SRI MANAKULA VINAYAGAR

ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

Volume - V

(DR.S. ANBUMALAR)

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society.

Mission

M1: Quality Education:

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: **Research and Innovation:**

To foster value based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.

M3: Employability and Entrepreneurship:

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values:

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society.

DEPARTMENT VISION AND MISSION

Vision

To promote proficiency in the field of Electrical and Electronics Engineering by creating a stimulating environment for research, innovation and entrepreneurship

Mission

M1: Quality Education:

To impart high quality technical education with problem solving capabilities by innovative pedagogy in emerging technologies.

M2: Industrial and Societal Needs:

To cater the dynamic needs of the industry and society by strengthening industry-institute interaction.

M3: Research and Innovation:

To nurture the spirit of research attitude by carrying out innovative technologies pragmatically.

M4: Placement and Entrepreneurship:

To inculcate the professionalism in career by advancing synergetic skills to compete in the corporate world.

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PROGRAMME OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

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

PO10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Professional Knowledge:

To possess strong educational foundation in Electrical and Electronics Engineering to attain successful career with professional responsibility

PEO2: Innovative Skills:

To enrich the skills to design and develop innovative solutions for engineering problems in a multidisciplinary environment

PEO3: Ethics:

To actively embrace leadership qualities for achieving professional goals with ethical values

PEO4: Adaptability:

To enhance intellectual competency along with technical skills by adapting to the current trends through eternal learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Core Proficiency:

Utilize the engineering core knowledge to identify, formulate, design, and investigate the complex engineering problems of Power Electronics, Electrical Machines and Power Systems.

PSO2: Cutting Edge Technologies:

Explore the new cutting edge technologies in the field of Electric Vehicle, Automation, Artificial Intelligence, Robotics and Renewable Energy to compete in global market

PSO3: Design and Evolution:

Capability to comprehend the technological advancements with the usage of modern design tools for analysing and designing systems to confront the rapid pace of industrial innovations.

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STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAMME

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Science (HS)	7
2	Basic Sciences(BS)	16
3	Engineering Sciences (ES)	18
4	Professional Core (PC)	84
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl. No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Science (HS)	-	-	1	1	3	-	1	1	07
2	Basic Sciences(BS)	3	3	3	3	4	-	-	-	16
3	Engineering Sciences (ES)	7	3	4	4	-	-	-	-	18
4	Professional Core (PC)	8	15	14	8	11	15	9	4	84
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	-	3	3	-	09
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	02
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**22**	**22**	**21**	**21**	**20**	**19**	**164**

**** EEC and MC are not included for CGPA calculation***

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SEMESTER – I										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST101	Engineering Mathematics – I Calculus and Linear Algebra	BS	2	2	0	3	25	75	100
2	U20EST101	Programming in C	ES	3	0	0	3	25	75	100
3	U20EST119	Engineering Mechanics	ES	2	2	0	3	25	75	100
4	U20EET101	Electrical Engineering	PC	3	0	0	3	25	75	100
5	U20EET102	Electronic Devices	PC	3	0	0	3	25	75	100
Practical										
6	U20ESP102	Programming in C Lab	ES	0	0	2	1	50	50	100
7	U20EEP101	Electrical Engineering Lab	PC	0	0	2	1	50	50	100
8	U20EEP102	Electronics Lab - I	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20EEC1XX	Certification Course – I**	EEC	0	0	4	-	100	-	100
Mandatory Course										
10	U20EEM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	375	525	900

SEMESTER – II										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST215	Engineering Mathematics –II Multiple Integrals and Transforms	BS	2	2	0	3	25	75	100
2	U20EST238	Basic Engineering Science for Electrical Engineering	ES	3	0	0	3	25	75	100
3	U20EET203	Electric Circuit Analysis	PC	2	2	0	3	25	75	100
4	U20EET204	Electrical Machines – I	PC	3	0	0	3	25	75	100
5	U20EET205	Electronic Circuits	PC	3	0	0	3	25	75	100
6	U20EET206	Digital Electronics	PC	3	0	0	3	25	75	100
Practical										
7	U20EEP203	Electric Circuit Analysis Lab	PC	0	0	2	1	50	50	100
8	U20EEP204	Electrical Machines Lab- I	PC	0	0	2	1	50	50	100
9	U20EEP205	Electronics Lab – II	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20EEC2XX	Certification Course – II **	EEC	0	0	4	-	100	-	100
11	U20EES201	Skill Development Course 1: Demonstration of Basic Engineering Science	EEC	0	0	2	-	100	-	100
Mandatory Course										
12	U20EEM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

***** Certification courses are to be selected from the list given in Annexure III***

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SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST320	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	2	2	0	3	25	75	100
3	U20EET307	Electrical Machines – II	PC	3	0	0	3	25	75	100
4	U20EET308	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U20EET309	Electromagnetic Theory	PC	3	0	0	3	25	75	100
6	U20EET310	Power Plant Engineering	PC	3	0	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency - I	HS	0	0	2	1	50	50	100
8	U20ESP357	Data Structures Lab	ES	0	0	2	1	50	50	100
9	U20EEP306	Electrical Machines Lab- II	PC	0	0	2	1	50	50	100
10	U20EEP307	Linear Integrated Circuits Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20EEC3XX	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U20EES302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20EEM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – IV										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20BST430	Probability and Statistics	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	2	2	0	3	25	75	100
3	U20EET411	Measurements and Instrumentation for Electrical Engineering	PC	3	0	0	3	25	75	100
4	U20EET412	Microprocessor and Microcontroller	PC	3	0	0	3	25	75	100
5	U20EEE4XX	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective – I $	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency - II	HS	0	0	2	1	50	50	100
8	U20ESP468	Programming in JAVA Lab	ES	0	0	2	1	50	50	100
9	U20EEP408	Measurements and Instrumentation Lab	PC	0	0	2	1	50	50	100
10	U20EEP409	Microcontroller and its applications Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20EEC4XX	Certification Course – IV **	EEC	0	0	4	-	100	-	100
12	U20EES403	Skill Development Course 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20EEM404	NSS / NCC	MC	0	0	2	-	100	-	100
							22	650	650	1300

**** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV***

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SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST542	Numerical Methods and Optimization	BS	2	2	0	3	25	75	100
2	U20EET513	Power Electronics	PC	3	0	0	3	25	75	100
3	U20EET514	Control Systems	PC	2	2	0	3	25	75	100
4	U20EET515	Transmission and Distribution	PC	3	0	0	3	25	75	100
5	U20EEE5XX	Professional Elective - II #	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective-II $	HS	3	0	0	3	25	75	100
Practical										
7	U20BSP543	Numerical Methods and Optimization Lab	BS	0	0	2	1	50	50	100
8	U20EEP510	Power Electronics and Drives Lab	PC	0	0	2	1	50	50	100
9	U20EEP511	Control Systems Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20EEC5XX	Certification Course – V **	EEC	0	0	4	-	100	-	100
11	U20EES504	Skill Development Course 4: Foreign Language/ IELTS - I	EEC	0	0	2	-	100	-	100
12	U20EES505	Skill Development Course 5: Presentation Skill using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20EEM505	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20EET616	Embedded System	PC	3	0	0	3	25	75	100
2	U20EECM01	Renewable Energy Sources	CM	3	0	0	3	25	75	100
3	U20EET618	Power System Analysis	PC	2	2	0	3	25	75	100
4	U20EET619	Electrical Machine Design	PC	2	2	0	3	25	75	100
5	U20EEE6XX	Professional Elective - III #	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective – III $	OE	3	0	0	3	25	75	100
Practical										
7	U20EEP612	Embedded System Lab	PC	0	0	2	1	50	50	100
8	U20EEP613	Renewable Energy Lab	PC	0	0	2	1	50	50	100
9	U20EEP614	Power System Analysis Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20EEC6XX	Certification Course – VI **	EEC	0	0	4	-	100	-	100
11	U20EES606	Skill Development Course 6: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U20EES607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20EES608	Skill Development Course 8: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20EEM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

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SEMESTER – VII										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20EET720	Industrial Automation and Control	PC	3	0	0	3	25	75	100
2	U20EECM02	Electric Vehicle Technology	CM	3	0	0	3	25	75	100
3	U20EEE7XX	Professional Elective – IV #	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective – IV $	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20EEP715	Industrial Automation and Control Lab	PC	0	0	2	1	50	50	100
7	U20EEP716	Electric and Hybrid Vehicle Lab	PC	0	0	2	1	50	50	100
8	U20EEP717	Electrical Software Simulation Lab	PC	0	0	2	1	50	50	100
Project Work										
9	U20EEW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20EEW702	Internship / Inplant Training	PW	-	-	-	2	100	-	100
Mandatory Course										
11	U20EEM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

SEMESTER – VIII										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U20EET822	Protection and Switchgear	PC	3	0	0	3	25	75	100
2	U20EEE8XX	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U20EEE8XX	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
5	U20EEP818	Comprehensive Viva	PC	0	0	2	1	50	50	100
Project Work										
6	U20EEW803	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
7	U20EES809	Skill Development Course 9: NPTEL / MOOC-II	EEC	0	0	0	-	100	-	100
							19	365	335	700

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Annexure – I
PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20EEE401	Electrical Safety Engineering
2	U20EEE402	Computer Aided Design for Electrical Apparatus
3	U20EEE403	Sensors and Transducers for Electrical Engineering
4	U20EEE404	Finite Element Analysis
5	U20EEE405	Energy Storage Technology
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20EEE506	Utilization of Electrical Energy
2	U20EEE507	Electric Traction
3	U20EEE508	Electrical Energy Audit and Conservation
4	U20EEE509	Automotive Electronics for Electrical Engineering
5	U20EEE510	Industrial Electrical System
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20ICCM02	Virtual Instrumentation
2	U20EEE612	High Voltage Engineering
3	U20EEE613	Electric Drives
4	U20EEE614	Digital Signal Processing
5	U20ECCM02	Robotics and Automation
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20EEE716	Distributed Generation and Microgrids
2	U20EEE717	Advanced Control Systems
3	U20EEE719	Power System Operation and Control
4	U20EEE720	Special Electrical Machines
5	U20ICCM01	Fuzzy Logic and Neural Networks
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20EEE821	Power System Economics
2	U20EEE822	FACTS
3	U20EEE823	SMPS and UPS
4	U20EEE824	Optimization Techniques
5	U20EEE825	Fundamentals of Solar photovoltaic system and applications
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20EEE826	Smart Grid
2	U20EEE827	EHV AC and DC transmission
3	U20EEE828	Restructured Power System
4	U20EEE829	Power System Stability
5	U20EEE830	Power Electronics for Renewable Energy Systems

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Annexure – II

OPEN ELECTIVE COURSES

S. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Industrial Safety Management	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics

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20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)				
1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICCM01	Fuzzy Logic and Neural Networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT

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14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics
17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EECM02	Electric Vehicle Technology	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECCM04	Internet of Things	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Sensors for Industrial Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITCM08	Automation Techniques and Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Ultrasonic Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH

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14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE
19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

Annexure – III

EMPLOYABILITY ENHANCEMENT COURSES – (A) CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20EECX01	3ds Max
2	U20EECX02	Advance Structural Analysis of Building using ETABS
3	U20EECX03	Advanced Java Programming
4	U20EECX04	Advanced Python Programming
5	U20EECX05	Analog System Lab Kit

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6	U20EECX06	Android Medical App Development
7	U20EECX07	Android Programming
8	U20EECX08	ANSYS -Multiphysics
9	U20EECX09	Artificial Intelligence
10	U20EECX10	Artificial Intelligence and Edge Computing
11	U20EECX11	Artificial Intelligence in Medicines
12	U20EECX12	AutoCAD for Architecture
13	U20EECX13	AutoCAD for Civil
14	U20EECX14	AutoCAD for Electrical
15	U20EECX15	AutoCAD for Mechanical
16	U20EECX16	Azure DevOps
17	U20EECX17	Basic Course on ePLAN
18	U20EECX18	Basic Electro Pneumatics
19	U20EECX19	Basic Hydraulics
20	U20EECX20	Bio Signal and Image Processing Development System
21	U20EECX21	Block chain
22	U20EECX22	Bridge Analysis
23	U20EECX23	Building Analysis and Construction Management
24	U20EECX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20EECX25	CATIA
26	U20EECX26	CCNA (Routing and Switching)
27	U20EECX27	CCNA (Wireless)
28	U20EECX28	Cloud Computing
29	U20EECX29	Computer Programming for Medical Equipments
30	U20EECX30	Corel Draw
31	U20EECX31	Creo (Modeling and Simulation)
32	U20EECX32	Cyber Security
33	U20EECX33	Data Science and Data Analytics
34	U20EECX34	Data Science using Python
35	U20EECX35	Data Science using R
36	U20EECX36	Deep Learning

