20EEH07.3	Describe the frequency control and voltage reserve from EVs		L2
20EEH07.4	Explain ICT solutions of EV development		L2
20EEH07.5	Explain decentralized charging schemes		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: Introduction of Vehicle electrification

12 Hours

Introduction, Impact of charging strategies, EV charging options and infrastructure, energy, economic and environmental considerations, Impact of EV charging on power grid, effect of EV charging on generation and load profile, Smart charging technologies, Impact on investment

Unit II: Influence of EVs on power system

12 Hours

Introduction, identification of EV demand, EV penetration level for different scenarios, classification based on penetration level, EV impacts on system demand: dumb charging, multiple tariff charging, smart charging, case studies

Unit III: Frequency Control Reserves & Voltage support from EVs

12 Hours

Introduction, power system ancillary services, electric vehicles to support wind power integration, electric vehicle as frequency control reserves and tertiary reserves, voltage support and electric vehicle integration, properties of frequency regulation reserves, control strategies for EVs to support frequency regulation.

Unit IV: ICT solutions to support EVs deployment

12 Hours

Introduction, Architecture and model for smart grid & EV, ICT players in smart grid, smart metering, information & communication models, functional and logical models, technology and solution for smart grid: interoperability, communication technologies.

Unit V: EV charging facility planning

12 Hours

Energy generation scheduling, different power sources, fluctuant electricity, centralized charging schemes, decentralized charging schemes, energy storage integration into Microgrid, Design of V2G Aggregator

Text Books

1. Amir Khajepour, Saber Fallah and Avesta Goodarzi, "Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach", John Wiley & Sons Ltd, 2014.
2. James Laminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2013.

Reference Books

1. Crouse W.H, Anglin D.L, "Automotive Transmission and Power Train construction", McGraw Hill, 2016
2. J.Gabrielleen, "Automotive In-Vehicle Networks", John Wiley & Sons, Limited, 2008

Web References

1. <https://www.coursera.org/lecture/electric-utilities/5-2-smart-grid-YUPgW>

2. <https://online.stanford.edu/courses/xeiet237-transforming-grid-ai-renewables-storage-evs-and-prosumers>
3. <https://nptel.ac.in/courses/108/102/108102121/>

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HO 20EEH08 Optimization Techniques

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

Code	Course Outcomes	Mapping with POs	DoK
20EE403.1	Understanding of the logics of various optimization techniques.		L2
20EE403.2	Formulate and solve optimization problems.		L2
20EE403.3	Interpret and analyze the solutions of optimization algorithms.		L2
20EE403.4	Use software tools in engineering design optimization problems.		L2
20EE403.5	Demonstrate various types of methods of optimization		L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Introduction **12 Hours**
Optimization – Optimal Problem Formulation, Engineering Optimization Problems, Optimization Algorithms, Numerical Search for Optimal Solution. Graphical Method, Big M Method, Two Phase Method.

Unit II: Single variable optimization - I **12 Hours**
Optimality criteria, Bracketing Methods - Exhaustive Search Method, - Region Elimination Method-Interval Halving, Fibonacci Search, Golden Section Search, Interpolation Methods, Point Estimation Method- Successive Quadratic Search, Gradient Based Method.

Unit III: Single variable optimization – II **12 Hours**
Initial Value Problems for Ordinary Differential Equations: Single Step Methods, Euler and Modified Euler Methods, Fourth Order Runge – Kutta Method for Solving First and Second Order Equations. Case Study and Simulation.

Unit IV: Multivariable optimization **12 Hours**
Optimality Criteria, Unconstrained Optimization - Solution by Direct Substitution Unidirectional Search- Direct Search Methods, - Steepest Descent Method, Shortest Path Algorithm Hook - Jeeves Pattern Search Method, Gradient Based Method. Newton's Method, Conjugate Gradient Method, Constrained Optimization-Kuhn- Tucker, Lagrange Multiplier Method. Case Studies and Simulation

Unit V: Stochastic methods of optimization **12 Hours**
Random Search Methods, Evolutionary Computation-Introduction, Survival of The Fittest, Fitness Computation, Cross Over, Mutation, Reproduction, Particle Swarm Optimization, Introduction to Multi-Objective Optimization. Case Study and Simulation.

Textbooks:

1. S. S. Rao, "Optimization Theory & Applications", New Age international ltd. Publishers, Second edition, 1995
2. Kalyan Moy Deb, "Optimization for Engineering Design Algorithms & Examples" Prentice Hall of India, New Delhi 2004.

Reference Books:

1. Edwin K. P. Chong, and Stanislaw H. Zak, "An Introduction to optimization", Wiley- interscience series in discrete mathematics and optimization, second edition, 2004.
2. M. Asghar Bhatti, "Practical optimization methods with mathematics applications", Springer Verlag Publishers, 2000.
3. G. A Vijayalakshmi Pai & S. Rajashekharan "Neural Network, Fuzzy Logic, Genetic Algorithms Synthesis & Applications", PH India,2003.

Web References:

1. <https://www.youtube.com/watch?v=aJKuM4U-eYg>
2. <https://nptel.ac.in/courses/106/105/106105173/>
3. <https://www.youtube.com/watch?v=K9gjuXjJeEM>

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HO 20EEH09 Illumination Engineering 4 0 0 4.0

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO 1	PO 6	
20EEH09.1	Understand basic concepts of lighting	3	2	L2
20EEH09.2	Explain different methods to measure light	3	2	L2
20EEH09.3	Describe different types of interior lighting	3	2	L2
20EEH09.4	Explain different types of street lighting	2	2	L2
20EEH09.5	Understand different types of flood lighting	2	2	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Introduction of Light

12 Hours

Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localised

Direct, Indirect, Semi Direct, Semi Indirect Lighting Systems.

Unit II: Measurement of Light

12 Hours

Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source

Illumination At Horizontal And Vertical Plane From Point Source

Unit III: Design of Interior Lighting

12 Hours

Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination such as DLOR and ULOR, Selection of lamp and luminance

Selection Of Utilization Factor, Reflection Factor And Maintenance Factor

Unit IV: Design of Outdoor Lighting : Street Lighting

12 Hours

Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio.

Calculation Of Illumination Level Available On Road

Unit V: Design of Outdoor Lighting : Flood Lighting

12 Hours

Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio,

Recommended Method For Aiming Of Lamp

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, "Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College", BiblioLife, 2009
2. Jack L. Lindsey, "Applied Illumination Engineering", 4th Edition, PHI, 1991
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2nd Edition, Springer, 1993.

Reference Books

1. M.A. Cayless, "Lamps and Lighting", 5th Edition, Routledge, 1996.
2. Leopold Bloch, "Science of Illumination; An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2008.

Web References

1. <https://nptel.ac.in/courses/108/105/108105060/>

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels


L1: Remember

1. What luminous flux?
2. What is lighting scheme?
3. What Uniformity ratio?
4. What is semi-indirect lighting?
5. What is candle power?

L2: Understand

1. Explain Terms related to street and street lighting.
2. Explain Inverse square law and Lambert's Cosine law.
3. Explain on what basis lamp and luminance are selected
4. Explain the requirements of good street lighting.
5. Explain different types of pictures used for street lighting.

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HO 20EEH10 Design and Testing of Battery Management System for Electric Vehicles 4 0 0 4.0

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

Code	Course Outcomes	Mapping with Pos	DoK
20EEH10.1	Discuss about the different types of energy storage system.		L2
20EEH10.2	Describe about the battery characteristic & parameters.		L2
20EEH10.3	Design of different battery models		L2
20EEH10.4	Apply the concepts of battery management system and design the battery pack.		L3
20EEH10.5	Explain about the battery testing, disposal and recycling.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Energy Storage System 12 Hours

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System

Unit II: Battery Characteristics & Parameters 12 Hours

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries

Unit III: Battery Modelling 12 Hours

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model, Simulation examples.

Unit IV: Battery Pack and Battery Management System 12 Hours

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

Unit V: Battery Testing, Disposal & Recycling 12 Hours

Battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries

Textbooks


1. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", John Wiley & Sons. 2017. (ISBN: 978-1-1193-2185-9)
2. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", Springer, 2018. (ISBN: 978-3-319-70571-2)
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd., 2016.

Reference Books

1. Chris Mi, Abul Masrur & David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011.
2. Pistoia G., Wiaux J.P., Wolsky S.P., "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)"
3. Crompton T.R., "Battery Reference Book-3rd Edition", Newnes- Reed Educational and Professional Publishing Ltd., 2000.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

Web References

1. https://www.researchgate.net/publication/337434169_Power_Electronics_Converters_for_an_Electric_Vehicle_Fast_Charging_Station_with_Energy_Storage_System_and_Renewable_Energy_Sources
2. https://www.researchgate.net/publication/305288782_Power_electronics_in_smart_grid_distribution_power_systems_a_review

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HO 20EEH11 Advanced Power System Protection

4 0 0 4.0

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

Code	Course Outcomes	Mapping with PO's			DoK
		PO2	PO7	PO10	
20EEH11.1	Define various Electromagnetic and static relays	3	2	2	L1
20EEH11.2	Outline various types of distance relays	3	2	2	L2
20EEH11.3	Analyse compensation for correct distance measurement	3	2	2	L4
20EEH11.4	Develop various digital relaying algorithms	3	2	2	L3
20EEH11.5	Experiment with microprocessor in implementation of digital relaying algorithms	3	2	2	L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Introduction to Protective Relays

12 Hours

Current transformers for protection, Coupling capacitor voltage transformers, transient performance of current transformer, CCVT potential transformer, review of electromagnetic relays static relays. Over current relays-time current characteristic, current setting time setting, directional relay, static over current relays

Unit II: Distance protection-I

12 Hours

Impedance, reactance, mho, angle impedance relays, Input quantities for various types of distance relays, effect of arc resistance on the performance of distance relays, selection of distance relays, MHO relay with blinders, quadrilateral relay, elliptical relay, Restricted mho, impedance directional, reactance relays, Swiveling characteristics.

Unit III: Distance protection-II

12 Hours

Compensation for correct distance measurement, reduction of measuring units, switched schemes, Pilot relaying schemes, Wire pilot protection, circulating current scheme, balanced voltage scheme, transley scheme, carrier current protection, phase comparison carrier current protection, carrier aided distance protection.

Unit IV: Digital relaying techniques

12 Hours

Digital relaying algorithms, differential equation technique, discrete Fourier transform technique, Walsh-Hadamard transform technique, rationalized Haar transform technique, removal of dc offset.

Unit V: Microprocessor based protective relays

12 Hours

Over current, directional, impedance, reactance relays, generalized mathematical expressions for distance relays, mho and offset mho relays, quadrilateral relay, Microprocessor implementation of digital distance relaying algorithms.

Text Books

1. Badri Ram, "Power System Protection and Switchgear", Tata McGraw-Hill Education, 2011.
2. Madhava Rao, "Power System Protection: Static Relays with microprocessor Applications", Tata Mc Graw-Hill Education, 2004.
3. C. Christopoulos and A. Wright "Electrical Power System Protection", Springer International, 2nd Edition 2013

Reference Books

1. Mark Brown, Ramesh Balakrishnan, L. G. Hewitson. Newans, "Practical Power System Protection" Elsevier, 2015
2. L. P. Singh, "Digital Protection- Protective Relaying from Electromechanical to Microprocessor" By New Age International 2016

Web References

1. <https://nptel.ac.in/courses/108/107/108107167/>
2. https://www.youtube.com/watch?v=QsGn7H_14VY&list=PLLy_2iUCG87BIJ6ZiIVIRCx2Crf9_fJMB

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HO 20EEH12 Power System Stability

4 0 0 4.0

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

Code	Course Outcomes	Mapping with Pos	DoK
20EEH12.1	Determine the model of synchronous machines.		L2
20EEH12.2	Know the steady state stability studies of synchronous machines		L2
20EEH12.3	Get the knowledge of solution methods of transient stability.		L3
20EEH12.4	Know the effect of different excitation systems in power systems.		L3
20EEH12.5	Know the effect of different voltage regulators in power systems.		L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Unit I: System Dynamics

12 Hours

Synchronous machine model in state space from computer representation for excitation and governor system –modelling of loads and induction machines.

Unit II: Steady state stability

12 Hours

steady state stability limit – Dynamics Stability limit – Dynamic stability analysis – State space representation of synchronous machine connected to infinite bus-time response.

Unit III: Digital Simulation of Transient Stability

12 Hours

Swing equation machine equations – Representation of loads – Alternate cycle solution method – Direct method of solution – Solution Techniques: Modified Euler method – Runge Kutta method.

Unit IV: Automatic Voltage Regulators

12 Hours

Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.

Unit V: Excitation Systems

12 Hours

Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme.

Text Books

1. Kimbark "Power System Stability" 3rd edition Vol. I&II, III, Wiley, 2022
2. Anderson and Fund "Power System control and stability", IEEE Press.

Reference Books

1. Prabha kundur "Power systems stability and control", TMH. 2013
2. Glenn.W.Stagg& Ahmed. H.El.Abiad "Computer Applications to Power Systems" TMH.
3. M.A.Pai, TMH. "Computer Applications to Power Systems " IEEE press 2008
4. S.S.Vadher "Power Systems Analysis & Stability", S.S.VadheraKhanna Publishers, 2013

Web References

1. <https://nptel.ac.in/courses/108/106/108106026/>
2. <https://unacademy.com/course/power-system-stability-484/WPVY3084>
3. <https://www.electrical4u.com/power-system-stability/>

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MI 20CEM02 Climate Change Mitigation and Adaptation

3 0 0 3

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

Code	Course Outcomes
20CEM02.1	Understand the concept of climate change scenarios
20CEM02.2	Outline the causes for the changes in the climate
20CEM02.3	Identify the impacts of climate change on various sectors
20CEM02.4	Adopt the methodologies in finding the changes in climate
20CEM02.5	Demonstrate the climate change adaptation and mitigation options for securing sustainable development

Unit I: Fundamentals of Climate Change

9 Hours

Greenhouse gases, radiative forcing potential, carbon dioxide equivalency, natural climate forcing factors, emissions sources and sinks

Unit II: Observed Changes and its Causes

9 Hours

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

Unit III: Impacts of Climate Change

9 Hours

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios - Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV: Clean Technology and Energy

9 Hours

Clean Development Mechanism - Carbon Trading- examples of future Clean Technology - Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Biofuels - Solar Energy – Wind – Hydroelectric Power.

Unit V: Adaptation and Mitigation Responses

9 Hours

Policy, Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC, Concept framework of urban adaptation to climate change, Mitigation Efforts in India and Adaptation funding.

Text Books

1. Jan C. Van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003
2. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Reference Books

1. Pielke, R., "Lifting the taboo on adaptation", Nature 445 (7128), 597-598, 2007
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013

Web References

1. IPCC Fourth Assessment Report – The AR4 Synthesis Report
2. <https://www.coursera.org/learn/climate-change-mitigation>
3. <https://www.usc.edu.au/study/courses-and-programs/courses/course-library/ens/ens204-climate-change-mitigation-and-adaptation>

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MI 20CSM02 Knowledge Discovery and Databases

3 0 0 3

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

Code	Course Outcomes
20CSM02.1	Illustrates the basic concepts of database management system
20CSM02.2	Able to summarize mining and preprocessing of data
20CSM02.3	Outline the functionalities of data mining(characterization)
20CSM02.4	Able to explain the processes of association analysis
20CSM02.5	Illustrate the features of various clustering techniques

Unit I: Introduction to Database and Data Warehouse

9 Hours

Overview of Data, What is Database and What is Database Management Base System, Meaning of Entity, Relation, Database Design and ER diagrams, Attributes, DMBS Software's available in Market, Structured Query Language (SQL) What is Data Warehouse, Types of Data Warehouse, On-Line Analytical Processing (OLAP)

Unit II: Data Mining Introduction

9 Hours

Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Data Objects and Attribute Types, Statistical Description of Data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and Discretization, Data Visualization

Unit III: Classification

9 Hours

Introduction and Basic Concepts of Classification, What is Training Data, Supervisory Learning and Unsupervisory Learning, Decision Tree Induction, Working of Decision Tree and Building a Decision Tree, Bayes' Theorem, Classification by Back Propagation

Unit IV: Association

9 Hours

What is Association Analysis, Frequent Item Set Generation, Association Rule Generation using Apriori Algorithm.

Unit V: Clustering and Outlier Analysis

9 Hours

What is Cluster Analysis, Different Types of Clusters, Partition Method – K-Means Algorithm, Hierarchical Methods – Hierarchical Cluster Algorithm, Density Based Method- DBSCAN and Outlier Analysis, What is Outlier Analysis?

Practicing Tool: SQL, Weka, Python and R

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson, 2016

Reference Books

1. Alex Berson, Stephen J. Smith, – "Data Warehousing, Data Mining & OLAP II", Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, Shyam Diwakar and V. Ajay, – "Insight into Data Mining Theory and Practice", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H. Witten, Eibe Frank, – "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Elsevier.

Web Resources

1. <https://www.tutorialspoint.com/>
2. <https://www.coursera.org/learn/>

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MI 20MEM02 Micro Electromechanical Systems

3 0 0 3

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

Code	Course Outcomes
20MEM02.1	Acquire the operation of micro devices, micro systems and their applications
20MEM02.2	Ability to design the micro devices, micro systems using the MEMS fabrication process.
20MEM02.3	Acquire basic approaches for various sensor design
20MEM02.4	Acquire basic approaches for various actuator design
20MEM02.5	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

Unit I: Basic Concepts

9 Hours

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology..

Unit II: Thermal Sensors And Actuators

9 Hours

Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit III: Micro-Opto-Electro Mechanical Systems

9 Hours

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement. MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device

Unit IV: Micro Fluidic Systems

9 Hours

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluorescence detection, calorimetric spectroscopy

Text Books

1. NitaigourPremchandMahalik, "MEMS" TMH Publishing co.

Reference Books

1. Chang Liu, "Foundation of MEMS", Prentice Hall Ltd.
2. Sergey EdwrLyshevski, "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu, "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Thomas M Adams, "Richard A Layton Introductory MEMS", Springer International Publishers.

Web References

1. <https://nptel.ac.in/courses/117/105/117105082/>

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MI 20EEM02 Basics of Electrical Machines and Drives

3 0 0 3

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

Code	Course Outcomes
20EEM02.1	Understand the basic concepts of different types of electrical drives
20EEM02.2	Able to explain the performance characteristics of electrical drives
20EEM02.3	Study the different methods of starting D.C motors and induction motors
20EEM02.4	Study the conventional and solid-state D.C. drives
20EEM02.5	Study the conventional and solid-state A.C. drives

Unit I: Introduction

9 Hours

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

Unit II: Drive Motor Characteristics

9 Hours

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors-

Unit III: Starting Methods

9 Hours

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors

Unit IV: Conventional and Solid State Speed Control of D.C. Drives

9 Hours

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

Unit V: Conventional and Solid State Speed Control of A.C. Drives

9 Hours

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme Using inverters and AC voltage regulators – applications

Textbooks

1. Nagrath J.J. & Kothari D.P, "Electrical Machines", Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, "Electric Drives (Concepts and Applications)", Tata McGraw-Hill, 2010

Reference Books

1. Partab. H., "Art and Science and Utilisation of Electrical Energy", Dhanpat Rai and Sons, 2017
2. Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 209
3. Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2006.