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37	U20EECX37	Design and Documentation using ePLAN Electric P8
38	U20EECX38	Design of Biomedical Devices and Systems
39	U20EECX39	Digital Marketing
40	U20EECX40	Digital Signal Processing Development System
41	U20EECX41	DigSILENT Power Factory
42	U20EECX42	Electro Hydraulic Automation with PLC
43	U20EECX43	Embedded System using Arduino
44	U20EECX44	Embedded System using C
45	U20EECX45	Embedded System with IoT
46	U20EECX46	ePLAN Data Portal
47	U20EECX47	ePLAN Electric P8
48	U20EECX48	ePLAN Fluid
49	U20EECX49	ePLAN PPE
50	U20EECX50	Fusion 360
51	U20EECX51	Fuzzy Logic and Neural Networks
52	U20EECX52	Google Analytics
53	U20EECX53	Hydraulic Automation
54	U20EECX54	Industrial Automation
55	U20EECX55	Industry 4.0
56	U20EECX56	Internet of Things
57	U20EECX57	Introduction to C Programming
58	U20EECX58	Introduction to C++ Programming
59	U20EECX59	IoT using Python
60	U20EECX60	Java Programming
61	U20EECX61	Machine Learning
62	U20EECX62	Machine Learning and Deep Learning
63	U20EECX63	Machine Learning for Medical Diagnosis
64	U20EECX64	Mechatronics
65	U20EECX65	Medical Robotics
66	U20EECX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20EECX67	Mobile Edge Computing

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68	U20EECX68	Modeling and Visualization using Micro station
69	U20EECX69	MX Road
70	U20EECX70	Photoshop
71	U20EECX71	PLC
72	U20EECX72	Pneumatics Automation
73	U20EECX73	Project Management
74	U20EECX74	Python Programming
75	U20EECX75	Revit Architecture
76	U20EECX76	Revit Inventor
77	U20EECX77	Revit MEP
78	U20EECX78	Robotics
79	U20EECX79	Search Engine Optimization
80	U20EECX80	Software Testing
81	U20EECX81	Solar and Smart Energy System with IoT
82	U20EECX82	Solid Works
83	U20EECX83	Solid Works with Electrical Schematics
84	U20EECX84	Speech Processing
85	U20EECX85	STAAD PRO V8i
86	U20EECX86	Structural Design and Analysis using Bentley
87	U20EECX87	Total Station
88	U20EECX88	Video and Image Processing Development System
89	U20EECX89	VLSI Design
90	U20EECX90	Web Programming - I
91	U20EECX91	Web Programming - II

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Annexure – IV

EMPLOYABILITY ENHANCEMENT COURSES – (B) SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U20EES201	Skill Development Course 1: Demonstration of Basic Engineering Science
2	U20EES302	Skill Development Course 2 *
		1) Testing of Electronics Devices and PCB Board Designing
		2) Design of Solar power plant and Installation
		3) Demonstration / Troubleshooting of Electrical and Electronics Equipments
3	U20EES403	Skill Development Course 3 *
		1) Mobile Phone Servicing
		2) Autonomous Robotics
		3) Repair and Maintenance of Power Supply, Inverter and UPS
4	U20EES504	Skill Development Course 4 : Foreign Language/ IELTS -I
5	U20EES505	Skill Development Course 5 : Presentation Skills using ICT
6	U20EES606	Skill Development Course 6 : Foreign Language/ IELTS - II
7	U20EES607	Skill Development Course 7 : Technical Seminar
8	U20EES608	Skill Development Course 8 : NPTEL / MOOC - I
9	U20EES809	Skill Development Course 9 : NPTEL / MOOC-II

** Any one course to be selected from the list*

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U20BST101	ENGINEERING MATHEMATICS – I CALCULUS AND LINEAR ALGEBRA (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.
- To understand the concept of partial differentiation.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus.

Course Outcomes

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

CO1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**
CO2 - Solve differential equations**. (K3)**
CO3 - Solve higher order differential equations.**(K3)**
CO4 - Solve different types of partial differential equation. **(K3)**
CO5 - Understand the use of vector calculus. **(K2)**

UNIT I MATRICES (12 Hrs)

Rank of a Matrix- Consistency of system of equations. Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors. Cayley-Hamilton Theorem - Diagonalization of matrices.

UNIT II DIFFERENTIAL EQUATIONS (12 Hrs)

Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type

UNIT III DIFFERENTIAL EQUATIONS (HIGHER ORDER) (12 Hrs)

Linear differential equations of higher order with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, Solution by variation of parameter method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variables. Partial differential equations of higher order with constant coefficients.

UNIT V VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl - Directional derivative- Irrotational and Solenoidal vector fields - Gauss Divergence Theorem and Stoke's Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley Publication, 10th Edition, 2019.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 6th Edition, 2018.
3. N. P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.

Reference Books

1. C.W. Evans, "Engineering Mathematics: A Programmed Approach", Routledge Publisher, 3rd Edition, 2019.
2. Dr. A. Singaravelu, "Engineering Mathematics for first year", Meenakshi Agencies, Tamil Nadu, Latest New Edition, 2019.
3. M.K. Venkataraman, "Engineering Mathematics (Third Year-Part A)", The National Publishing Company, Madras, 2nd Edition, 2016.
4. S.Narayanan and Manicavachagom T.K. Pillay, "Differential Equations and Its Applications", Paperback, Viswanathan.S, Printers & Publishers Pvt. Ltd, 2009.
5. Dr.G Balaji., " Engineering Mathematics-I", G.Balaji publishers, 2017

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Web References

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra slidessystemsofquationhandout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	3	-	1
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	1
3	3	2	1	1	-	1	1	-	-	-		1	3	-	1
4	3	2	1	1	-	1	1	-	-	-	-	1	3	-	1
5	2	1	-	-	-	-	1	-	-		-	1	3	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EST101	PROGRAMMING IN C (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the Fundamentals of Computers and introduction to C language.
- To study about the programs using Control structures.
- To understand the programs using looping and arrays.
- To understand the concepts of Functions and Pointers.
- To study about Structure, Union and File Management Operations in C.

Course Outcomes

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

CO1 - Comprehend the basic constructs of C programming. **(K2)**
CO2 - Illustrate the concepts of sequential, selection and repetition control structures in C program. **(K2)**
CO3 - Implement simple programs using looping structure and arrays. **(K3)**
CO4 - Demonstrate programs using Functions and Pointers. **(K3)**
CO5 - Build programs using Structure, Union and understand the concept of File management Operations. **(K3)**

UNIT I INTRODUCTION TO C (9 Hrs)

C programming: Overview of C – Visual Studio code-Constants – Compiling a C Program – Variables and Data Types – Technical Difference between Keywords and Identifiers – Types of C Qualifiers and format specifies – Operators and Expressions – Operators Precedence – Type conversion – Input-Output Statements.

UNIT II DECISION MAKING (9 Hrs)

Decision Making and Branching – Relational operators – Logical operators – If – If else – If else If – Nested if. Switch-case.

UNIT III LOOPING AND ARRAYS (9 Hrs)

Looping: while - do while – for – break – continue - nested loop Arrays: One Dimensional Arrays-Two-Dimensional Arrays-Multi-Dimensional Array-Dynamic arrays-Character Arrays and String-Sorting - Searching.

UNIT IV FUNCTIONS, POINTERS (9 Hrs)

Functions: Introduction - Definition – Declaration – Categories of Functions - Nesting of Functions, Recursive functions - Passing Arrays to Functions - Strings – String library function. Pointers: Introduction - Declaring Pointer Variables - Initialization of Pointer Variables - Accessing the address of a variable - Accessing a variable thorough Pointer - Chain of Pointers - Pointer Expressions - Pointers and arrays – Pointers and functions – Call by Reference - Pointers and character strings - Array of Pointers - Pointers and Structures.

UNIT V STRUCTURES AND UNIONS, FILE MANAGEMENT (9 Hrs)

User defined data types: Introduction – Structure: definition - declaration - Arrays of Structures – Nested structures – Passing structures to functions –– Union - Enumeration and Typedef. Introduction to File Handling in C, Input and Output operations on a file – Error Handling - Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. E.Balagurusamy, “Programming in ANSI C”, Tata McGraw Hill, 8th Edition, 2019.
2. Herbert Schildt, “C: The Complete Reference”, McGraw Hill, 4th Edition, 2014.
3. Yashvant Kanetkar, “Let us C”, BPB Publications, 16th Edition, 2017.

Reference Books

1. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Impression, 2012.
2. Vikas Verma, “A Workbook on C “, Cengage Learning, 2nd Edition, 2012.
3. Dr. P. Rizwan Ahmed, “Office Automation”, Margham Publications, 2016.
4. P.Visu, R.Srinivasan and S.Koteeswaran, “Fundamentals of Computing and Programming”, Fourth Edition, Sri Krishna Publications, 2012.
5. Pradip Dev, Manas Ghoush, “Programming in C”, Oxford University Press, 2nd Edition, 2011.

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Web References

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	1	3
2	2	1	-	-	3	-	-	-	-	-	-	-	2	1	3
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EST119

ENGINEERING MECHANICS

(Common to EEE, ECE, MECH, Mechatronics)

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

- To understand the basics of force and moment, static equilibrium of particles in two and three dimensions.
- To examine the equilibrium of rigid bodies and components of a moment.
- To discuss the properties of surfaces and solids.
- To integrate the relationship between the motion of bodies
- To associate the various structural analysis and load on system of rigid bodies.

Course Outcomes

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

CO1 - Recognize the basics of equilibrium of particles in 2D and 3D. **(K1, K2)**
CO2 - Review the requirements of equilibrium of rigid bodies in 2D and 3D. **(K2)**
CO3 - Compute the center of mass and moment of inertia of surfaces and solids. **(K2, K3)**
CO4 - Predict displacement, velocity and acceleration of dynamic particles. **(K2, K3)**
CO5 - Solve for friction force and rigid body dynamics. **(K2, K3)**

UNIT I BASICS AND STATICS OF PARTICLES (12 Hrs)

Introduction - Units and Dimensions - Vectorial representation of forces and moments – Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces - Resolution and Composition of forces - Equilibrium of a particle - Principle of transmissibility - Single equivalent force - Free body diagram

UNIT II EQUILIBRIUM OF RIGID BODIES (12 Hrs)

Types of supports and their reactions - requirements of stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Equilibrium of Rigid bodies in two dimensions – Forces in space -Equilibrium of a particle in space - Equivalent systems of forces - Equilibrium of Rigid bodies in three dimensions – Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS (12 Hrs)

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas- Parallel axis theorem and perpendicular axis theorem, radius of gyration of area- product of inertia- mass moment of inertia.

UNIT IV DYNAMICS OF PARTICLES AND FRICTION (12 Hrs)

Displacements, Velocity and acceleration, their relationship - Relative motion -Curvilinear motion -Newton's law -Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies.
Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction- Rolling resistance

UNIT V STRUCTURAL ANALYSIS OF TRUSSES AND RIGID BODY DYNAMICS (12 Hrs)

Trusses: Definition of a truss - Simple Trusses - Analysis of Trusses - Method of joints- Method of sections. - Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder disc/wheel and sphere.

Text Books

1. F.P. Beer and E. R. Johnston Jr, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd., 11th Edition, 2016. (Unit I,II,III,IV,V)
2. J.L.Meriam & L.G. Karidge, "Engineering Volume I and Engineering Mechanics: Dynamics", 8th Edition, Wiley student edition, 2016. (I,II,III)
3. R. C. Hibbeller, "Engineering Mechanics", Prentice hall, 14th Edition, 2016. (Unit I,II,III,IV,V)

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Reference Books

1. Arthur P. Boresi and Richard J. Schmidt, “Engineering Mechanics: Statics and Dynamics”, Thomson Asia Private Limited, Singapore, 1st Edition, 2010. (Unit I,II,III,IV,V)
2. D.P.Sharma, “Engineering Mechanics”, Dorling Kindersley (India) Pvt. Ltd, 2010. (Unit II,III,IV,V).
3. S. Rajasekaran, G. Sankarasubramanian,“Fundamentals of Engineering Mechanics”, Vikas Publishing House Pvt., Ltd., 3rd Edition, 2012. (Unit I,II,III,IV,V)
4. S.S. Bhavikattand K.G. Rajashekarappa, “Engineering Mechanics”, New Age International(P) Ltd, New Delhi, 7th Edition, 2019. (Unit I,II,III,IV,V)
5. Dr.I.S. Gujral, “Engineering Mechanical”, Lakshmi Publication (P).Ltd., 2nd Edition, 2011. (Unit I,II,III,IV,V)
6. Vela Murali, “Engineering Mechanics”, Oxford University Press, 2nd Edition, 2018. (Unit I,II,III,IV,V)

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / engg. mechanics /ui/ Table of Contents.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	-	-	-	-	-	-	1	1	1	1
2	3	2	2	1	1	-	-	-	-	-	-	1	1	1	1
3	3	2	2	1	1	-	-	-	-	-	-	1	1	1	1
4	3	2	2	1	1	-	-	-	-	-	-	1	1	1	1
5	3	2	2	1	1	-	-	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET101	ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic definitions and laws governing electricity, calculation of current, voltage and power for DC circuits.
- To have a clear knowledge about the various definitions of magnetism, concepts related to various effects on magnetic / electrical parameters
- To carry out various analysis on R, L and C circuits and to have a detailed study on their electrical quantities.
- To have an overview of the domestic wiring and electrical safety.
- To understand the fundamental estimation of industrial wiring.