Web References

1. <https://link.springer.com/book/10.1007/978-3-319-72730-1>
2. <https://www.routledge.com/Electrical-Machine-Drives-Fundamental-Basics-and-Practice/Franchi/p/book/9781138099395>

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MI 20ECM02 Digital Electronics

3 0 0 3

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

Code	Course Outcomes
20ECM02.1	Utilize theory of Boolean algebra & the underlying features of various number systems
20ECM02.2	Choose the concepts of Boolean algebra for the minimization of switching functions
20ECM02.3	Design of various combinational logic circuits using basic gates
20ECM02.4	Design various simple programmable logic devices to complex programmable logic devices & arrays
20ECM02.5	Develop of various sequential logic circuits

Unit I: Introduction to Boolean Algebra and Switching Functions

9 Hours

Conversion from One Radix to Another Radix, $r - 1$ and r 's complement
4 Bit Codes: BCD, Excess - 3, 2421, 84 - 2 - 1, 9's Compliment Code, Gray Code etc. Realization of logic operations for Basic and Universal gates

Unit II: Boolean Minimization

9 Hours

Minimization of Logic Functions using Boolean Theorems, Minimization of Switching Functions using K-Map Up to 6 Variables, Quine - McCluskey Method, Standard SOP And POS forms

Unit III: Finite State Machines and Bipolar Logic Families

9 Hours

Design of synchronous FSMs, Asynchronous FSMs. Bipolar Logic Families (ECL), MOS logic families (NMOS and CMOS) and their electrical behaviour

Unit IV: Memory Elements

9 Hours

Basic structures and realization of Boolean functions using PROM, PAL, PLA, PLD, CPLD, FPGA, Buffers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA)

Unit V : Elementary combinational and sequential digital circuits

9 Hours

Adders, Subtractors, Multiplexer, Demultiplexer, Encoder, Decoder, Comparators, Latches, Flip-flops, Shift registers, Counters

Text Books

1. Taub, H. and Schilling, D., "Digital Integrated Electronics", McGraw Hill, 1977
2. Hodges, D.A. and Jackson, H.G., "Analysis and Design of Digital Integrated Circuits", International Student Edition, McGraw Hill, 1983
3. Hill, F.J. and Peterson, G.L., "Switching Theory and Logic Design", John Wiley, 1981
4. Anand Kumar, A., "Switching Theory and Logic Design", 3rd Edition, Prentice Hall International Learning, 2016

Reference Books

1. Kohavi, Z., "Switching and Finite Automata Theory", McGraw Hill, 1970
2. Jain, R.P., "Modern Digital Electronics", 3rd Edition, Tata McGraw Hill, 2003
3. Charles Roth, H. and Larry Kinney, L.Jr., "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

Web Resource

1. https://onlinecourses.nptel.ac.in/noc19_ee51/preview
2. <https://nptel.ac.in/courses/117/105/117105080/>
3. https://gate.iitkgp.ac.in/gate_syllabus.html
4. <https://www.ee.iitb.ac.in/web/academics/courses/EE221>

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MI 20AIM02 Machine Learning with Python

3 0 0 3

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

Code	Course Outcomes
	At the end of the course, the students will be able to
20AIM02.1	Solve simple computational problems with python
20AIM02.2	Identify and use appropriate functions to handle data in python code
20AIM02.3	Describe the foundational concepts and terminologies of machine learning
20AIM02.4	Explain various unsupervised learning algorithms
20AIM02.5	Evaluate the performance of the machine learning algorithm

Unit 1: Basics of Python Programming

9 hours

Introduction to Python: evolution, features – Python IDE installation – Syntax – Comments – Variables – Data types – Numbers – Strings – Booleans – Operators – Control statements – Data structures: lists, dictionary, tuples, sets, arrays – Functions

Unit 2: Python modules for ML

9 hours

NumPy – Pandas – SciPy – Matplotlib

Unit 3: Introduction to Machine Learning

9 hours

Machine Learning essentials: data set, mean, median, mode, standard deviation, percentile, data distribution, normal distribution – Types of learning: supervised, unsupervised – Supervised learning: classification and regression – Classification algorithms: KNN, Naïve Bayes classifier, Decision trees, Linear models, SVM

Unit 4: Unsupervised Learning and Pre-processing

9 hours

Types of unsupervised learning – Challenges in unsupervised learning – Pre-processing and Scaling – Dimensionality reduction: Principal Component Analysis – Clustering: k-means, agglomerative, DBSCAN

Unit 5: Data representation and Model evaluation

9 hours

Categorical variables: one-hot encoding – Binning – Discretization – Automatic feature selection – Model evaluation: cross-validation – Grid search – Evaluation metrics and scoring

Text Books

1. Andreas C. Miller and Sarah Guido, "Introduction to Machine Learning with Python – A guide for Data Scientist", O.Reilly Publisher, 1st edition, 2016
2. Peter Flach, "Machine Learning – The art and science of algorithms that make sense of data", Cambridge Press, 2012
3. Tom Mitchell, "Machine Learning", McGraw Hill, 2014

Reference Books

1. Peter Harington, "Machine Learning in Action", Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012

Web Resources

1. <https://www.tutorialspoint.com/python>
2. <https://www.w3schools.com/python>

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N.S. Raju, Chairman
Board of Studies (AIML)
Sontyam, Visakhapatnam - 531173

Mi 20DSM02 Data Management and Analysis

3 0 0 3.0

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

Code	Course Outcomes
20DSM02.1	Understand database and be familiar with relational database concepts
20DSM02.2	Demonstrate knowledge of terms, methods of ER Modelling
20DSM02.3	Demonstrate knowledge of trends in data management in Entity Clustering
20DSM02.4	Demonstrate how to acquire, transform, analyse in SQL
20DSM02.5	Demonstrate how to solve problems in accounting using Transactions

Unit I: Database Concepts and Design Concepts **9 hours**
Why Databases? Data Versus Information, Why Database Design is Important? Evolution of File System Data Processing, Problems with File System Data Processing, Database Systems.
Relational Database Model- A Logical View of Data, Keys, Integrity Rules, Relational Algebra, Relationships within the Relational Database, Data Redundancy

Unit II: Entity Relationship (ER) Modeling **9 hours**
Entities, Attributes, Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Participation, Relationship Degree, Recursive Relationships, Associative Entities, Developing an ER diagram

Unit III: Entity Clustering **9 hours**
Entity Integrity: Selecting Primary Keys, Natural Keys and Primary Keys, Primary Key guidelines, when to use Composite Primary Keys, when to use Surrogate Primary Keys, Design Cases: Learning Flexible Database Design

Unit IV: Introduction to SQL **9 hours**
Data Definition Commands, Data Manipulation Commands, SELECT Queries, Additional Data Definition Commands, Additional SELECT Query Keywords, Creating VIEW, Joining Database Tables

Unit V: Transaction Management and Concurrency Control **9 hours**
What is Transaction? Concurrency Control, Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods

Text Books

1. Carlos Coronel and Steven Morris, "Database systems: Design, Implementation, & Management", 13th Edition. Cengage Learning. ISBN-13: 978-1337627900, 2019
2. Sholom M. Weiss, Nitin Indurkha, Tong Zhang, and Fred Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured Information", First Edition. Springer, 2020

Reference Books

1. Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, "Database Systems: The Complete Book". 2nd Edition. Pearson, 2001
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques". 3rd Edition. Elsevier. 2006

Web Resources

1. <https://www.niti.gov.in/verticals/data-management-and-analysis>
2. <https://searchdatamanagement.techtarget.com/definition/data-management>
3. <https://nptel.ac.in/courses/110/104/110104094/>

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MI 20SHM03 English for the Media

3 0 0 3

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

Code	Course Outcomes
20SHM03.1	Understand what media literacy is and its importance
20SHM03.2	Introduce the essential requirements of writing for the media
20SHM03.3	Familiarise the learners with the process of writing for the media
20SHM03.4	Make them familiar with the specific use of English in the field of media
20SHM03.5	Generate interest in various aspects of media and thereby equip them with the basic writing skills required for the same

Unit I: Introduction to Media Literacy

9 Hours

Understand what media literacy is and its importance, analyze and interpret media messages through guided questions, Practice reading strategies to preview a text & skimming and scanning when you read
Practice reading for the main idea, Define and accurately use content - related vocabulary in course activities and games, Apply comprehension strategies as you read, watch, and listen to a variety of texts and multimedia sources Demonstrate your understanding of these texts and key course ideas through comprehension check quizzes and a discussion board response

Unit II: Writing for the Print Media

9 Hours

Newspaper: Writing headlines – Analysing newspaper articles- Practising interview skills – Planning and writing a newspaper article
Magazine: Composing magazine covers – Planning the contents of a magazine – Giving instructions for a photo shoot – Planning and writing a true life story

Unit III: Writing for Radio, Television and Film

9 Hours

Radio: Understanding the language of radio presenters – Understanding the production process – Planning a newscast – Giving post production feedback.
Television: Understanding the pre-production process – Organising a filming schedule – Filming on location – Editing a TV documentary
Film: Writing a screenplay – Pitching successfully – Organizing a shoot – Writing a film review

Unit IV: Writing for Advertisements

9 Hours

Advertisement : Creating a print advert –Creating a screen advert –Presenting a finished advert- Analysing market trends – Setting up a marketing communication strategy – Organising the relaunch of a product – Evaluating the success of a Relaunch