Course Outcomes

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

CO1 - Calculate current, voltage and power using laws for DC circuits. **(K3)**
CO2 - Use various terms, laws and parameters governing the magnetic circuits. **(K3)**
CO3 - Analyze different AC circuits and understand the concepts of poly phase system.**(K4)**
CO4 - Do house wiring schemes with the safety measures. **(K4)**
CO5 - Do wiring and protection schemes for industries. **(K4)**

UNIT I DC CIRCUITS (9 Hrs)

Concept of Potential difference, voltage, current, work, Power, Energy, Electric networks, voltage source and current sources, linear passive and active elements, current-voltage relation, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Simplifications of networks using series-parallel, Star/Delta transformation.

UNIT II MAGNETIC CIRCUITS (9 Hrs)

Basic Definitions of magnetism-Magnetic effect on electric current – Important terms of magnetic circuits – Comparison of Magnetic and Electric circuits - Electromagnetic induction - Lenz law – Induced emf – Self and Mutual Induction – Amperes law- Energy stored in magnetic circuits – Magnetic Hysteresis and Eddy current-Magnetic Material and B-H Curve.

UNIT III AC CIRCUITS (9 Hrs)

AC waveform - definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (Y-∆ and Y-Y), relationship between line and phase values -power measurement – two Wattmeter method.

UNIT IV ELECTRICAL SAFETY AND DOMESTIC WIRING (9 Hrs)

Safety measures in electrical system - Electrical tools and accessories–wiring Standards - Types of domestic wiring - Staircase, doctor’s room, fluorescent lamps and corridor wiring- Layout of electrical power system and its functions - Insulators, Cables, Fuses, circuit breaker, Necessity of earthing, Types of earthing - Electrical shock and rescue methods - energy audit - Application – House wiring.

UNIT V INDUSTRIAL WIRING (9 Hrs)

Introduction to Single line diagram - Three phase wiring connections - Factory wiring - Godown wiring – panel wiring - Electrical Estimation and installation - Types of Conductors, Insulators and Cables – Earthing - types of earthing - Introduction to Megger - Introduction to ECAD - Applications – Commercial wiring.

Text Books

1. S. K. Sahdev, “Fundamentals of Electrical Engineering and Electronics”, Dhanpat Rai & Co, 2017.
2. S.S. Dash, C. Subramani, K. Vijayakumar, “Basic Electrical Engineering”, Vijay Nicole Imprints Pvt. Ltd, 1st Edition, 2013.
3. Leonard S Bobrow, “Foundations of Electrical Engineering”, Oxford University Press, Asian Edition, 2013.
4. D P Kothari and I.J. Nagarath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education (India) Private Limited, 3rd Reprint, 2016.

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5. B. L. Thereja, A. K. Thereja, “A text book of Electrical Technology- Basic Electrical Engineering-Volume-1”, S. Chand & Co. Ltd., 23rd Edition, 2015.
6. Black and Decker, “The Complete Guide to Wiring”, Quarto publishing group, USA, 7th Edition, 2018.

Reference Books

1. Smarajt Ghosh, “Fundamentals of Electrical and Electronics Engineering”, PHI Learning, 2nd Edition, 2007.
2. V. K. Metha, Rohit Metha, “Basic Electrical Engineering”, S. Chand & Co, 5th Edition, 2012.
3. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education India, New Delhi, 2nd Edition, 2015.
4. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, 1st Indian Edition, 2006.
5. Stephen L. Herman, “Electrical Wiring”, Cengage Learning India, 15th Edition, 2014.
6. S. K. Bhattacharya, S. Chatterji, “Projects in Electrical, Electronics, Instrumentation and Computer Engineering”, S. Chand & Co, 2nd Edition, 2010.
7. David Herres, “The Homeowner's DIY Guide to Electrical Wiring”, McGraw Hill Professional, 7th Edition, 2015.
8. Gaurav Verma and Matt Weber, “AutoCAD Electrical 2018 Black Book”, Ingram short title, 4th Edition, 2018.

Web References

1. https://www.electrical4u.com/
2. https://www.allaboutcircuits.com/
3. https://nptel.ac.in/courses/108105112/
4. https://nptel.ac.in/courses/108108076/
5. https://demonstrations.wolfram.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
2	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	2	-	-	-	2	-	-	3	3	3	3
5	3	3	3	2	2	-	-	-	2	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET102	ELECTRONIC DEVICES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide a platform for students to understand the characteristics of devices such as Diode, BJT, FET, MOSFET and special devices.
- To introduce biasing techniques for stable operating point in BJT and FET.
- To explain the operation and applications of special diodes and opto electronic devices.
- To explore the application of diode as rectifiers, clipper and clamper circuits.
- To learn the switching characteristics of power devices.

Course Outcomes

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

CO1 - Use the PN junction and Zener diode for applications like rectifiers, clippers, clampers and regulator circuits respectively. **(K3)**
CO2 - Apply CB, CE and CC Configurations of BJT in applications like isolator, amplifier and voltage follower circuit respectively. **(K3)**
CO3 - Use FET as a buffer , voltage variable resistor etc., **(K3)**
CO4 - Use special devices for various application as variable capacitance, oscillator etc., **(K3)**
CO5 - Use optoelectronics devices for isolator, light intensity measurement and display devices. **(K3)**
CO6 - Discriminate the switching characteristics of power devices and to use in suitable power conversion application. **(K4)**

UNIT I PN JUNCTION DEVICES (9 Hrs)

Introduction –Semiconductor– PN junction diode – Mathematical model of PN diode – Effect of temperature on diode operation – Static and Dynamic resistance – Diode equivalent models – Transition and diffusion capacitances – Diode switching Characteristics – Reverse Recovery time – Diode applications: Rectifiers, Clippers and Clampers – Zener diode – VI Characteristics – Zener as regulator – Special devices: Varactor diode – PIN diode – Gunn Diode–Tunnel diode – Schottky diode – SCR – SCS – DIAC and UJT – Selection of devices using specification sheets– Introduction to SiC diodes

UNIT II BIPOLAR JUNCTION TRANSISTORS (9 Hrs)

BJT: NPN and PNP transistors – Ebers - Moll model - CB, CE and CC configurations – Transistor characteristic– Biasing– DC and AC load line – Operating point – Stabilization– Bias compensation techniques – Thermal stability and runaway – Amplification –Transistor switching times – Base width modulation – Early Effect– breakdown voltage – Voltage in open emitter configuration and open base configuration – BJT ratings – Selection of devices using specification sheets– Introduction to HBT and SJT.

UNIT III FIELD EFFECT TRANSISTORS (9 Hrs)

FET: JFET – Drain and transfer characteristics – Shockley's equation – Comparison between JFET and BJT – Biasing– MOSFET: Types and characteristics–MOSFET as a voltage variable resistor and current limiter –FET ratings – Selection of devices using specification sheets– Introduction to SiC MOSFET- HFET.

UNIT IV OPTO ELECTRONIC DEVICES (9 Hrs)

Optical absorption in a semiconductor, photon absorption coefficient – Electron hole pair generation– Homo junction and hetero junction– Optical absorption, loss and gain – Threshold current –LEDs and LCDs – Photo diodes – Photo transistors – Photoconductive cells – PV cells – Applications of photodiode – Opto couplers .

UNIT V POWER DEVICES (9 Hrs)

Power switching devices overview: ideal and real switching characteristics – power diode, BJT, SCR, TRIAC, MOSFET, GTO, IGBT – V-I characteristics – SCR: Two Transistor model, Triggering Methods, Commutation Circuits and Snubber circuits– protection-di/dt, dv/dt, overcurrent, overvoltage – specifications – losses – thermal characteristics – series and parallel operation - Interpretation of power device data sheet.

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Text Books

1. David A. Bell, "Electronic devices and circuits", Oxford University higher education, 5th Edition, 2008.
2. Muhammad H. Rashid, "Microelectronic Circuits: Analysis & Design", Cengage learning Inc, 2nd Edition 2011.
3. Dr. R. S. Sedha, "A textbook of Applied Electronics", S. Chand Publications, Multicolor Edition, 2019.
4. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit theory", Pearson Education, 9th Edition, 2007.
5. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 6th Edition, 2012.

Reference Books

1. Thomas L. Floyd, "Electronic devices", Pearson prentice hall, 10th Edition, 2017.
2. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
3. Robert L. Boylestad, "Electronic devices and circuit theory", Pearson Prentice Hall, 10th Edition, 2009.
4. Mahesh B. Patil, "Basic electronic devices and circuits", PHI Learning Pvt. Ltd., 1st Edition, 2013.
5. M. D. Singh, K. B. Khanchandani, "Power Electronics", Tata McGraw Hill, New Delhi, 2nd Edition, 2017.
6. Albert C. Beer, Eicke R. Weber, R. K. Willardson, Richard A. Kiehl, T. C.L. Gerhard Sollner, "High Speed Heterostructure Devices", Academic Press, 1994.

Web References

1. https://nptel.ac.in/courses/108108112/
2. https://nptel.ac.in/content/storage2/courses/113106062/Lec22.pdf
3. https://nptel.ac.in/courses/117106086/
4. https://www.ee.iitb.ac.in/~sequel/ee101/ee101_bjt_1.pdf
5. http://www.iitg.ac.in/apvajpeyi/ph218/Lec-5.pdf
6. https://www.ee.iitb.ac.in/~sequel/ee101/ee101_jfet_1.pdf
7. https://www.elprocus.com/high-electron-mobility-transistor-hemt-construction-applications/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
2	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
3	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
4	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
6	2	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ESP102	PROGRAMMING IN C LAB (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To practice the fundamental programming methodologies in the C programming language.
- To apply logical skills for problem solving using control structures and arrays.
- To design, implement, test and debug programs that use different data types, variables, strings, arrays, pointers and structures.
- To design modular programming and provide recursive solution to problems.
- To understand the miscellaneous aspects of C and comprehension of file operations.

Course Outcomes

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

CO1 - Implement logical formulations to solve simple problems leading to specific applications**. (K3)**
CO2 - Execute C programs for simple applications making use of basic constructs, arrays and strings**. (K3)**
CO3 - Experiment C programs involving functions, recursion, pointers, and structures. **(K3)**
CO4 - Demonstrate applications using sequential and random access file processing. **(K3)**
CO5 - Build solutions for online coding challenges. **(K3)**

List of Exercises

1. Simple programming exercises to familiarize the basic C language constructs.
2. Develop programs using identifiers and operators.
3. Develop programs using decision-making and looping constructs.
4. Develop programs using functions as mathematical functions.
5. Develop programs with user defined functions – includes parameter passing.
6. Develop program for one dimensional and two dimensional arrays.
7. Develop program for sorting and searching elements.
8. Develop program to illustrate pointers.
9. Develop program with arrays and pointers.
10. Develop program for dynamic memory allocation.
11. Develop programs for file operations

Reference Books

1. Zed A Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)”, Addison Wesley, 2016.
2. Anita Goel and Ajay Mittal, “Computer Fundamentals and programming in C”, Pearson Education, 1st Edition, 2011.
3. Yashvanth Kanethkar, “Let us C”, BPB Publications, 13th Edition, 2008.
4. Maureen Sprankle, Jim Hubbard, “Problem Solving and Programming Concepts”, Pearson, 9th Edition, 2011.
5. B.W. Kernighan and D.M. Ritchie, “The C Programming language”, Pearson Education, 2nd Edition, 2006.

Web References

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html
5. https://fresh2refresh.com/c-programming/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP101 **ELECTRICAL ENGINEERING LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- Make aware of the various safety procedures to be followed when working with electricity and various tools and accessories used for wiring.
- To understand the line diagram representation of any electrical circuits.
- To implement various wiring circuits in domestic and industries.
- To know about the usage of Megger.
- To trouble shooting of various domestic appliances.
- To gain knowledge about the domestic power distribution.

Course Outcomes

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

CO1 - Follow the safety procedures when working with Electricity and various equipments. **(K2)**
CO2 - Use the protection circuits for electrical networks. **(K3)**
CO3 - Do line diagram and wiring for domestic and industries. **(K3)**
CO4 - Design and calculate the domestic power distribution. **(K4)**
CO5 - Use megger for earth resistance measurements. **(K3)**
CO6 - Troubleshooting of domestic appliances. **(K4)**

List of Experiments

1. Electrical Safety Precautions and study of tools, accessories, Electrical joints and electrical symbols.
2. Study of different types of Fuses, Circuits breakers, AC and DC meters.
3. Testing of series and parallel lamp circuits.
4. Domestic Wiring Practice
   a. Staircase wiring
   b. Doctor's room wiring
   c. Bed room wiring
   d. Godown wiring
   e. Lamp controlled from three different places
   f. Ceiling fan and fluorescent lamp wiring.
5. Design of Domestic power distribution.
6. Estimation of material requirement for Residential building/Flat wiring
7. Single line diagram for industrial wiring
8. Estimation of material requirement for industrial wiring
9. Measurement of earth resistance using Megger.
10. Characteristics of fluorescent and incandescent lamp.
11. To study and measure the inductance of choke coil.
12. Study of Electric shock phenomenon, precautions, preventions and Earthing
13. Study and Troubleshooting of electrical equipments (Fan, Iron box)

Reference Books

1. S. K. Sahdev, “Fundamentals of Electrical Engineering and Electronics”, Dhanpat Rai & Co, 2017.
2. B. L. Thereja, “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., Multicolor Edition, 2015.
3. David Herres, “The Homeowner's DIY Guide to Electrical Wiring”, McGraw Hill Professional, 7th Edition, 2015.
4. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education India, New Delhi, 2nd Edition, 2015.
5. Allan S Moris, “Measurement and Instrumentation Principles”, Elseveir, 1st Indian Edition, 2006.
6. Stephen L. Herman, “Electrical Wiring”, Cengage Learning India, 15th Edition, 2014.
7. S. K. Bhattacharya, S. Chatterji, “Projects in Electrical, Electronics, Instrumentation and Computer Engineering”, S. Chand & Co, 2010.

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Web References

1. https://www.electrical4u.com/
2. https://www.allaboutcircuits.com/
3. https://nptel.ac.in/courses/108105112/
4. https://nptel.ac.in/courses/108108076/
5. https://demonstrations.wolfram.com/

COs/POs/PSOs Mapping

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2	3	3	3	3	2	-	-	-	-	-	-	2	3	2	3
3	3	3	3	2	2	-	-	-	-	-	-	2	3	2	3
4	3	3	3	3	2	-	-	-	-	-	-	-	3	2	3
5	3	3	3	3	2	-	-	-	-	-	-	2	3	2	3
6	3	3	3	3	2	-	-	-	-	-	-	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP102	ELECTRONICS LAB - I	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To test electronic device characteristics and circuits using Bread boards.
- To study and implement diode applications on rectifiers, clippers and clampers.
- To develop the biasing circuits for BJT and FET for proper amplification.
- To impart knowledge on design trade-offs in regulator circuits.
- To study and observe power electronic devices and its characteristics.

Course Outcomes

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

CO1 - Analyze the characteristics of different electronic devices such as diode, BJT, FET etc. **(K4)**
CO2 - Design clippers, clamper, rectifier and regulator circuits using PN and Zener diodes. **(K4)**
CO3 - Demonstrate the characteristics of opto electronic devices. **(K3)**
CO4 - Experiment the characteristics of various special devices. **(K3)**
CO5 - Demonstrate the characteristics of power devices like SCR, MOSFET, IGBT, etc. **(K3)**

List of Experiments

1. Study of operation of Cathode Ray Oscilloscope, signal generator, multi-meter.
2. Obtain the V-I characteristics of PN junction diode and determine its static, dynamic resistances.
3. Design of half wave, full wave rectifier circuits with and without filters and determine the ripple factor.
4. Design of clipping and clamping circuits using PN junction diode.
5. Determine the VI characteristics of zener diode and design series, shunt voltage regulator.
6. Determine the input and output characteristics of BJT and identify cut-off, active and saturation region for CB, CC, CE configurations.
7. Design of voltage follower, inverter switch using NPN transistor.
8. Obtain the transfer and drain characteristics of JFET, MOSFET and determine their drain resistance, mutual conductance.
9. Design of self-bias and fixed bias circuits using transistor and compare their performance.
10. Determine the VI characteristics of LED, varactor diode, tunnel diode and design of current limiting resistors.
11. Determination of intrinsic stand-off ratio of UJT.
12. Obtain the characteristics of GTO and IGBT.
13. Determine the characteristics of SCR and TRIAC.

Reference Books

1. Louis E. Frenzel, “Practical Electronic Design for Experimenters”, McGraw Hill Professional, 1st Edition 2020.
2. David A. Bell, “Fundamentals of Electronic Devices and Circuits Lab Manual”, Oxford University higher education, 5th Edition, 2009.
3. David A. Bell, “Laboratory Manual for Electronic Devices and Circuits”, Oxford University higher education, 4th Edition, 2001.
4. Dr. R. S. Sedha, “A textbook of Applied Electronics”, S. Chand Publications, Multicolor Edition, 2019.
5. Thomas L. Floyd, “Electronic devices”, Pearson prentice hall, 10th Edition, 2017.
6. Donald A. Neamen, “Electronic Circuit Analysis and Design”, Tata McGraw Hill, 3rd Edition, 2003.

Web References

1. https://nptel.ac.in/courses/122/106/122106025/
2. https://nptel.ac.in/courses/122/106/122106026/
3. https://nptel.ac.in/courses/117/106/117106091/
4. https://nptel.ac.in/courses/108/107/108107142/
5. https://nptel.ac.in/courses/113/106/113106065/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	-	-	-	2	-	-	1	3	3	3
2	3	3	2	3	2	-	-	-	2	-	-	1	3	3	3
3	3	3	2	3	2	-	-	-	2	-	-	1	3	3	3
4	3	3	2	3	2	-	-	-	2	-	-	1	3	3	3
5	3	3	2	3	2	-	-	-	2	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEC1XX	CERTIFICATION COURSE - I	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20EEM101 **INDUCTION PROGRAM**

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring and Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures and Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

(DR.S. ANBUMALAR)

4.1. Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2. Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3. Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4. Lectures and Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, Vivekanand Kendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5. Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6. Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

(DR.S. ANBUMALAR)

U20BST215	ENGINEERING MATHEMATICS - II MULTIPLE INTEGRALS AND TRANSFORMS (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To equip themselves familiar with Laplace, transform and solve the differential equations using Laplace transform techniques.
- To enable the students to expand functions into Fourier series using change of intervals.
- To gain good knowledge in application of Fourier transforms.
- To inculcate the computational knowledge in Z-transforms

Course Outcomes

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

CO1 - Understand the concept of double and triple integrals. **(K2)**
CO2 - Apply Laplace transform and inverse Laplace transform of simple functions**. (K3)**
CO3 - Convert a periodic function into series form. **(K3)**
CO4 - Compute Fourier transforms of various functions. **(K3)**
CO5 - Solve difference equations using Z – transforms. **(K3)**

UNIT I MULTIPLE INTEGRALS (12 Hrs)

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT II LAPLACE TRANSFORMS AND INVERSE LAPLACE TRANSFORMS (12 Hrs)

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems, Methods for determining inverse Laplace Transforms, Convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT III FOURIER SERIES (12 Hrs)

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

UNIT IV FOURIER TRANSFORM (12 Hrs)

Fourier Integral theorem Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, Convolution and Parseval's identity.

UNIT V Z - TRANSFORMS (12 Hrs)

Difference equations, basic definition, z – transform - definition, Standard z – transforms, Damping rule, Shifting rule, Initial value and final value theorems and problems, Inverse z – transform. Applications of z – transforms to solve difference equations.

Text Books

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 1st Edition, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumar, "Engineering Mathematics", Pearsons, New Delhi, 2017.
3. M. D. Petale, "A text book on Z- Transforms (Engineering Mathematics)", Bames and Noble, New Edition, 2020

Reference Books

1. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.
2. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition, 2019.

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4. C. B. Gupta, Shree Ram Singh, M. Kumar, “Engineering Mathematics for semester I & II”, Tata McGraw Hill, New Delhi, 2016.
5. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill, New Delhi 2018

Web References

1. https://nptel.ac.in/courses/111105121/
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/111107119/
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
3	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
4	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
5	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EST238	BASIC ENGINEERING SCIENCE FOR ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To identify the fleet of scientific channels exploring the generation of Modern engineering materials.
- To identify, formulate and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.
- To study about the zeroth law, first law and second law of thermodynamics.
- To study the classification of IC engines and its applications.
- To study the various types of pumps and turbines.

Course Outcomes

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

CO1 - Identify, analyze the properties and applications of magnetic and dielectric materials. **(K2)**

CO2 - List the properties and applications of modern engineering materials. **(K1)**

CO3 - Appreciate concepts of conservation of mass, conservation of energy, and the Laws of thermodynamics. **(K2)**

CO4 - Understand the construction and functioning of IC engines, refrigeration system. **(K2)**

CO5 - Attain knowledge about types of pumps and turbines. **(K2)**

UNIT I MAGNETIC AND DIELECTRIC MATERIAL (9 Hrs)

Magnetic Materials: Types and Characteristics of magnetic materials – Hysteresis - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature –Domain Theory- Hard and Soft magnetic materials. Applications: Soft Magnets in Power conversion - electrical – mechanical. Hard Magnets in Sensors and Data storage.

Dielectric materials: Characteristics of Dielectric material. Polarization mechanism: Ionic, Electronic and orientation – Local or Internal electric field - Clausius-Mossotti relation -Temperature and frequency dependence of dielectric - Dielectric losses - Dielectric breakdown. Application: Cables and Transformers.

UNIT II MODERN ENGINEERING MATERIALS (9 Hrs)

Superconductors: Basic phenomena - excitations and energy gap - Meissener effect - Type-I and Type-II superconductors - High-temperature superconductors- Preparation and Applications.

Advanced materials: Liquid crystals Display (LCD) - types - shape memory alloys (SMA) - properties and applications of SMA – Metallic Glasses - Nanomaterials - methods of synthesis (CVD AND PVD)- properties and applications of nanomaterials - carbon nanotubes (CNT) - synthesis (Electric Arc Discharge and LASER ablation), properties. Applications of nanotechnology: Aerospace components, sensors, medicine.

UNIT III LAWS OF THERMODYNAMICS (9 Hrs)

Zeroth law of thermodynamics –Types of thermodynamic system - Equilibrium and quasistatic process –Point and path functions - Comparison between heat and work - Internal energy. First law of thermodynamics: Isochoric, isobaric, isothermal and adiabatic process - work done. Second law of thermodynamics: Entropy – Enthalpy – Refrigerator and Heat pump - Reversible and irreversible process – Carnot cylcle.

UNIT IV IC ENGINES, POWER CYCLES AND REFRIGERATION SYSTEM (9 Hrs)

IC Engine: Classifications - Basic components and terminology of IC engines - working of two stroke/four stroke - SI and CI engine - application of IC engines. Power Cycles: Otto cycle - Diesel cycle - Dual cycle - Brayton cycle – Rankine cycle. Refrigeration system: Vapor compression refrigeration-Vapour absorption refrigeration – Gas refrigeration Cycles.

UNIT V PUMPS AND TURBINES (9 Hrs)

Pumps: Functions of pumps - Types of pumps- Pump components – operation - Centrifugal Pumps, Reciprocating Pump - Submergible pumps, Piston pumps - Pump Troubleshooting and Maintenance.

Turbine: Classification of turbines - impulse and reaction -Radial and axial - tangential and mixed flow turbines Working of Pelton wheel, Francis turbine, Kaplan turbine - Selection of turbines - governing of turbines.

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Text Books

1. V. Raghavan, "Materials Science and Engineering - A First Course", PHI Learning, 6th Edition, 2015.
2. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publishing, 6th Edition, 2017.
3. P. N. Modi and S. M. Seth, "Hydraulics and Fluid mechanics", Standard Publishing House, Delhi, 22nd Edition, 2017.
4. V. Ganesan, "Internal Combustion Engines", Tata McGraw Hill Publishing, 6th Edition, 2012.

Reference Books

1. William D. Callister Jr., "Material Science and Engineering", John Wiley and sons, 9th Edition, 2014.
2. Charles Kittel, "Introduction to Solid State Physics", John Wiley & sons, 8th Edition, 2012.
3. C. P. Arora, "Thermodynamics", McGraw Hill Education, 2017.
4. Y. A. Cengel and M. A. Boles, "Thermodynamics - An Engineering Approach", McGraw Hill, 9th Edition, 2019.
5. R. K. Rajput. "Fluid Mechanics and Hydraulic Machines", S. Chand & Company, New Delhi, 6th Edition, 2016.