Unit V: Writing for the New Media

9 Hours

New Media: Briefing a website designer – Analysing problems and providing solutions – Planning and writing a blog – Creating a podcast- Vlogs – Graphic novel [It is suggested for students to follow the different styles of reporting in various media and to familiarize themselves with the emerging trends in the new media]
Core Reading: Ceramella, Nick and Elizabeth Lee. Cambridge English for the Media. CUP, 2008

Text Books

1. Ryan, Michael and James W Tankard, Writing for Print and Digital Media, McGraw-Hill, 2005
2. Allen, Victoria, Karl Davis et. al., Cambridge Technicals Level 3 Digital Media, Hodder, 2016
3. Hayward, Susan. Cinema studies: The Key Concepts, Routledge, 1996

Reference Books

1. Parthasarathy, Rangaswami, Here is the News! Reporting for the Media. Sterling Publications, 1998
2. Axford, Barrie and Richard Huggins. New Media and Politics, Sage, 2001

Web References

1. https://www.google.co.in/books/edition/Designing_New_Media/
2. https://www.google.co.in/books/edition/AS_Media_Studies
3. https://www.google.co.in/books/edition/Social_Media_and_Democracy

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MI 20SHM04 Statistical Inference

3 0 0 3

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

Code	Course Outcomes
20SHM04.1	Understand the concept of sampling distribution for large and small samples
20SHM04.2	Calculate the estimator of a parameter using point estimation and bias
20SHM04.3	Compare means and variances of two independent or paired samples using interval estimation
20SHM04.4	Understand the framework of hypothesis testing for carrying out statistical inference
20SHM04.5	Carry out the NP tests with due regard to the assumptions underlying these procedures

Unit I: Sampling Distribution

9 Hours

Population, Samples, Parameter and statistics, Standard error, Sampling distribution of a statistic, Sampling distribution of mean (known and unknown variance) for large and small samples, Sampling distribution of difference of means, Central limit theorem

Unit II: Point Estimation

9 Hours

Definition of point estimator, General properties of estimators, Uniformly minimum variance unbiased estimators, Sufficient statistics, Factorization theorem, CR Rao inequality, Cramer - Rao lower bound and UMVUE, Methods of finding point estimators by MLEstimation, Method of moments

Unit III: Interval Estimation

9 Hours

Notion of interval estimation, Review of sampling distributions, Confidence Intervals, Confidence interval for the mean (population variance is known and unknown), Confidence interval for the variance (population mean is known and unknown), Confidence interval for the difference between two means

Unit IV: Testing of Hypothesis

9 Hours

Statistical hypothesis, null and alternative hypothesis, Simple and composite hypotheses, Test of hypothesis, critical region, type I and type II errors and their probabilities, Simple null hypothesis versus simple alternative, Neyman - Pearson lemma, Examples from the normal population, Tests on the mean, Tests on the variance

Unit V: Non-Parametric Methods

9 Hours

Introduction, assumptions of Np methods, Advantages and disadvantages, Testing a hypothesis about median, Test for randomness, sign test, Wilcoxon signed rank test

Text Books

1. Gupta Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand Publications, New Delhi
2. Rao C. R., Linear Statistical Inference and its Applications, Wiley Eastern Publications

Reference Books

1. Richard A., Gupta C. B., "Probability and Statistics for Engineers", Miller & Freund, Pearson's Edition, 2010
2. Rohatgi V., K. Statistical Inference, Dover Publications, 2003
3. Iyengar T. K. V., Krishna Gandhi B., Prasad M. V. S. S. N., "Probability and Statistics", Revised Edition, 2012
4. Wasserman L., "A Concise Course in Statistical Inference", Springer Publications, 2004

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2. https://onlinecourses.nptel.ac.in/noc20_ma19/preview
3. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

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MI 20MBM03 Organizational Behaviour

3 0 0 3

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

Code	Course Outcomes
20MBM03.1	Understand basic concepts of organizational behavior and its nature
20MBM03.2	Understand the basic concepts personality, values and motivation
20MBM03.3	Understand inter personal behavior and its significance
20MBM03.4	Know the group behavior and its dynamics
20MBM03.5	Know about organizational climate, culture and organizational change

Unit I: Introduction

9 Hours

Organisational Behaviour - Concept and Emergence of OB Concept, Nature and Theoretical frameworks, Disciplines contributing to the field of OB, Historical Background - Hawthorne Studies, Psychological foundations

Unit II: Individual Behaviour

9 Hours

Personality, Learning, Values and Attitudes, Perception, Learning-Behaviourist, cognitive and social learning; Stress at work. Motivation -Maslow's Need Hierarchy, Herzberg's Two Factors Theory

Unit III: Inter - Personal Behaviour

9 Hours

Interpersonal communication and Feedback, Transactional Analysis (TA), Johari Window- Managing mis() behaviour at work, Substance abuse, cyber slacking, Aggression, and Violence

Unit IV: Group Behaviour

9 Hours

Group Dynamics, Cohesiveness and Productivity, Management of Dysfunctional groups, Group Decision Making, Organisational Politics. Leadership- Concept and Styles, Fielder's Contingency Model, House's Path - Goal Theory, Leadership Effectiveness

Unit V: Organizational Process

9 Hours

Organizational Climate: Concept, Determinants, Organization Culture - Concept, Forming, Sustaining, and Changing a Culture, Organizational effectiveness - concept and measurement, Organizational change - resistance and management.

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Udai Pareek, Organizational Behavior, 3rd Edition, Oxford University Press, 2011
2. Subba Rao P., "Management and Organizational Behavior", 3rd Edition, Himalaya Publishing House, 2017
3. Ghuman, K. and Aswathappa K., Management: Concepts, Practice and Cases, Tata Mc - Graw Hill

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1. <https://nptel.ac.in/courses/105/102/105102012/>
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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 Chairman
 Board of Studies

MI 20MBM04 Compensation Management & Employee Welfare Laws

3 0 0 3

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

Code	Course Outcomes
20MBM04.1	Understand different pay structures and pay levels
20MBM04.2	Know about wage act 1936 and its implications
20MBM04.3	Understand the factors influence the wage fixation
20MBM04.4	Understand the components of bonus act 1965
20MBM04.5	Understand various incentive plans and international compensation concept

Unit I: Compensation Management

9 Hours

Compensation management process, forms of pay, financial and non - financial compensation. Compensation Strategies, Assessing job values, pay structures, designing pay levels, construction of optimal pay structure. Paying for performance, skills and competence. International pay systems: comparing costs and systems

Unit II: The Payment of Wages Act, 1936

9 Hours

Objects, Application, Responsibility for payment of wages, Fixation of wage periods, time - limits, Deduction from wages, Remedies available to worker, Powers of authorities, Penalty for offences

Unit III: The Minimum Wages Act, 1948

9 Hours

Objects, application, minimum fair and living wages, determination of minimum wage, taxation of minimum wage, advisory board, remedy to worker for non - payment of minimum wages

Unit IV: The Payment of Bonus Act, 1965

9 Hours

Objects, Scope and Application, Definitions, Calculation of amount payable as Bonus, Eligibility and Disqualifications for Bonus, Minimum & maximum Bonus, Application of Act in Establishment in Public Sector, Bonus linked with Production or Productivity

Unit V: Incentives Incentive Plan

9 Hours

Individual incentives, pay for performance, compensation of special group Benefits, legally required benefits: Retirement, medical and other benefits, Employee profit sharing, employee stock option, gain sharing International Compensation: Recognizing variation, the social contract, Culture and pay, Preliminary considerations of international compensation

Text Books

1. Belchor, David W., "Compensation Administration", Prentice Hall, Englewood Cliffs. NT.
2. Henderson R. I., Compensation Management in a Knowledge Based World, New Delhi: Pearson Education
3. Milkovich G., Newman J. and Ratnam C. S. V., Compensation, Tata Mc - Graw Hill, Special Indian Edition

Reference Books

1. Armstrong M. & Murlis H., Reward Management: A Hand book of Salary administration, London: Kegan Paul
2. Sharma J. P., An Easy approach to Company and Compensation Laws, New Delhi: Ane Books Pvt. Ltd.
3. Malik P. L., Hand book of Labourer and Industrial Law, Eastern Book Company
4. Government of India Report of the National Commission on Labour Ministry of Labour and Employment, New Delhi. (latest)

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1. <https://nptel.ac.in/courses/105/102/105102012/>
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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20CEM03 Sustainability and pollution prevention practices

3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEM03.1	Concept of sustainability and its goals		L1,L2
20CEM03.2	Sources and effects of environmental pollution		L1, L2
20CEM03.3	Identify the prevention measures for environmental protection		L2,L3
20CEM03.4	Approach for analysis and assessment of developmental activities and their impacts on environment		L2, L3
20CEM03.5	Objectives and components of environmental management		L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
 L1 Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit -1 Concept of sustainability and development

9 Hours

Sustainability and its goals, Growth and development, Development and environment, Causes for industrialization, changing life styles, regulatory aspects of industrialization, overall impact of industrialization and urbanization on quality of human life , Global environmental issues

Unit -2 Pollution, Monitoring and Control

9 Hours

Definition, types and sources of pollution, Quality standards for air, water, soil; types of pollutants; Methods of monitoring and control of air, water, soil Pollution (Physicochemical and bacteriological sampling and analysis); effects of pollution on plants, animals and Human beings.

Unit-3 Measures for Environmental Protection

9 Hours

Formal and informal environmental education, awareness for nature conservation and protection, environmental ethics and morality, conservation of natural habitats, National parks and wild life sanctuaries, role of youth and women, role of NGO's, urban planning and land-use pattern

Unit-4 Environmental Impact Assessment

9 Hours

Definition, significance and scope of impact assessment, Need & objective, types of environmental impacts, methods of environmental impacts, major steps in impact assessment procedure, generalised approach to impact analysis

Unit-5 Environmental Management.