Web References

1. https://nptel.ac.in/courses/113/104/113104005/
2. https://nptel.ac.in/courses/113/105/113105081/
3. https://nptel.ac.in/courses/112/105/112105123/
4. https://nptel.ac.in/courses/112/103/112103262/
5. https://nptel.ac.in/courses/112/104/112104117/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1
2	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1
3	2	3	2	3	-	-	-	-	-	-	-	1	1	1	1
4	2	3	2	3	-	-	-	-	-	-	-	1	1	1	1
5	2	2	2	3	-	-	-	-	-	-	-	1	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET203	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To gain knowledge on computing electrical parameters like current, voltage and power using various network theorems for AC and DC circuits
- To gain knowledge on three phase circuits using phasor diagram and to apply for different load conditions
- To gain knowledge on the analysis of electric circuits using Graph theory.
- To gain knowledge on transient response of RL, RC and RLC circuits for DC and AC excitation
- To gain knowledge of R, L, C components for resonance and coupled circuits

Course Outcomes

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

CO1 - Analyze and solve DC networks using various network theorems. **(K4)**

CO2 - Analyze and solve AC networks using various network theorems. **(K4)**

CO3 - Analyze the behavior of three phase circuits using network topology for different type of loads under balanced and unbalanced conditions. **(K4)**

CO4 - Analyze the steady state and transient behavior of RL, RC and RLC circuit using Laplace transformations for DC and AC excitations. **(K4)**

CO5 - Analyze the resonance and tuned circuits for series and parallel connections. **(K4)**

UNIT I CIRCUIT ANALYSIS AND NETWORK THEOREMS FOR DC CIRCUITS (12 Hrs)

Review - Mesh and Nodal methods for DC circuits. Theorems – Thevenin's, Norton's, Superposition, Compensation, Tellegan's, Reciprocity, Maximum power transfer theorem, Millman's theorem.

UNIT II CIRCUIT ANALYSIS AND NETWORK THEOREMS FOR AC CIRCUITS (12 Hrs)

Mesh and Nodal methods for AC circuits. Theorems - Thevenin, Norton's, Superposition, Compensation, Tellegan's, Reciprocity, Maximum power transfer theorems, Millman's theorem.

UNIT III THREE PHASE CIRCUITS AND NETWORK TOPOLOGY (12 Hrs)

Three phase circuits: Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected balanced and unbalanced loads.

Basic concepts of graph theory: Graph, directed graph, branch, chord, Tree, incidence and reduced incidence matrices - application to network solutions - tie set, cut set, duality and dual networks- Introduction to two port networks.

UNIT IV TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER CIRCUITS (12 Hrs)

Transient response of RL, RC and RLC circuits to DC and AC excitation - Natural and forced oscillations - Laplace transform application to transient solution.

UNIT V RESONANCE AND COUPLED CIRCUITS (12 Hrs)

Resonant circuits: series, parallel and series – parallel circuits – effect of variation of Q on resonance. Relations between circuit parameters - Q, resonant frequency and bandwidth.

Coupled circuits: Self-inductance, mutual inductance – coefficient of coupling – dot convention – analysis of simple coupled circuits- Inductively coupled circuits- single tuned and double tuned circuits.

Text Books

1. William H Hayt, J. E. Kemmerly and Steven M Durbin, "Engineering Circuit Analysis", McGraw Hill, 8th Edition, 2013.
2. Charles K. Alexander and Matthew N. Q. Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill International Edition, 3rd Edition, 2013.
3. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", John Wiley & Sons, Inc. 7th Edition, 2015.
4. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 5th Edition, 2013.
5. Dr. M.Arumugam, Dr. N. Premakumaran, "Electric Circuit Theory", Khanna Publishers, 5th Edition, 2015.

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Reference Books

1. A. Sudhakar, Shyammohan S. Palli , “Circuits and Networks: Analysis and Synthesis”, McGraw Hill Publications, 5th Edition, 2015.
2. Mahmood Nahvi, Joseph Edminister, “Electric Circuits (Schaum's Outline series)”, McGraw-Hill Publications, 5th Edition, 2017.
3. Sukhija and Nagsarkar, “Circuits and Networks”, Oxford University Press, 2nd Edition, 2016.

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://www.electronics-tutorials.ws/accircuits/series-circuit.html
3. https://www.youtube.com/watch?v=83IVK6i8EB0&list=PLX2gX-ftPVXUkVZ2eafafDwcs5nDldeBD
4. https://www.youtube.com/watch?v=zDcXt9Vx34o
5. https://www.youtube.com/watch?v=YLGrugmDvc0
6. https://www.academia.edu/35158206/EE8251_CIRCUIT_THEORY_OBJECTIVES

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	2	3	3	3
2	3	3	3	2	3	-	-	-	-	-	-	2	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3
4	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3
5	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET204	ELECTRICAL MACHINES – I	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the performance characteristics of DC machines.
- To equip the students to test and analyze the characteristics of DC machines.
- To get familiar with performance characteristics of single phase transformers and special transformers.
- To learn different types of three phase transformer connections and savings of copper in autotransformer.
- To equip the students to test and analyze the characteristics of Transformers.

Course Outcomes

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

CO1 - Analyze the performance of DC machines under various operating conditions using their characteristics. **(K4)**
CO2 - Interpret the efficiency of DC machines by conducting Suitable tests. **(K4)**
CO3 - Inspect the performance of single phase transformers using phasor diagrams and equivalent circuits and understand the characteristics of special transformers. **(K4)**
CO4 - Outline the different types of connections in three phase transformers and savings of copper in autotransformers. **(K2)**
CO5 - Interpret the efficiency of Transformers by conducting Suitable tests.**(K4)**

UNIT I DC MACHINES (9 Hrs)

Electromechanical energy conversion concept–Single and multiple excited systems.

DC Generators: Construction of DC Machine – Principle of operation – Types of Windings – EMF equation - Armature Reaction – Commutation - methods of improving commutation – DC Generators types - Performance characteristics– Applications.

DC Motors: Principle of operation - Back emf - Torque equation – types - Performance characteristics. Starters: Need for starter – types – 2, 3, 4 point starters – electronic soft starters. Speed control: Armature and field Speed control - Solid state speed control. Electric braking – Applications

UNIT II TESTING OF DC MACHINES (9 Hrs)

Testing of DC Machines: Losses – efficiency – Condition for maximum efficiency - Power flow diagram – Testing: Load test – Swinburne's test - Hopkinson's test - Retardation test - Field's test – Separation of losses.

UNIT III SINGLE PHASE TRANSFORMERS AND SPECIAL TRANSFORMERS (9 Hrs)

Single Phase Transformers: Construction - Types – Principle of operation - emf equation - Equivalent circuit - phasor diagram - Parallel operation. Auto transformer: copper savings – Applications.
Special Transformer: Variable frequency transformer– audio frequency Transformer– Instrument transformers– Pulse transformer– Welding transformer – Traction transformer– Isolation transformer – Applications.

UNIT IV POLYPHASE TRANSFORMERS (9 Hrs)

Three Phase Transformers: Construction – Principle of operation – Types of connections – Open delta – Scott connection – three-phase to single phase conversion – three phase to two phase conversion – three phase to six phase conversion – Tap changing transformers – Three winding transformer– Transformers for HVDC applications.

UNIT V TESTING OF TRANSFORMERS (9 Hrs)

Testing of Transformers: Losses - Efficiency - Condition for maximum efficiency - all day efficiency – voltage regulation - Power flow diagram – Testing: Load test – OC and SC test – Polarity test - Sumpner's test – Separation of no load losses.

Text Books

1. A. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi, 7th Edition, 2013.
2. J. B. Gupta, "Theory and Performance of Electrical Machines", S. K. Kataria and Sons, New Delhi, 14th Edition, 2010.
3. B. L. Theraja and A. K. Theraja, "A Textbook of Electrical Technology-Vol. II", S. Chand & Co. Ltd., New Delhi, 23rd Multicolor Edition, 2009.

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Reference Books

1. Stephen J. Chapman, “Electric Machinery Fundamentals”, McGraw Hill Education Pvt. Ltd, 5th Edition, 2012.
2. D. P. Kothari and I.J. Nagrath, “Electric Machines”, Tata McGraw Hill, New Delhi, 5th Edition, 2017.
3. Vincent Del Toro, “Basic Electric Machines”, Pearson India Education, 1st Edition, 2016.
4. Irving. L. Kosow, “Electrical Machines and Transformers”, PHI, 2nd Edition, 2007.
5. Albert E. Clayton, “The performance and design of direct current machines”, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2004.

Web References

1. https://ndl.iitkgp.ac.in
2. https://nptel.ac.in/courses/108/105/108105017/
3. https://www.studocu.com/
4. http://electrical-engineering-portal.com/
5. http://www.electrical4u.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	2	-	-	-	-	-	-	1	3	3	3
2	3	2	2	-	2	-	-	-	-	-	-	1	3	3	3
3	3	3	2	-	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	-	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	-	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET205	ELECTRONIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on frequency response of small signal and large signal amplifiers.
- To explore the working of amplifiers with positive and negative feedback systems.
- To familiarize in time base and sweep circuits.
- To impart the importance of multi stage amplifier.
- To introduce stable operating point for BJT on various classes of power amplifiers.

Course Outcomes

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

CO1 - Design the transistor Amplifiers using its small signal model. **(K4)**
CO2 - Design cascade amplifiers and sweep circuits. **(K3)**
CO3 - Evaluate the performance analysis of large signal amplifier. **(K4)**
CO4 - Design the feedback amplifiers and analyze frequency response. **(K4)**
CO5 - Design oscillators for different types of signal generation. **(K3)**

UNIT I SMALL SIGNAL AMPLIFIERS (9 Hrs)

Transistor hybrid model and H-parameters – Determination of H-parameters from transistor characteristics – Analysis of CB, CE and CC circuits using H-parameter model – Voltage follower – Comparison of CB, CE and CC circuits – CE amplifier with unbiased emitter resistance – Transistor R_e model – Small signal equivalent model of HBT – High frequency transistor model – Low frequency FET model – Source follower – Analysis of CS and CD circuits.

UNIT II LARGE SIGNAL AMPLIFIERS (9 Hrs)

Classification of Power amplifiers – Class A power amplifier – Direct coupled and transformer coupled – Class B amplifier – push-pull arrangement and complementary symmetry amplifiers – Conversion efficiency calculations – cross-over distortion – Class AB amplifier – Amplifier distortion – Power transistor heat sinking – Class C , Class D, Class E and Class S amplifiers – Introduction to Doherty power amplifier.

UNIT III MULTISTAGE AMPLIFIERS AND TIME BASE CIRCUIT (9 Hrs)

Cascading amplifier – Direct and RC coupled two stage CE amplifiers – Darlington pair –Cascode amplifier – Tuned amplifier: Single tuned – Double tuned – Stagger tuned amplifiers – Schmitt trigger and Multivibrators circuits: using BJT – UJT sweep circuits – Voltage and current sawtooth sweeps – Fixed amplitude sweep – Miller and bootstrap time base – Multivibrators using negative resistance devices (UJT and Tunnel diodes). BJT Differential amplifiers: Common mode and differential mode – CMRR

UNIT IV FEEDBACK AMPLIFIERS (9 Hrs)

Feedback concept – Gain with feedback – General characteristics of negative feedback amplifiers – Four basic types of feedback and the effect on gain, input and output resistances – Multistage feedback amplifiers –Two stage CE amplifier with series voltage negative feedback – Frequency response and stability.

UNIT V OSCILLATORS (9 Hrs)

Conditions for sustained oscillations – Barkhausen criterion – LC oscillators – Analysis of Hartley, Colpitt, Tuned oscillators, RC Phase shift , Wein-bridge oscillators , Franklin , Armstrong and Twin T oscillators – Analysis – Crystal oscillators and frequency stability – UJT relaxation oscillators.

Text Books

1. David A. Bell, “Electronic devices and circuits”, Oxford University higher education, 5th Edition, 2008.
2. Muhammad H. Rashid, “Microelectronic Circuits: Analysis & Design”, Cengage learning Inc, 2nd Edition, 2011.
3. G.S. Tomar, Ashish Bagwari, “Fundamentals of Electronic Devices and Circuits”, Springer Nature, 2019.
4. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices & Circuit theory” Pearson Education, 9th Edition, 2007.
5. Dr. R. S. Sedha, “A textbook of Applied Electronics”, S. Chand Publications, Multicolor Edition, 2019.

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Reference Books

1. Thomas L. Floyd, “Electronic devices”, Pearson prentice hall, 10th Edition, 2017.
2. Donald A Neamen, “Electronic Circuit Analysis and Design”, Tata McGraw Hill, 3rd Edition, 2003.
3. Robert L.Boylestad, “Electronic devices and circuit theory”, Pearson Prentice Hall, 10th Edition, 2009.
4. Mahesh B. Patil, “Basic electronic devices and circuits”, PHI Learning Pvt. Ltd., 1st Edition, 2013.
5. Battula Tirumala Krishna and Dharma raj cheruku, “Electronic Devices and circuits”, Pearson Education India, 2nd Edition, 2008.
6. Andrei Grebennikov, “RF and Microwave Transistor Oscillator Design”, John Wiley & Sons, 2007.