9 Hours

Objectives and components of environmental management need for training, Environmental Impact Statement and Environment Management Plan, Role of remote sensing in environmental management. Sustainable use of natural resources, management of soil, wildlife and its methods, agriculture management, Public participation in resource management

Text Books

1. Lars F. Niklasson, 2009, Improving the Sustainable Development Goals: Strategies and the Governance Challenge
2. Herman Koren Best Practices for Environmental Health: Environmental Pollution, Protection, Quality and Sustainability, 21 April 2017
3. McCully, P. 1996. Rivers no more: the environmental effects of dams (pp. 29-64). Zed Books.
4. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

Reference Books

1. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
2. Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The Hopkins Press Ltd., London.
3. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

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1. <http://mcic.ca>
2. <https://www.drishtijas.com>
3. <https://www.jica.go.jp>

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MI 20CSM03 Database Security 3 0 0 3

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

Code	Course Outcomes
20CSM03 1	Explain the Cossets DBMS
20CSM03 2	Explain the Constrains in Database
20CSM03 3	Describe different Database Schemas
20CSM03 4	Illustrate Desecrate Data Models and Water Marking Processes
20CSM03 5	Explains Geospatial Data Models and Access Methods

Unit I: Database Introduction 9 Hours
 Introduction to Database – Relational Database & Management System, Data Abstraction (Physical Level, Logical Level & View Level) - Multi-level Database, Distributed Database, Database Architecture.

Unit II: Database Securities 9 Hours
 Security issues in Database – Integrity constraints, Access Control (Grant & Revoke Privileges) - Statistical Database, Differential Privacy. Distributed Database Security.

Unit III: Schema Models 9 Hours
 Security in Data Warehouse & OLAP – Introduction, Fact table, Dimensions, Star Schema, Snowflake Schema, Multi-Dimension Range Query, Data Cubes.

Unit IV: Data Mining Introduction 9 Hours
 Data Mining – Introduction - Randomization methods, Data Swapping, Database Watermarking – Basic Watermarking Process - Discrete Data, Multimedia, and Relational Data, Different Data Migration Techniques.

Unit V: Geospatial Database 9 Hours
 Geospatial Database Security – Geospatial data models – Geospatial Authorization, Access Control Models: Geo-RBAC, Geo- LBAC

Text Books

1. Michael Gertz, Sushil Jajodia, "Handbook of Database Security: Applications and Trends", ISBN-10: 0387485325, Springer, 2007
2. Osama S. Faragallah, El-Sayed M. El-Rabaie, Fathi E. Abd El-Samie, Ahmed I. Sallam, and Hala S. El-Sayed, "Multilevel Security for Relational Databases", ISBN 978-1-4822- 0539-8, CRC Press, 2014.

Reference Books

1. Bhavani Thuraisingham, "Database and Applications Security: Integrating Information Security and Data Management", CRC Press, Taylor & Francis Group, 2005.
2. Elmasri navrate, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
3. Peter Rob & Carlos Coronel, "Database Systems Design, Implementation and Management," Tenth Edition, Pearson Education, 2013.

Web Resources

1. <http://www.nptelvideos.in/2012/11/database-managementsystem.html>
2. <https://www.ibm.com/in-en/cloud/learn/database-security>
3. <http://data.conferenceworld.in>

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Technology

MI 20MEM03 Surface Engineering**3 0 0 3**

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

Code	Course Outcomes	DoK
20MEM03.1	Decide the surface preparation methods suitable for different substrate materials.	L2
20MEM03.2	Apply knowledge on properties offered by different Coatings based on the application requirement.	L3
20MEM03.3	Interpret the testing & evaluation of metallic coatings.	L2
20MEM03.4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.	L3
20MEM03.5	Explain the importance & role of surface modifications to achieve several technological properties.	L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Fundamentals of Surface Engineering**11+1 Hours**

Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc.,

Coatings: Classification, Properties and applications of Various Coatings

Unit II: Chemical-Conversion Coating**11+1 Hours**

Chromating, Phosphating, Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.

Unit III: Coating from Vapor Phase**11+1 Hours**

PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.

Unit IV: Metallic coating**11+1 Hours**

Hot Dipping, Galvanizing, Electrolytic and Electro less plating: Methodology used, mechanisms, important reactions involved, Process parameters and applications. Testing/ evaluation of metallic coatings.

Unit V: Thermal spray coatings**11+1 Hours**

Processes, Types of spray guns, Comparison of typical thermal spray processes, Surface Preparation, Finishing Treatment, Coating Structures and Properties, Applications.

Text Books

1. J. R. Davis-Surface Engineering for Corrosion and Wear Resistance. 1st Edison, 1997
2. George J. Rudzki -Surface Finishing Systems. metal and non-metal finishing handbook-guide, 1st Edison Metals Park : ASM, 1983
3. James A. Murphy- Surface Preparation and Finishes for Metal, McGraw-Hill, New York 1971
4. P. G. Sheasby and R. Pinner - Surface treatment and finishing of Aluminium and its alloy, 1st Edison., ASM, Metals Park, 1987

Reference Books

1. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, ASM International 2006
2. Friction Stir Welding and Processing, R.S. Mishra and M.W. Mahoney, ASM International, 2007,
3. Advances in Friction-Stir Welding and Processing, M-K Besharati-Givi and P. Asadi, ASM International 2008

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2. www.btechguru.com
3. www.ocw.mit.edu

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MI 20EEM03 Electrical Engineering Material Science

3 0 0 3.0

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

Code Course Outcomes

20EEM03.1	Understand the phenomena of metal conductivity
20EEM03.2	Explain the properties of di-electric properties
20EEM03.3	Understand the magnetic properties of materials
20EEM03.4	Explain the types of semi conductors
20EEM03.5	Understand the modern techniques used for studying the material science

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Unit I: Conductivity of Metal

9 Hours

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials

Unit II: Dielectric Properties

9 Hours

Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system,

Unit III: Magnetic Properties of Materials

9 Hours

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials

Unit IV: Semiconductors

9 Hours

Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, intrinsic semiconductors, impurity type semiconductor, diffusion, thermal conductivity of semiconductors, electrical conductivity of doped materials

Unit V: Modern Techniques for Materials Studies

9 Hours

Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, "Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College", BiblioLife, 2019
2. Jack L. Lindsey,, "Applied Illumination Engineering", 4th Edition, PHI, 2011
3. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", 2nd Edition, Springer, 2013.

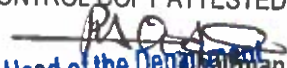
Reference Books

1. M.A. Cayless, "Lamps and Lighting", 5th Edition, Routledge, 2016.
2. Leopold Bloch, "Science of Illumination: An Outline Of The Principles Of Artificial Lighting", Kessinger Pub, 2018.

Web References

1. <https://nptel.ac.in/courses/108/105/108105060/>

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MI 20ECM03 Analog Electronic Circuits

3 0 0 3

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

Code	Course Outcomes
20ECM03.1	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers
20ECM03.2	Classify, analyze types of multistage amplifiers
20ECM03.3	Classify, analyze and design different types of feedback amplifiers and Oscillators
20ECM03.4	Analyze the response of different signals for linear and Non linear wave shaping circuits
20ECM03.5	Understand the internal operation of Op-Amp and its Applications

Unit I: Transistor Biasing

9 Hours

Need for biasing, operating point, BJT biasing methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE} , I_c , and β , Stability factors, (S, S', S'').

Unit II: BJT and Multistage Amplifiers

9 Hours

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductance, Hybrid π capacitances, Multistage Amplifiers: Classification of amplifiers, methods of coupling, cascaded transistor amplifier.

Unit III: Feedback Amplifiers and Oscillators

9 Hours

Feedback Amplifiers: Feedback principle and concept, types of feedback, classification of feedback amplifiers. Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wien bridge oscillators with BJT, Generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT.

Unit IV: Linear Wave Shaping

9 Hours

Linear wave shaping: High pass, low pass RC circuits, response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators, Diode clippers.

Unit V: : Linear Applications of Op-Amp

9 Hours

Internal Block Diagram of various stages of Op-Amp and Roll of each Stage, Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier.

Text Books

1. Robert, L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 10th Edition, Prentice Hall of India, 2009.
2. Millman, J., TaubH., Mothiki Surya Prakash Rao and Millman's, "Pulse Digital and Switching Waveforms", 2nd Edition, Tala McGraw-Hill, 2008.
3. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", Prentices Hall of India, 1987.

Reference Books

1. Donald A. Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata Mc Graw-Hill, 2010
2. Paul Gray, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Willey & Sons, 2005
3. Anand Kumar, A., "Pulse and Digital Circuits", 2nd Edition, Prentice Hall of India, 2005
4. Sanjay Sharma, "Operational Amplifiers & Linear Integrated Circuits", 2nd Edition, S. K. Kataria & Sons, 2010.

Web Resource

1. <https://nptel.ac.in/courses/108102112>
2. <https://www.udemy.com/course/analog-electronics-basic-concepts/>

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MI 20AIM03 Interpretable Machine Learning

3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AIM03.1	Introduction to interpretability		L1,L2
20AIM03.2	Different interpretable models		L1,L2
20AIM03.3	Explain the software's for interpretable models.		L1,L2
20AIM03.4	Illustrate plotting of prediction changes.		L1,L2
20AIM03.5	Explains individual predictions of any black box classification model.		L1,L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction

9 hours

Importance of Interpretability, Taxonomy of Interpretability Methods, Scope and evaluation of Interpretability, Properties of Explanations, Human-friendly Explanations

Human-friendly Explanations

Unit II: Interpretable Models-I

9 hours

Data Sets-Regression, Text Classification. Interpretable Models -Linear Regression, Logistic Regression, Decision Tree, Decision Rules.