Web References

1. https://nptel.ac.in/courses/108108112/
2. https://nptel.ac.in/content/storage2/courses/113106062/Lec22.pdf
3. https://nptel.ac.in/courses/117106086/
4. https://www.ee.iitb.ac.in/~sequel/ee101/ee101_bjt_1.pdf
5. http://www.iitg.ac.in/apvajpeyi/ph218/Lec-5.pdf
6. https://www.ee.iitb.ac.in/~sequel/ee101/ee101_jfet_1.pdf
7. http://www.ece.ubc.ca/~pulfrey/paper_encyclo.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET206 **DIGITAL ELECTRONICS**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To study various number systems and to simplify the logical expressions using Boolean functions.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the design procedures for synchronous and asynchronous sequential circuits.
- To study the various semiconductor memories and its related technology.
- To introduce digital simulation for development of application oriented logic circuits.

Course Outcomes

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

CO1 - Use the Boolean laws to simplify the logical functions. **(K3)**
CO2 - Design ‘n’ bit counters and shift registers. **(K4)**
CO3 - Design and analyze the synchronous and asynchronous sequential circuits. **(K4)**
CO4 - Gain knowledge on the design and fabrications of semiconductor memories. **(K2)**
CO5 - Design, debug and test digital logic circuits using VHDL. **(K4)**

UNIT I COMBINATIONAL CIRCUITS (9 Hrs)

Number systems: Binary, Decimal, Octal and Hexa decimal – 1s and 2s complement – Binary Arithmetic – BCD addition and subtraction – Boolean theorems – Digital Logic gates – Universal Gates –Design of combination circuits using NAND and NOR gates – POS, SOP simplification – Minterms and Maxterms – Karnaugh map – Don’t Care conditions – Design of adders, subtractor – half, full – Multiplexers – Demultiplexers – Application of Multiplexer as Logic function generator – Magnitude comparators – Encoder and Decoders – Priority Encoders – Parity Generator – Code Converters and BCD to Seven Segment Display driver.

UNIT II COUNTERS AND SHIFT REGISTERS (9 Hrs)

Flip flops: SR, D, JK, T and Master Slave – Edge and level triggered– Design of Synchronous counters – Asynchronous counter: UP/Down counter – decade counter – Modulo – n counter – Ring counter – Johnson counter – BCD Counters – Application of counters as frequency divider – Registers – Shift Registers – Application of shift register as Delay line – Bi directional shift registers – Parallel/serial converter.

UNIT III DESIGN OF SEQUENTIAL CIRCUITS (9 Hrs)

Design of Synchronous sequential circuits: Model Selection – State transition diagram – state synthesis table – Design equations and circuit diagram – State reduction technique – Asynchronous sequential circuits – Analysis – Problems with asynchronous sequential circuits – Design of asynchronous sequential circuits State transition diagram, Primitive table, State reduction, state assignment and design equations –Transition stability –flow stability-race conditions, hazards and errors in digital circuits.

UNIT IV MEMORIES AND LOGIC FAMILIES (9 Hrs)

Memory structure: RAM - ROM – PROM – EPROM – EEPROM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – CPLD – FPGA.
Logic families: RTL, DTL, TTL, I^2L and ECL Circuits – Metal Oxide Semiconductor (MOS) – Complementary MOS (CMOS).

UNIT V VHDL (9 Hrs)

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers and De multiplexers).

Text Books

1. Morris. M. Mano and Michael. D. Ciletti, “Digital Design”, Pearson Education, 5th Edition, 2013.
2. Floyd and Jain, “Digital Fundamentals”, Pearson Education, 11th Edition, 2015.
3. Comer “Digital Logic & State Machine Design”, Oxford, 3rd Edition, 2012.
4. John F.Wakerly, “Digital Design Principles & Practices”, Prentice Hall, 4thEdition, 2008.
5. M. Morris Mano, “Digital Design with an introduction to the VHDL”, Pearson Education, 5th Edition, 2013.

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Reference Books

1. D. P. Kothari, J. S. Dhillon, “Digital circuits and Design”, Pearson Education, 1st Edition, 2016.
2. Raj Kamal, “Digital systems-Principles and Design”, Pearson Education, 2nd Edition, 2007.
3. Roger L.Tokheim, “Digital Electronics: Principles and Applications”, McGraw Hill Education, 8th Edition, 2014.
4. William Keitz, “Digital Electronics-A Practical Approach with VHDL”, Pearson, 9th Edition, 2013.
5. Charles H. Roth, Jr. LizyLizy Kurian John, “Digital System Design using VHDL”, Cengage, 3rd Edition, 2018.

Web References

1. https://nptel.ac.in/courses/117103064/
2. https://nptel.ac.in/courses/117/105/117105080/
3. https://nptel.ac.in/courses/117/108/117108040/
4. http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html
5. http://nptel.unipune.ac.in/LocalG/listLectures.php?cid=70cfb15a91cff73d&bid=927d7542627865a3
6. https://www.elprocus.com/what-is-a-shift-register-different-types-counters-and-applications/
7. https://www.allaboutcircuits.com/textbook/digital/chpt-12/ring-counters/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	2	-	-	-	-	-	-	-	2	2	2
2	2	2	2	3	2	-	-	-	-	-	-	-	2	2	2
3	2	3	3	3	2	-	-	-	-	-	-	-	2	2	2
4	1	1	1	2	2	-	-	-	-	-	-	-	2	2	2
5	1	1	1	3	3	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP203 **ELECTRIC CIRCUIT ANALYSIS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course objectives

- To gain practical experience on electric circuits to measure various electrical parameters like current, voltage and power using various network theorems for DC and AC circuits
- To gain practical experience to evaluate the solution of three phase AC balanced and unbalanced circuits for star and delta connection
- To gain practical experience to evaluate steady state and transient behavior of networks with RL, RC and RLC circuit for DC and AC excitations.
- To gain practical experience to analyze series and parallel resonance circuits
- To simulate various electric circuit using simulation software.

Course Outcomes

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

CO1 - Verify the basic laws and simplify more complicated circuits into simple equivalent circuits using network theorems to compute various parameters of typical DC and AC electrical circuits. **(K4)**
CO2 - Evaluate the solution of three phase AC balanced and unbalanced circuits with different types of loads. **(K4)**
CO3 - Analyze the transient response of RL, RC and RLC circuits with DC and AC input used in power converters, choppers and sweep circuits. **(K4)**
CO4 - Design tuned circuit for given frequency used in radio amplifiers for frequency tuning. **(K5)**
CO5 - Make use of simulation software for simulating various electrical circuits. **(K5)**

List of Experiments

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff’s voltage and current laws
2. Simulation and experimental verification of electrical circuit problems using Superposition theorem
3. Simulation and experimental verification of electrical circuit problems using Thevenin‘s theorem and Norton’s theorem
4. Simulation and experimental verification of electrical circuit problems using Maximum Power Transfer theorem
5. Simulation and experimental verification of electrical circuit problems using Reciprocity theorem
6. Simulation and experimental verification of electrical circuit problems using Compensation and Millman’s theorem
7. Simulation and verification in between voltage and current in three phase balanced star and delta connected loads
8. Simulation and experimental validation of time response of R-L circuit
9. Simulation and experimental validation of time response of R-C circuit
10. Simulation and experimental validation of time response of RLC circuit
11. Design and simulation of R-L-C series resonance circuit for $X_L > X_C$ and $X_L < X_C$
12. Design and simulation of R-L-C parallel resonance circuit for $X_L > X_C$ and $X_L < X_C$

Reference Books

1. William H Hayt, J E Kemmerly and Steven M Durbin, “Engineering Circuit Analysis”, McGraw Hill, 8th Edition, 2013.
2. Charles K. Alexander and Matthew N. Q. Sadiku, “Fundamentals of Electric Circuits”, McGraw-Hill International Edition, 3rd Edition, 2013.
3. A. Sudhakar, Shyammohan S. Palli, “Circuits and Networks: Analysis and Synthesis”, McGraw Hill Publications, 5th Edition, 2015.
4. Mahmood Nahvi, Joseph Edminister, “Electric Circuits (Schaum's Outline Series)”, McGraw-Hill Publications, 5th Edition, 2017.
5. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 5th Edition, 2013.
6. J. Nagrath and Kothari, “Theory and Problems of Basic Electrical Engineering”, PHI Learning Private Limited, Delhi, 2nd Edition, 2016.

(DR.S. ANBUMALAR)

Web References

1. https://www.youtube.com/watch?v=CfnBDLL1ReI
2. http://tuttle.merc.iastate.edu/ee201/spice/pspice_transient.pdf
3. https://www.circuitlab.com/
4. https://www.youtube.com/watch?v=VjWliIjcDQg
5. http://www.circuit-magic.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	3	3	-	-	-	2	-	-	-	3	3	2
2	2	3	2	3	3	-	-	-	2	-	-	-	3	3	2
3	3	3	2	3	3	-	-	-	2	-	-	-	3	2	2
4	3	3	3	3	3	-	-	-	2	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	2	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP204	ELECTRICAL MACHINES LAB - I	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To equip the students to test and evaluate the performance of various DC machines and transformers by conducting appropriate experiments.
- To learn different methods to predetermine the characteristics of DC machines and transformers.
- To get familiar with different types of speed control of DC motors.
- To understand the parallel operation and load sharing of single phase transformers.
- To learn the assembling of different types of DC machines

Course Outcomes

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

CO1 - Test the performance of any DC machine (shunt, series or compound) and transformer by conducting suitable experiments and report the results. **(K5)**

CO2 - Predetermine the different performance characteristics of DC machines and transformers. **(K5)**

CO3 - Experiment and analyze the various speed control techniques for DC motors. **(K5)**

CO4 - Experiment the parallel operation and analyze the load sharing of single phase transformers. **(K4)**

CO5 - Develop any prototype modules implementing different control techniques in DC machine and transformers for various applications. **(K5)**

List of Experiments

DC Machines

1) (a). Load test on DC shunt Motor
   (b). Load test on DC series Motor
   (c). Load test on DC Compound Motor
2) Speed control of DC Motors: Field control, Armature control
3) Electrical braking in DC shunt motor
4) (a). Open Circuit Characteristics and Load test on separately excited DC Generator
   (b). Open Circuit Characteristics and Load test on DC shunt Generator
   (c). Load test on DC series Generator
5) Swinburne's Test
6) Separation of losses in a DC shunt machine
7) Hopkinson's test on DC Machines
8) Study on Retardation test on DC shunt motor
9) Assembling and Testing of DC machines

Transformers

10) Load test on single phase transformer
11) O.C and S.C test on single phase transformer and separate its losses.
12) Parallel operation of single phase transformers
13) Study of Sumpner's test on single phase transformers
14) Study of three phase transformer connections
15) Load test on three phase transformer
16) O.C and S.C test on three phase transformer

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Reference Books

1. D. P. Kothari, B. S. Umre, "Laboratory Manual for Electrical Machines", I.K. International Publishing House, New Delhi, 2nd Edition, 2017.
2. D. R Kohli and S.K Jain, "A laboratory course in electrical machines", New Chand and Bros, Roorkee, 2nd Edition, 2000.
3. Dr. D. K. Chaturvedi, "Electrical Machines Lab Manual with MATLAB Programs", Laxmi Publications Pvt Limited, 1st Edition, 2015.
4. A. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi, 7th Edition, 2013.
5. Albert E. Clayton, "The performance and design of direct current machines", Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2004.

Web References

1. http://em-coep.vlabs.ac.in/
2. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
3. http://em-iitr.vlabs.ac.in/
4. https://ndl.iitkgp.ac.in
5. https://nptel.ac.in/courses/108/105/108105017/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	1	3	2	-	-	-	2	-	-	-	3	3	3
2	2	2	1	3	2	-	-	-	2	-	-	-	3	3	3
3	2	2	1	3	2	-	-	-	2	-	-	-	3	3	3
4	2	2	1	3	2	-	-	-	2	-	-	-	3	3	3
5	2	2	1	3	2	-	-	-	2	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP205	ELECTRONICS LAB - II	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the effects of negative feedback on amplifier circuits
- To provide the basic concepts and design procedure for Combinational circuits.
- To learn the simplification of K-Map
- To design various synchronous and asynchronous counter circuits.
- To acquire knowledge on code converters, multiplexer, de-multiplexer circuits in real time applications.

Course Outcomes

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

CO1 - Evaluate the frequency response of amplifier circuits.**(K4)**
CO2 - Design oscillator circuits for different types of signal generation. **(K3)**
CO3 - Implement projects using amplifiers and oscillator circuits. **(K4)**
CO4 - Design and verify the combinational circuits using K-Map. **(K3)**
CO5 - Design and verify the different sequential circuits. **(K3)**
CO6 - Design and verify counters, shift registers and display devices. **(K3)**

List of Experiments

1. Assemble and observe Characteristics of clipping and clamping circuits using diodes and zener diodes.
2. Rectifiers and filters with and without shunt capacitors - Characteristics of half-wave, full wave and bridge rectifiers- Ripple factor, Rectification efficiency and % regulation.
3. Design the common emitter BJT amplifier and analyze the frequency response characteristics.
4. Design the common source FET amplifier and analyze the frequency response characteristics.
5. Design a UJT relaxation oscillator.
6. Design a wein bridge and Phase shift oscillators using BJT and verify its performance.
7. Design and verify the Schmitt trigger using BJT.
8. Design and analysis of wave shaping circuits using RC, RL and RLC components.
9. Study of logic gates, verification of De Morgan laws using logic gates, implementation of basic gates using universal gates
10. Design and testing of adders, subtractors, Simplification of logic function using K-map.
11. Design and testing of SR, D, JK (Master-slave configuration) and T flip-flops using universal gates.
12. Design and testing of Encoder and Decoder
13. Design of Multiplexer and Demultiplexer using logic gates and ICs
14. Design of Parity generator and Checker using logic gates and ICs
15. Design of Code Converters: BCD to Binary, Binary to BCD using logic gates.
16. Implementation of BCD to Seven Segment Display using ICs
17. Design and implementation of 4-bit shift registers in SISO, SIPO, PISO,PIPO modes using ICs
18. Design and implementation of synchronous and Asynchronous Counters using ICs
19. Implementation of Ring and Johnson counters using ICs.
20. Using UP DOWN COUNTER and a DAC ICs, generate triangular waveform
    a. Using CD 4047 IC, design and set up gated/ungated astable and monostable multivibrators
    b. Using CD 4093 Schmitt NAND IC, design and set up astable and monostable multivibraors

Reference Books

1. David A Bell, "Fundamentals of Electronic Devices and Circuits", Oxford University Press, Incorporated, 2009.
2. Muhammad H. Rashid, "Microelectronic Circuits: Analysis & Design", Cengage learning Inc, 2nd Edition 2011.
3. William Kleitz, "Lab Experiments--Digital Electronics, a Practical Approach", Prentice Hall, 2nd Edition, 2009.
4. Norman Ahlhelm, "Lab Experiments in Digital Electronics", Createspace Independent Pub, 2010.

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5. Abraham Michelen, “Digital Electronics Lab Manual”, Prentice Hall, 2000.
6. Ulrich Tietze, Christoph Schenk, Eberhard Gamm, “Electronic Circuits: Handbook for Design and Application”, Springer, 2nd Edition, 2015.
7. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2007.
8. Robert L. Boylestad, “Electronic devices and circuit theory”, Pearson Prentice Hall, 10th Edition, 2009.
9. P. Kothari, J. S. Dhillon, ‘Digital circuits and Design’, Pearson Education, 2016.
10. Raj Kamal, “Digital systems-Principles and Design”, Pearson education, 2nd Edition, 2007.

Web References

1. https://nptel.ac.in/courses/108/106/108106084/
2. https://learnabout-electronics.org/Oscillators/osc21.php
3. https://swayam.gov.in/nd1_noc19_ee54/preview
4. https://www.ee.iitb.ac.in/~sequel/ee101/ee101_jfet_1.pdf
5. https://nptel.ac.in/courses/117103064/
6. https://nptel.ac.in/courses/117/106/117106086/
7. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/
8. https://nptel.ac.in/courses/108/102/108102095/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	c	2	3	3	3	-	-	-	2	-	-	1	3	3	3
2	2	2	3	3	3	-	-	-	2	-	-	1	3	3	3
3	2	2	3	3	3	-	-	-	2	-	-	1	3	3	3
4	2	2	3	3	3	-	-	-	2	-	-	1	3	3	3
5	2	2	3	3	3	-	-	-	2	-	-	1	3	3	3
6	2	2	3	3	3	-	-	-	2	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEC2XX	CERTIFICATION COURSE - II	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

(DR.S. ANBUMALAR)

U20EES201	SKILL DEVELOPMENT COURSE 1: DEMONSTRATION OF BASIC ENGINEERING SCIENCE	L	T	P	C	Hrs
		0	0	2	-	30

Course Objectives

- To provide exposure to the students with hands on experience on basic engineering practices in Mechanical Engineering.
- To impart knowledge and skill on various basic engineering process and tools used in it.
- To educate students on machine assembly practices of pumps and air conditioners.
- To handling tools used in carpentry and preparation.
- To use of tools in casting and preparation, greens and dry sand moulding process.

Course Outcomes

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

CO1 - Distinguish between tools of various trades such as carpentry, fitting, sheet metal, welding, and foundry. **(K2)**

CO2 - Describe the use of carpentry and fitting joints such as lap, butt, mortise joint, various sheet metal models and casting processes. **(K2)**

CO3 - Illustrate on centrifugal pump, Air conditioner. **(K2)**

CO4 - Apply on hand tools used in carpentry and preparation. **(K4)**

CO5 - Analyze of machine tools used in sheet metal work and fabrication work. **(K5)**

List of Experiments

1. Demonstration on use of hand tools used in fitting and preparation of acute angle fitting and Symmetric fitting experiments.
2. Demonstration of arc and gas welding tools and equipments and preparation of Simple lap welding and Single V butt welding experiments.
3. Demonstration on use of hand tools used in carpentry and preparation of Butt joint, Lap joint and T - joint experiments.
4. Demonstration on use of tools and machineries used in sheet metal work and fabrication of truncated tray and cone and frustum of cone.
5. Demonstration on use of tools in casting and preparation of green sand and dry sand moulding experiment.
6. Demonstration on machine assembly practice of centrifugal pump.
7. Demonstration on machine assembly practice of air conditioner.

Reference Books

1. H. S. Bawa, “Workshop Practices”, Tata McGraw Hill Publishing Co Ltd, 2015.
2. S.K. Hajra Choudhury, A. K. Hajra Choudhury, “Elements of Workshop Technology, Volume I: Manufacturing Processes”, Media Promoters & Publishers Pvt Ltd., 15th Edition Reprinted, 2013.
3. D. Sathish, “Engineering Workshop Practices Laboratory Manual”, Notion press publisher, 2019.
4. R. K. Rajput, “Workshop Practice”, Laxmi Publications Pvt. Ltd., 2011.
5. R. S. Khurmi and J. K. Gupta, “Basics of Workshop Practice”, S Chand Publisher, 2011.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	3	-	-	1	1	2	1
2	3	1	-	-	3	-	-	-	3	-	-	1	1	2	1
3	3	1	-	-	3	-	-	-	3	-	-	1	3	2	3
4	3	1	-	-	3	-	-	-	3	-	-	1	3	2	3
5	3	1	-	-	3	-	-	-	3	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20EEM202	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**	**Hrs**
		2	**0**	**0**	**-**	**30**

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii. Slogan making event
iii. Poster making event
iv. Cycle rally
v. Lectures from experts

(b) Actual Activities:

i. Plantation
ii. Gifting a tree to see its full growth
iii. Cleanliness drive
iv. Drive for segregation of waste
v. To live some big environmentalist for a week or so to understand his work
vi. To work in kitchen garden for mess
vii. To know about the different varieties of plants
viii. Shutting down the fans and ACs of the campus for an hour or so

(DR.S. ANBUMALAR)

U20BST320	COMPLEX ANALYSIS AND APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (Common to EEE, ICE, MECH, Mechatronics)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the analytic functions of complex variables.
- To apply the analytic function techniques to transform irregular geometry into regular geometry.
- Expose to the concept of complex integration.
- To understand the nature of wave equations.
- To know the solutions of one dimensional and two-dimensional heat flow equations.

Course Outcomes

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

CO1 - Understand the concepts of function of a complex variable. **(K2)**
CO2 - Transform complex functions from one plane to another plane. **(K3)**
CO3 - Apply the concepts of complex integration over contour. **(K3)**
CO4 - Understand the concept of initial and boundary value problems **(K2)**
CO5 - Solve the one and two dimensional heat equation using Fourier series. **(K3)**

UNIT I FUNCTION OF A COMPLEX VARIABLE (12 Hrs)

Continuity, derivative and analytic functions – Necessary conditions – Cauchy-Riemann equations and sufficient conditions – Harmonic and orthogonal properties of analytic function – Construction of analytic function

UNIT II CONFORMAL MAPPINGS (12 Hrs)

Conformal mapping – Simple and standard transformations like $w = z + c, cz, z^2, e^z, \sin z,$ $\cosh z,$ $z + 1/z$ – Bilinear transformation and cross ratio property - Taylor's and Laurent's theorem – Series expansion of complex valued functions – classification of singularities.

UNIT III COMPLEX INTEGRATION (12 Hrs)

Cauchy's integral theorem and its application – Cauchy's integral formula and problems – Residues and evaluation of residues – Cauchy's residue theorem – Contour integration: Cauchy's and Jordan's Lemma – Application of residue theorem to evaluate real integrals – unit circle and semicircular contour.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solutions of one-dimensional wave equation – Transverse vibration of an elastic string.

UNIT V ONE AND TWO DIMENSIONAL HEAT EQUATIONS (12 Hrs)

Fourier series solutions of one-dimensional heat flow equation – Fourier series solutions of two-dimensional heat flow equation under steady state conditions.

Text Books

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2020.
2. N. P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons Publication, New Delhi, 4th Edition, 2017.

Reference Books

1. C. Gupta, B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 1st Edition, 2015.
2. H. K. Dass and Dr. Rama Verma, "Introduction to Engineering Mathematics-volume II", S. Chand and Co., New Delhi, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, New Delhi, 10th Edition,2019.
4. Ravish R. Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, New Delhi, 1st Edition, 2016.
5. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 3rd Edition, 2018.

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Web References

1. https://nptel.ac.in/courses/122107036/
2. https://nptel.ac.in/courses/111107119/
3. https://youtu.be/W3HXK1Xe4nc
4. https://youtu.be/Mwpz1zjPlzI
5. https://youtu.be/CnrAivf9I6o

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	2	2	2
2	3	2	1	1	-	-	-	-	-	-	-	1	2	2	2
3	3	2	1	1	-	-	-	-	-	-	-	1	2	2	2
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	2
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EST356	DATA STRUCTURES (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		2	2	0	3	45

Course Objectives

- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes

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

CO1 - Compute time and space complexity for given problems **(K3)**
CO2 - Demonstrate stack, queue and its operation. **(K3)**
CO3 - Illustrate the various operations of linked list. **(K3)**
CO4 - Use the concepts of tree for various applications. **(K3)**
CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)

Introduction: Basic Terminologies – Elementary Data Organizations. Data Structure Operations: Insertion – Deletion – Traversal. Analysis of an Algorithm. Asymptotic Notations. Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques – Complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)

Stacks and Queues: ADT Stack and its operations. Applications of Stacks: Expression Conversion and evaluation. ADT Queue and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.

UNIT III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)

Trees: Basic Tree Terminologies. Different types of Trees: Binary Tree – Threaded Binary Tree – Binary Search Tree – Binary Tree Traversals – AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS (9 Hrs)

Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table – Hash Function and its characteristics. Graph: Basic Terminologies and Representations – Graph traversal algorithms.

Text Books

1. Ellis Horowitz, Sartaj Sahni, “Fundamentals of Data Structures”, Computer Science Press, Illustrated Edition, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, PHI, 3rd Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, “Data Structures and Algorithms”, 4th Edition, 2009.

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Reference Books

1. Balagurusamy, “Data Structures”, Tata McGraw-Hill Education, 2019.
2. D.Samanta, “Classic Data Structures”, Prentice-Hall of India, Second Edition, 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, “Data Structures and Program Design in c”, Prentice-Hall of India, Second Edition, 2007.
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education”, 2nd Edition, 2006.
5. Mark Allen Weiss, “Algorithms, Data Structures and Problem Solving with C++”, Addison-Wesley Publishing Company, Illustrated Edition, 1995.

Web References

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
2	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
3	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
4	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2
5	3	2	1	1	-	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET307 **ELECTRICAL MACHINES – II**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To equip the students to understand and analyze the characteristics of three phase induction motor.
- To learn different types of starters and speed control of three phase induction motor.
- To equip the students to understand and analyze the characteristics of alternator.
- To learn characteristics of synchronous motor and effect of varying load and excitation.
- To get familiar with performance characteristics of single phase induction motors and special machines.