Decision Rule Fit

Unit III: Interpretable Models-II

9 hours

Generalized Linear Models (GLM) - Non-Gaussian Outcomes, Advantages; Generalized Additive Models (GAM) - Nonlinear Effects, Advantages and software; Other interpretable Models: Naive Bayes Classifier.

K-Nearest Neighbors

Unit IV: Model Agnostic Methods

9 hours

Partial Dependence Plot (PDP), Accumulated Local Effects (ALE) Plot, Feature Interaction, Functional Decomposition, Permutation Feature Importance, Global Surrogate.

Local Surrogate

Unit V: Local Model Agnostic Methods

9 hours

Individual Conditional Expectation (ICE), Local Surrogate (LIME), Counterfactual Explanations, Scoped Rules (Anchors), Shapley Values.

SH Additive exPlanations (SHAP)

Text Books

1. "Interpretable Machine Learning, A Guide for Making Black Box Models Explainable", By Christoph Molnar · 2020
2. "Interpretable Machine Learning with Python, Learn to Build Interpretable High-performance Models with Hands-on Real-world", By Serg Masis · 2021

Reference Books

1. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning", By Andrea Vedaldi, Grégoire Montavon, Klaus-Robert Müller, Lars Kai Hansen, Wojciech Samek, 2019.
2. "Interpreting Machine Learning Models, Learn Model Interpretability and Explainability Methods", By Anirban Nandi, Aditya Kumar Pal · 2021

Web References

1. <https://christophm.github.io/interpretable-ml-book/index.html>
2. <https://ai.googleblog.com/2021/12/interpretable-deep-learning-for-time.html>
3. <https://arxiv.org/abs/2103.10689>

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MI 20DSM03 Data Governance 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20DSM03.1	Understanding of the role computation can play in solving problems and optimization techniques		L1, L2
20DSM03.2	Understanding the usage of computational techniques.		L1, L2
20DSM03.3	Understanding Stochastic programming and statistical thinking		L1, L2, L3
20DSM03.4	Identify the problem using Monte Carlo simulations		L1, L2, L3
20DSM03.5	Plotting with the pylab package		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction, Data Literacy and Concepts 9 + 3 hours
Data is an asset, Data governance and governance, Data management, The governance "V", Solutions Other terms, Some final core concepts

Unit II: Overview: A Day in the life of a data governance program and its capabilities 9 + 3 hours
What does it look like? - The scope of data governance and data management, Business model, Content, Development methods -Federation, Elements of data governance programs,Principles,Policies, Metrics, The critical success factors for data governance

Unit III: The data governance business case 9 + 3 hours
The business case, Objectives of the business case for data governance, Components of the business case - The big picture (vision), Program risks, Business alignment, Costs of data quality issues, Costs of missed opportunities, Data debt, Obstacles, impacts, and changes, Presentation of the case. The process to build the business case - Fully understand business direction, identify possible opportunities, identify usage opportunities, define business benefits, confirm business benefits, quantify costs, Prepare the business case documentation, Approach considerations

Unit IV: Overview of data governance development and deployment 9 + 3 hours
Types of approaches, The data governance delivery framework, Process overview, Engagement, Strategy, Architecture and design, Implementation, Operation, and changes

Unit V:Engagement 9 + 3 hours
Initiation- Obtain program approval,Develop DG rollout team structure. Definition- Define DG for your organization, identify business units (subject to DG), Identify business capabilities that need data governance (and don't have it). Scope- Define scope and constraints with the initial plan for DG, Approve scope and constraints. Assessment- Information maturity, Change capacity, Data environment

Text Books

1. John Ladley, "Data Governance", Academic Press, Second Edition, 2012

Reference Books

1. EvrenEryuek, Uri Gilad, "Data Governance: The Definitive Guide", O'Reilly Media, Inc., 2021

Web Resources

1. <https://nptel.ac.in/courses/110/106/110106072/>
2. <https://nptel.ac.in/courses/110/104/110104094/>

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MI 20SHM05 Journalism

3 0 0 3

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

Code	Course Outcomes
20SHM05.1	Understand the concepts of mass communication in general and journalism in particular
20SHM05.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM05.3	Get exposed to different faces of journalism
20SHM05.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM05.5	Prepare the report for the representation

Unit I: Introduction

9 Hours

Journalism: Meaning, Definition Nature, Scope, Functions, Truth, Objectivity, Verification, independent monitor, forum for criticism and comment, watch dog role of press and democracy principles of journalism will stop types of journalism: print, broadcast and online

Unit II: Process Control and Capability Analysis

9 Hours

Mass Media And Development - Early Journalism in the world, India and Karnataka global context Colin rise of advocacy journalism, professionalism, modern journalism and mobile journal journalism. Community journalism, rural journalism, yellow journalism, penny press, tabloid press, and citizen journalism

Unit III: Process - monitoring and Control Techniques

9 Hours

Journalism as a profession, responsibilities and criticism, do you know any his interest understanding the public taste, press as a tool in social service relationship between press and other mass media

Unit IV: Acceptance Sampling

9 Hours

Normative theories of press enter relevance to the present day, wire services- Indian and international news agencies

Unit V: Reliability and Life Testing

9 Hours

Photojournalism - caption writing, photo feature, visual composition- case studies Danish Siddiq, Jimmy Nelson, Margaret Brooke-white, Philip Jones Griffiths, Rathika Ramaswami Raghu Rai exercise assignments analysis of daily newspaper in the classroom practice of writing new stories on various topics writing reports on civic problems incorporating information from civil organization based on interviews prepare questions for a specific interview rewriting news stories from newspapers for magazine filing report of more press conferences filing report for an actual press conference practice of writing to wall journal twice a week

Text Books

1. Keval Kumar J., Mass Communication in India, Jaico Publication, New Delhi, 2001
2. Seema Hasan, Mass Communication – Principles and Concepts, CBS Publishers and Distributors, New Delhi, 2010
3. Gupta V. S. and Vir Bala Aggarwal, Handbook of Journalism and Mass Communication, Concept Publishing Company, New Delhi, 2001

Web References

1. http://wikipedia.org/wiki/media_of_india#cite
2. http://wikipedia.org/wiki/mass%2520_media_of_india#cite
3. http://wikipedia.org/wiki/mass_media_of_india#cite-buzzle

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Chairman
Board of Studies

M 20SHM06 Statistical Quality Control

3 0 0 3

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

Code	Course Outcomes
20SHM06.1	Identify application of various Statistical quality tools
20SHM06.2	Use control chart techniques for quality improvement
20SHM06.3	Planning, establishing, and operating SQC procedures
20SHM06.4	Design a procedure testing incoming batches
20SHM06.5	Carry out reliability tests and perform statistical analysis

Unit I: Introduction

9Hours

Quality Improvement in the Modern Business Environment, Modeling Process Quality, Methods and Philosophy of Statistical Process Control

Unit II: Process Control and Capability Analysis

9 Hours

Control Charts for Variables, Control Charts for Attributes, Process and Measurement System Capability Analysis

Unit III: Process - Monitoring and Control Techniques

9 Hours

Cumulative Sum and Exponentially Weighted Moving Average Control Charts, Univariate Statistical Process Monitoring and Control Techniques

Unit IV: Acceptance Sampling

9 Hours

Concepts of acceptance sampling, Lot-by-lot acceptance sampling for attributes, Other acceptance sampling techniques

Unit V: Reliability and Life Testing

9 Hours

Common models and distributions, Estimation of mean life with complete samples, Reliability Estimation, Types of reliability tests

Text Books

1. Montgomery D. C., Introduction to Statistical Quality Control, 5th Edition, Wiley Eastren Ltd., 2005
2. Gupta V., Kapoor V. K., Fundamentals of Applied Statistics Sultan Chand Publications, New Delhi

Reference Books

1. Chang D. and Macmillan S., Statistical Quality Design and Control, Contemporary Concepts and Methods, 1992
2. Mahajan M., Statistical Quality Control, Danpatrai & Co., Delhi
3. Gupta R. C., Statistical quality Control and Quality management, 10th Edition, Kanna Publishers, New Delhi

Web References

1. <https://www.digimat.in/nptel/courses/video/112107259/L01.html>
2. <https://freevidelectures.com/course/4539/nptel-operations-management/49>
3. <https://freevidelectures.com/course/4384/nptel-engineering-metrology/48>

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MI 20MBM05 Entrepreneurship and Business Venture planning

3 0 0 3

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

Code	Course Outcomes
20MBM05.1	Know the role of entrepreneurship development in economy
20MBM05.2	Understand the entrepreneurship and creativity
20MBM05.3	Understand the concept of project planning
20MBM05.4	Understand the sources of financing to ventures
20MBM05.5	Know the methods of entrepreneurship training

Unit I: Introduction

10 Hours

Concept of Entrepreneurship, Role of entrepreneurship in economic Development; factors impacting emergence of entrepreneurship, types of entrepreneurs. Characteristic of successful entrepreneurs; Women Entrepreneurs, Social entrepreneurship, Entrepreneurial challenges

Unit II: Entrepreneurship Development

10 Hours

Types of start-ups, Entrepreneurial class Theories, Entrepreneurial training; EDP Programme, Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership, Source of innovative ideas, Entrepreneurship and creativity

Unit III: Project Planning

10 Hours

Concept of Project and classification of Project, Identification, Project Formulation, Project Report, Project Design, Project Appraisal, Profitability Appraisal, Social cost benefit analysis, Financial analysis, Developing a Marketing plan-customer analysis, sales analysis, steps in marketing research, Marketing Mix; business plan preparation, elements of a business plan; Business plan failures

Unit IV: Project Financing & Venture Capital

10 Hours

Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals; Evaluating the Venture Capital-process; Sources of financing for Indian entrepreneurs.

Unit V: Entrepreneurship Training

10 Hours

Designing appropriate training programmes to inculcate entrepreneurial spirit, significance of entrepreneurial training, training for new and existing entrepreneurs, role of entrepreneurship development institutes, MSMEs in providing entrepreneurial training

Note: Discuss case studies from every unit**Text Books**

1. Kumar, Arya and Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India
2. Hishrich, Peters, Entrepreneurship: Starting, Developing and Managing New Enterprise, Irwin

Reference Books

1. Allen K. R., Launching New Ventures: An Entrepreneurial Approach, Cengage Learning
2. Rama Chandran K., Entrepreneurship Development, Tata McGraw-Hill, India
3. Roy, Rajeev, Entrepreneurship, Oxford University Press
4. Vasant, Desai, Small – Scale Industries and Entrepreneurship, Himalya Publication, India

Web References

1. <https://nptel.ac.in/courses/105/102/105102012/>
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20MBM06 Performance Management and Talent Management

3 0 0 3

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

Code	Course Outcomes
20MBM06.1	Know about performance management process
20MBM06.2	Understand the performance management system
20MBM06.3	Understand the issues and challenges in implementation of performance management system
20MBM06.4	Understand the talent management approaches
20MBM06.5	Understand the talent management practices and process of companies

Unit I: Introduction

9 Hours

Performance management process, Objectives of performance management system; Historical development in India, Performance management and performance appraisal, Linkage of performance management system with other HR practices

Unit II: Performance Management System

9 Hours

Performance planning, Ongoing support and coaching, Performance measurement and evaluation, Performance management and appraisal; Methods of performance appraisal, Appraisal Communication; Counselling, Identifying potential for development, Linking pay with performance

Unit III: Issues in Performance Management

9 Hours

Implementing performance management system - Strategies and challenges, Role of HR professionals in performance management, Performance management as an aid to learning and employee empowerment, Performance management documentation, Performance management audit, Ethical and legal issues in performance management

Unit IV: Talent Management

9 Hours

Concept and approaches, Frame work of talent management, Talent identification, integration and retention

Unit V: Talent Management Practices and Process

9 Hours

Building the talent pipeline, Managing employee engagement, Key factors and different aspects of talent management, using talent management processes to drive culture of excellence

Note: Discuss case studies from every unit

Text Books

1. Bhattacharyya, D. K., Performance Management Systems and Strategies, Pearson Education
2. Robert B., Performance Management, McGraw-Hill Education, India
3. ASTD, Talent Management: Strategies for success from six leading companies, Cengage Learning

Reference Books

1. Armstrong M., & Baron A., Performance Management and Development, Jaico Publishing House, Mumbai
2. Rao T. V., Hurconomics for Talent Management: Making the HRD missionary business - driven, Pearson Education

Web References

1. <https://nptel.ac.in/courses/105/102/105102012/>
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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ICC : 20ICC01 Competitive Programming

2 0 8 6
Version: 01.00

Duration 240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
23ICC07.1	Understand the basics of Programming	1, 2, 3, PSO #1	3	L1, L2, L3
23ICC07.2	Explain various types of Operators, operations, relations, and techniques in programming	1, 2, 3, PSO #1	3	L1, L2, L3
23ICC07.3	Demonstrate gaming basics	1, 2, 3, PSO #1	3	L1, L2, L3
23ICC07.4	Execute various Operations on Linked lists	1, 2, 3, PSO #1	3	L1, L2, L3
23ICC07.5	Explore various applications of the techniques.	1, 2, 3, PSO #1	3	L1, L2, L3
23ICC07.6	Solving various problems of Binary Trees, insertion, deletion and updation.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Deliverables

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum

WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8- More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and Implementation, Dijkstra, Topological sort.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	9 (Nine)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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N.S.Raju Institute of Technology
Sontyam, Visakhapatnam
Board of Reg. No. 521 173

ICC 20ICC02 Web Technologies – Transferring to Practice**2 0 8 6****Version: 01.00**

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above

Industry Collaborator M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC02. 1	Learn the basics and application of HTML	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 2	Understand the CSS3 module operation	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 3	Explain JAVA script and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 4	Demonstrate the basics of jQuery	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 5	Study the basics of Bootstrap and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 6	Understand the basics of Angular JS	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables**Module 1**

Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments & Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTML I frames, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms

Module 2

Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Borders, CSS3 Padding, CSS3 Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS3 Links, CSS3 Lists, CSS3 Tables, CSS3 Box Model, CSS3 Outline, CSS3 Display, CSS3 Max-width, CSS3 Position, CSS3 Float, CSS3 Inline-block, CSS3 Align, CSS3 Combinators, CSS3 Pseudo-class, CSS3 Pseudo-element, CSS3 Navigation Bar, CSS3 Dropdowns, CSS3 Tooltips, CSS3 Images, CSS3 Attr Selectors, CSS3 Forms, CSS3 Counters, CSS3 Animations, CSS3 Buttons, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive

Module 3:

Introduction to JavaScript, JavaScript Language Basics, JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM

Module 4:

Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, jQuery Misc.

Module 5:

Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS

Module 6:

Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n and i10n

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC03 Java Spring boot

2 0 8 6

Version: 01.00

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above

Industry Collaborator M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC03.1	Understand the JAVA programming.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.2	Execute various methods in JAVA programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.3	Study and execute the OOPS concept	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.4	Demonstrate the debugging and testing of units	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.5	Learn the basics of Spring Boot	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.6	Explore the applications of Spring Boot and JAVA	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Deliverables**Java**

Introduction to the course, software tools set up, Introduction about programming, Hello World Project and defining the main method. Variables, Starting with out expressions, Primitive data types, byte short, float, char, Boolean, double, casting.

Operators, operands, expressions. If else statement, Bit wise Operator, Ternary operator, Operator precedence and operator challenge. Keywords and expressions, statements white space and Indentation, code blocks, if then else statement.

Methods in Java, final Method. Code problems on JAVA – HACKERRANK. Method Overloading and Over riding, Control flow statements – if else, while do while, Problems on coding – Prime Number, Even Number, Fibonacci series

OOPS concept – classes, constructors and inheritance, composition, encapsulation, polymorphism, Arrays, Java list, Auto boxing and unboxing. Inner and Abstract classes and interfaces, Java Generics, Naming conventions and package, static and final keywords.

Java Collections, Debugging and unit testing, Data Bases. Basic input and output including Java.util, Concurrency in Java, Lambda expression, regular expressions

Spring Boot:

Introduction to Spring Boot – Build a hello world API, Understanding Spring boot project, Auto configuration. Create a Spring boot web application development, overview of spring boot project. Annotations, step by step code and debugging

Introduction to Junits, Mockito. Spring boot deep dive with rest API

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC04 Robotic Process Automation

2 0 8 6

Version: 01.00

Duration 240 hours (2 hours theory and 14 hours practical per week) as specified above
 Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC04.1	Explore the Robotic Automation Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04.2	Understand the Process Flow and basic inputs and outputs	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04.3	Demonstrate the functioning of Business Objects	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04.4	Demonstrate the application of Object Studio attributes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04.5	Explain the Case management and additional features	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04.6	Understand the functioning of Error management	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Module: 1 – Robotic Automation Process Studio

Running a Process, Basic Skills, Process Validation, Decision Stage, Calculation Stage, Data Items

Module: 2 – Process Flow

Decisions, Circular Paths, Controlling Play, Set Next Stage, Breakpoints, Collections and Loops, Layers of Logic, Pages for Organization

Module: 3 – Inputs and outputs

Input Parameters, Stepping and Pages, Data Item Visibility, Data Types, Output Parameters, Start-up Parameters, Control Room, Process Outputs

Module: 4 – Business Objects

Object Studio, Business Objects, BLUE PRISM CONTENT, Action Stage, Inputs and Outputs, The Process Layer

Module: 5 – Object Studio

Creating a Business Object, Application Modeler, Spying Elements, Attributes, Attribute Selection, Launch, Wait, , Timeouts, Terminate, Write, Press, Attach and Detach, Read, Actions, Action Inputs and Outputs, Data Items as Inputs

Module: 6 – Error Management

Exception Handling, Recover and Resume, Throwing Exceptions, Preserving the Current Exception, Exception Bubbling, Exception Blocks, Exception Handling in Practice.

Module: 7 – Case Management

Queue Items Commercial in Confidence, BLUE PRISM CONTENT, Work Queue Configuration, Defer, Attempts, Pause and Resume, Filters Reports

Module: 8 – Additional Features

Safe Stop, Collection Actions, Choice Stage, Logging, Log Viewer, System Manager, Process/Business Object , Grouping, Process and Object References, Export and Import

Module: 9 – Consolidation Exercise

Order System Process

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC05 Information Security and Forensics

2 0 8 6

Version: 01.00

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above

Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC05. 1	Understand the basic terminology of various servers, networking, security and hacking.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 2	Explore the web applications, testing, debugging, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 3	Understand the coding techniques	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 4	Demonstrating the usage of tools for testing, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 5	Execute the code using various algorithms	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 6	Perform various case studies to dive deep.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables**Domain 1 – Introduction & Terminology**

Global Anonymous: Proxy Server, TOR Browser, VPN, SOCKS, RDP, Psiphon, Surface Web, Deep Web, Dark Web, etc., Terminology about Web, Servers, Systems, Network Programming Languages, Hacking, IT Security, Intro to OWASP Top 10 Vulnerability. Intro to Bug Bounty & Enterprise Security and Risk Management with IT Security Life Cycle, Case Studies of Hacking, IT Security & C Forensics. Phishing + Live Hacking Impact Demonstration

Domain 2 – Hacking to Explore

Web Application Penetration Testing based in OWASP TOP 10 Vulnerabilities with Live Ex. Live Demonstration of SQLi, XSS, CSRF, and other bugs with tools and with Manual Testing. Bug Bounty, Latest CMS Exploitation, Cryptography & Practical Implementation, SSL Vulnerabilities & Live Testing, Mobile Hacking, Sniffing, Virus, Ransomware, Intro to Carding & Luhn algorithm

Domain 3 – Defence in Depth

Secure Code Review & Code Brabbing Techniques, Enterprise Security, Risk Management & Report, Tools & Web Apps Penetration Testing, Hacking Attacks & Case Studies, WAF, Firewall, Honeypots, UTM, Introduction to Security Compliance, Introduction to Mobile Apps Pen testing, Defence for Vulnerabilities

Domain 4 – Hacking Automation

Virtualization, Tools for Penetration Testing & Hacking, Kali Linux & It's Applications with Uses, Cloud Security & It's Fundamentals, SQLMAP, Metasploit, nmap etc, Exploits & Incident Response Analysis, Intro to Exploit Development & Research.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC06 Battery System – Design Engineering

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC06.1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell

by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC07 Block Chain Technology

2 0 8 6
Version: 01.00

Duration 150 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC07.1	Learn basics of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.2	Understand various Types of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.3	Demonstrate the concepts of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.4	Study the basics of Ethereum	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.5	Learn Solidity	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.6	Implement the Dapp	1, 2, 3, PSO #1	3	L1, L2, L3

1: Weakly Contributing | 2: Moderately Contributing | 3: Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Deliverables

Introduction to Blockchain

Definition of Blockchain, History of Blockchain, Explaining Distributed Ledger, Blockchain ecosystem, Explaining Distributed Ledger

Types of Blockchain

Private/Consortium/Permission-less, Public/Permissioned implementation difference, What Blockchain has to offer across Industry? Companies currently using Blockchain, Overview of what we are going to study in this course,

Key Concepts of the Blockchain

Mining -Mining algorithm, Node, peer, and block explanation, Merkle tree and Blockchain, Consensus Mechanisms- proof of work, proof of stake, How Bitcoin Blockchain works? What is Transaction?

Introduction to Ethereum

Ethereum: Blockchain with smart contract, What is Ether? Bitcoin vs Ethereum Blockchain, What is Ethereum wallet? What is Smart Contract? Ethereum clients, Geth Introduction, Setting up Private Blockchain using Geth.

Learn Solidity

Introduction to solidity, Hands on solidity, Understand and implement different use cases, Implement and deploy smart contract on Blockchain.

Implement Dapp

Setting up the environment, Tools to install – Truffle, MetaMask ,Testrpc, Implement and deploy your first Dapp, Different use cases for implementation of Dapp.

Future Scope

Talk about the future of the Blockchain, What is Hyperledger? What is Hash graph? Discussion on current

research on Blockchain, Understand current industry challenges and needs.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Sontyam, Visakhapatnam - 531 173
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ICC 20ICC08 Network Administration

2 0 8 6

Version: 01.00

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above
 Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC08.1	Understand the processes of updation, Installation of Operating System.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.2	Understand the mapping of Hardware devices	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.3	Demonstrate the management of group and Computer accounts	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.4	Explain the File System Management	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.5	Study the server administration	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.6	Explore the disaster recovery	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
 L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK Depth of Knowledge

Deliverables

Overview of Networking.

Installing or Upgrading a Network Operating System, Preparing for installation, Installing from different installation mediums, Upgrade process, Identifying setup errors

Managing Hardware Devices

Understanding device drivers and PnP. Adding new devices. Hardware resource settings and driver signing, Hardware profiles

Creating and Managing Accounts

User authentication. User profiles. Creating, managing and troubleshooting user accounts.

Implementing Group and Computer Accounts

Creating group objects. Group types and scopes. Build-in groups. Creating and managing computer accounts.

Managing File Access

Introduction to file systems. Creating and managing shared folders. Managing shared folder permissions. NTFS permissions

Managing Disks and Data Storage

Disk management concepts. Managing partitions and volumes. Fault tolerant disk strategies. Monitoring disk health. Disk utilities.

Advanced File System Management

File and folder attributes. Advanced attributes. Disk quotas The distributed file system.

Implementing and Managing Printers

Installing and sharing printers, Configuring and managing printer resources.

Using Group Policy

Creating and editing group policy objects. Group policy inheritance.

Server Administration

Procedures and standards. Terminal services and remote administration. Delegating administrative authority. Software update services.

Monitoring Server Performance and Disaster Recovery

Task manager, event viewer and performance console. Planning disaster recovery. Backing up data. Automated system recovery.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC09 Product Engineering

2 0 14 9

Version: 01.00

Duration 240 hours (2 hours theory and 14 hours practical per week) as specified above

Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC09.1	Understand the basics of Manufacturing Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.2	Explain the Manufacturing Design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.3	Explore various Production Processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.4	Demonstrate various Production Machine Operations	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.5	Study the Product monitoring	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.6	Execute the Product Logistics	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables**Manufacturing Process Overview**

Product concepts, Market feasibility, Engineering design, Prototyping, Production, Marketing/sales

Manufacturing Design

Product analysis: Materials, Cost

Production methods: Assembly lines, Work cells, Inventory, Work flow

Quality control: Production monitoring, Product testing

Production Processes

Machine and process overviews: Boring and machining, Presses, Molding/Casting, Welding, Finishing, Assembly

Materials: Applicable types, Cost, Availability

Production Machine Operations

Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence, Automation, Programmable Logic Controllers

Production Monitoring

Monitoring production processes: Baselines, Environmental control

Quality improvement: Production improvement

Finished Product Logistics

Delivery methods, Delivery options, Customer interaction

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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531 173

ICC 20ICC10 Machine Learning Engineer

2 0 8 6

Version: 01.00

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC10.1	Evaluate the existing Machine Learning (ML) processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.2	Analyse large and complex datasets to extract insights and select the appropriate technique to be used	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.3	Develop models to achieve the business objectives	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.4	Analyses the machine learning algorithms that could be used to solve a given problem	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.5	Perform statistical analysis to resolve data set problems	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.6	Train models and optimize their hyper-parameters	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables**Prepare to Develop Machine Learning (ML) Systems:**

Machine Learning (ML) processes, appropriate datasets and data representation methods, large and complex datasets to extract insights, need of retraining the existing machine programs based on objectives, data validation strategies, pre-processing or feature engineering for a given dataset, data augmentation pipelines, models to achieve the business objectives, along with the relevant metrics to track.

Develop and Assist in the Implementation of Machine Learning (ML) Systems:

Machine learning algorithms, Logistic Regression, and Naive Bayes, based on statistical modelling procedures, data cleaning to remove the irrelevant data and ensure its quality and accuracy, data acquisition process, prepare the data by transforming textual and graphical data into numbers for use in the machine learning system, create data pipeline depending on the machine learning application needs Linear Regression, , differences in data distribution, statistical analysis to resolve data set problems, solve complex problems with multi-layered data sets, use data modelling and evaluation strategy to find patterns and predict unseen instances, evaluate and transform data science prototypes.

Perform machine learning tests:

Design machine learning systems/applications and self-running Artificial Intelligence (AI) software to automate predictive models, carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results, carry out research and implement best practices to improve the existing machine learning infrastructure, optimize existing machine learning libraries and frameworks based on testing, create useful information from unstructured data by auto-tagging images and text-to-speech conversions.

Train and retrain models:

Train models and optimize their hyper-parameters, analyses the errors of the model and develop appropriate strategies to rectify them, retrain the existing systems based on new machine learning model, document the machine learning processes as per the organizational policy, follow the latest machine learning developments and technologies.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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531 173

ICC 20ICC11 Data Scientist

2 0 8 6

Version: 01.00

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above

Industry Collaborator M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC11.1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables**Determining specifications of the Battery system**

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell by using hydrometer.

Performing load test:

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 23ICC12 Industrial IOT**2 0 8 6****Version: 01.00**

Duration 150 hours (2 hours theory and 8 hours practical per week) as specified above
 Industry Collaborator M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
23ICC03.1	Understand the basics of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
23ICC03.2	Demonstrate the components of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
23ICC03.3	Describe the Communication Technologies of IIoT	1, 2, 3 & PSO1	3	L1-L3
23ICC03.4	Analyze the Visualization and Data Types of IIoT	1, 2, 3 & PSO1	3	L1-L3
23ICC03.5	Describe the methods of Retrieving the data	1, 2, 3 & PSO1	3	L1-L3
23ICC03.6	Explain the Control & Supervisory Level of Automation	1, 2, 3 & PSO1	3	L1-L3

Deliverables**MODULE 1: Introduction & Architecture****Theory**

IIoT and connected world, the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

Practice

Introduction to Arduino, ESP8266, Introduction to raspberry Pi.

MODULE 2: IIOT Components**Theory**

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): Sensor, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Practice

Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT**Theory**

Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

Practice

Demonstration of MQTT communication.

Demonstration of LoRa communication.

MODULE 4: Visualization and Data Types of IIoT

Theory

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')
Sending alert message to the user. ways to control and interact with your environment)

MODULE 5: Retrieving Data

Theory

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

Device control using mobile Apps or through Web pages.
Machine to Machine communication.

MODULE 6: Control & Supervisory Level of Automation

Theory

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Practice

Digital logic gates programming using ladder diagram.
Implementation of Boolean expression using ladder diagram.
Simulation of PLC to understand the process control concept.

MODULE 7: Application of IIOT

Case study: Health monitoring, lot smart city, Smart irrigation, Robot surveillance.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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