Course Outcomes

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

CO1 - Evaluate and analyze the performance of three phase induction motor using equivalent circuits and circle diagram. **(K3)**
CO2 - Apply suitable starting and speed control methods to enhance the performance of three phase induction motors. **(K3)**
CO3 - Analyze the performance characteristics of alternator and compute voltage regulation with different methods. **(K4)**
CO4 - Analyze the characteristics of synchronous motor and its performance with effect of varying load and excitation. **(K4)**
CO5 - Recognize the characteristics of single phase induction motors and special machines as well as choose an appropriate motor for any industrial application. **(K3)**

UNIT I INDUCTION MOTOR (9 Hrs)

Single phase Induction Motors: Construction – Principle of operation - Double revolving field theory - Torque-speed characteristics – starting methods – Applications.
Three phase Induction Motors: Construction – principle of operation – Types - Effect of slip on rotor parameters – Torque equation - phasor diagram - effect of voltage variation and rotor resistance on torque slip characteristics - Power Stages - equivalent circuit – no load and blocked rotor test - circle diagram – Separation of no load losses - Losses and efficiency – Applications.

UNIT II STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR (9 Hrs)

Starters: Need for starters – Starting methods. Speed control: Stator side – Rotor side – Solid state control. Cogging and Crawling - Electric Braking - deep bar and double cage rotor – Synchronous induction motor – Induction generator – Applications.

UNIT III ALTERNATOR (9 Hrs)

Alternator: Construction – operation – Types of rotors – EMF equation – Synchronous reactance – Armature reaction - Alternator on load – phasor diagram. Voltage regulation: EMF, MMF, ZPF. Synchronizing and parallel operation – effect of change of excitation and prime mover inputs – automatic voltage regulators – Two reaction theory of Salient pole machines – slip test - power angle diagram – Applications.

UNIT IV SYNCHRONOUS MOTOR (9 Hrs)

Construction - principle of operation - starting methods - Torque and power equations - speed control– phasor diagram – effect of varying load and excitation - 'V' and inverted 'V' curves - hunting – synchronous condenser – Applications.

UNIT V SPECIAL MACHINES (9 Hrs)

Stepper motors - Reluctance motor - Hysteresis motor– Servo motor– Linear induction motor– AC series motor - switched reluctance motor - Brushless DC motors– PMSM – Applications.

Text Books

1. A. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", Tata McGraw Hill, New Delhi, 7th Edition, 2013.
2. R. K. Rajput, "Electrical Machines", Laxmi publications Pvt. Ltd, New Delhi, 6th Edition, 2008.
3. B. L. Theraja and A. K. Theraja, "A Textbook of Electrical Technology", Vol. II, S. Chand & Co. Ltd., New Delhi, 23rd Edition, 2009.

(DR.S. ANBUMALAR)

Reference Books

1. M. G. Say, “Alternating Current Machines”, Pitman Publishing, 5th Edition, 2002.
2. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 3rd Edition, 2013.
3. Alexander S. Langsdorf, “Theory of Alternating-Current Machinery”, McGraw Hill Publications, 2nd Edition, 2001.
4. D. P. Kothari and I. J. Nagrath, “Electric Machines”, Tata McGraw Hill, New Delhi, 5th Edition, 2017.
5. Theodore Wildi, “Electrical Machines, Drives, and Power Systems”, Pearson Education, 6th Edition, 2006.

Web References

1. https://ndl.iitkgp.ac.in
2. https://nptel.ac.in/courses/108/105/108105131/
3. http://electrical-engineering-portal.com/
4. http://shodhganga.inflibnet.ac.in/
5. http://www.electrical4u.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
2	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
5	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET308	LINEAR INTEGRATED CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce IC fabrication process and basic building blocks of linear integrated circuits.
- To familiarize the AC and DC characteristics of OP AMP 741 and its basic application circuits.
- To outline the design procedure of active filters and waveform generation using operational amplifiers.
- To illustrate the design procedure of various Regulator ICs for power supply circuits.
- To impart knowledge on the fundamental blocks and applications of special ICs like 555 and 565 ICs.

Course Outcomes

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

CO1 - Describe the IC fabrication process for any circuits. **(K2)**
CO2 - Design and analyze OP AMP based circuits for different applications like A/D and D/A conversion. **(K3)**
CO3 - Design filters and waveform generators using OP AMP. **(K3)**
CO4 - Design regulators for power supply circuits. **(K3)**
CO5 - Design multi-vibrators using 555 timer and demodulators using 565 PLL. **(K3)**

UNIT I IC FABRICATION (9 Hrs)

IC classification – Fundamental of monolithic IC technology – Epitaxial growth, masking and etching, diffusion of impurities – Realization of monolithic ICs and packaging: Fabrication of resistance, diode, capacitance and PV cells –BJT – FET – HFET – CMOS technology.

UNIT II OPERATIONAL AMPLIFIERS AND APPLICATIONS (9 Hrs)

OP-AMP equivalent circuit – CMRR – AC and DC characteristics – Open and closed loop configuration – Properties of practical op-amps (LM741, LM124, OP07, TL082) – Interpretation of OP-AMP data sheet – Applications – Instrumentation amplifier – Clipper and Clamper – D/A converters– A/D converter – TLC0820 and TLC7524 ICs–S/H circuit.

UNIT III ACTIVE FILTERS AND WAVEFORM GENERATOR USING OP AMP (9 Hrs)

Ist and IInd order Active filter – Low pass, high pass, wide band pass and band stop Butterworth filters –Narrow band pass and notch filters – State variable filter – Switched capacitor filter – Waveform generator: RC Phase shift and Wienbridge oscillators – Triangular and saw tooth wave generator – Effect of Slew Rate on waveform generation – Schmitt trigger and Multivibrators – Applications

UNIT IV ANALOG IC APPLICATIONS (9 Hrs)

Series op-amp regulator – IC voltage regulators: LM78XX, LM79XX Dual tracking regulators – Positive and Negative voltage regulators IC 723 – Adjustable voltage regulators: LM117, LM317 – Switching regulator – SMPS – LM2524 – V/F converter – F/V converter – Analog Multiplier MPY634– AGC and AVC– INA121 Instrumentation Amplifier – LM 380 Power amplifier – Comparator IC LM311

UNIT V PHASE LOCKED LOOP AND TIMER (9 Hrs)

PLL: 74HCT7046 – phase comparator – PLL Applications: Frequency synthesis, AM and FM detection, FSK demodulator and Motor speed control – IC555 timer – Functional diagram – Multivibrators – Schmitt trigger – Application as Missing pulse detector, Frequency counter – Dual timer SN74AH – CD4093 ICs.

Text Books

1. Ramakant A. Gayakward, “Op-amps and Linear Integrated Circuits”, Pearson Education, 5th Edition, 2015.
2. J. Michael Jacob, “Applications and Design with Analog Integrated Circuits”, Prentice Hall of India, New Delhi, 2nd Edition, 2010.
3. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, McGraw Hill, 1st Edition, 2018.
4. Muhammad H. Rashid, “Microelectronic Circuits: Analysis and Design”, Cengage learning Inc, 2nd Edition, 2011.
5. D. Roy Choudhary, Sheil. B. Jani, “Linear Integrated Circuits”, New Age Publication, 5th Edition, 2018.
6. David A. Bell, “Op-amp and Linear ICs”, Oxford Higher Education, 3rd Edition, 2013.

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Reference Books

1. James M. Fiore, “Opamps and Linear Integrated Circuits Concepts and Applications”, Cengage learning, 1st Edition, 2010.
2. Bruce Carter, Ron Mancini, “Op Amps for Everyone”, Newnes Publication, 5th Edition, 2017.
3. Floyd, Buchla, “Fundamentals of Analog Circuits”, Pearson Education, 2nd Edition, 2013.
4. Jacob Millman, Christos C. Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill, 2nd Edition, 2009.
5. Robert F. Coughlin, Fredrick F. Driscoll, “Op-amp and Linear ICs”, PHI Learning, 6th Edition, 2012.

Web References

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://nptel.ac.in/courses/117/107/117107094/
3. https://nptel.ac.in/courses/108/108/108108114/
4. https://www.electronics-tutorials.ws/opamp/opamp_1.html
5. https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_operational_amplifiers.htm
6. https://www.allaboutcircuits.com/video-lectures/op-amp-applications/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	-	-	-	-	-	-	-	-	-	-	1	1	3
2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET309	ELECTROMAGNETIC THEORY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the basic mathematical concepts related to electrostatic vector fields.
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To familiarize the students with the different concepts of magneto-statics, magnetic flux density, scalar and vector potential and their applications.
- To impart knowledge on the application of magnetic field.
- To expose concepts of electromagnetic waves and wave propogation.

Course Outcomes

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

CO1 - Apply the mathematical concepts to electrostatic vector fields. **(K3)**
CO2 - Analyze the distribution of the charges in electric field applications. **(K4)**
CO3 - Calculate the magnetic field for the analysis of all electrical machines. **(K4)**
CO4 - Design an inductor to produce magnetic field. **(K4)**
CO5 - Compute Maxwell equation for electromagnetic field applications. **(K3)**

UNIT I ELECTROSTATIC FIELD (9 Hrs)

Co-ordinate Systems: Cartesian, Cylindrical and Spherical – Scalar and vector product - Coulomb's law - Electric field – Electric field intensity(E) due to point, line, surface and volume charge distribution - Electric flux density (D) - gradient and Curl of a field, Gauss Law and its applications, Divergence of a vector field - Testing equipment to electrostatic discharge. Case study - communication cables.

UNIT II ELECTRIC FIELDS IN MATERIAL SPACE (9 Hrs)

Electric potential and potential gradient - Electric dipole and dipole moment - Nature of Dielectrics and Conductors - Polarization in dielectrics - Electric field in multiple dielectrics - Boundary conditions for electrostatic field - Poisson's and Laplace's Equations – Capacitance-Energy density - Applications - Electrostatic Precipitators, Xerography.

UNIT III MAGNETOSTATIC FIELDS (9 Hrs)

Biot-Savart law - Magnetic field intensity (H) and magnetic flux density (B) - Ampere's Circuital Law, magnetic flux density in a finite and infinite conductor, solenoid and toroid - Magnetic field in multiple media - Magnetic dipole - Scalar and vector magnetic potential – Stoke's theorem - Micro magnetics, Application: LF Magnetic shielding.

UNIT IV APPLICATION OF MAGNETIC FIELD (9 Hrs)

Boundary condition for magneto static fields - Magnetic field in matter and magnetic circuits. Magnetic Forces and torque on current carrying conductors – potential energy and force on magnetic energy - Inductance of solenoids, toroid's and transmission lines – Application of magnetic field in induction heating, Helmholtz coil.

UNIT V ELECTROMAGNETIC AND WAVE PROPAGATIONS (9 Hrs)

Maxwell's equation: displacement current - continuity equation, Differential and integral forms - Wave equation- Wave propagation in lossless media, good conductor and dielectrics - Flow of electromagnetic Power and Poynting vector: instantaneous and average power densities. Applications of electromagnetic waves –Antennas and radiation of electromagnetic energy, Case study: Effects of Electromagnetic fields (EMF) near high voltage transmission line.

Text Books

1. Mathew N. O. Sadiku, "Principles of Electromagnetics", Oxford University Press Inc., 6th Edition, 2015.
2. Ashutosh Pramanik, "Electromagnetism Applications - Vol. 2: Magnetic Diffusion and Electromagnetic Waves", PHI Learning Private Limited, New Delhi, 2014.
3. K.A. Gangadhar, P.M. Ramanthan "Electromagnetic Field Theory (including Antennas and wave propagation", Khanna Publications, 16th Edition, 1997.

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Reference Books

1. Joseph. A. Edminister, Schaum's, "Outline of Electromagnetics", (Schaum's Outline Series), Tata McGraw Hill, 4th Edition, 2014
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, 9th Edition, 2018.
3. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5th Edition, 2010.
4. Bhag Singh Guru and Hüseyin R. Hiziroglu, "Electromagnetic field theory Fundamentals", Cambridge University Press, 2nd Revised Edition, 2009.

Web References

1. http://hyperphysics.phy-astr.gsu.edu/hbase/emcon.html#emcon
2. https://www.youtube.com/watch?v=9Tm2c6NJH4Y
3. https://www.youtube.com/watch?v=HcPDc23ZLEs
4. http://scienceworld.wolfram.com/physics/ElectromagneticForce.html
5. http://www.unitconversion.org/unit_converter/magnetic-field-strength.html
6. http://www.wolfsonelectrostatics.com/04_news/index.html#can-shocks-from-static-electricity-damage-your-health

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	-	-	-	-	-	-	-	3	2	2
2	3	3	3	2	1	-	-	-	-	-	-	-	3	2	2
3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET310	POWER PLANT ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic knowledge of various types of power plants and the factors considered for site selection
- To have a clear idea about the operation of Steam Power Plants with detailed study of the associated equipments and machineries
- To know the working principle, basic components and various modern reactors of the nuclear power plants
- To get a clear knowledge about how power is generated using diesel, gas and combined cycle power plants
- To know the importance in selection of equipments and various tariff structures involved with power plants.

Course Outcomes

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

CO1 - Relate the various conventional energy systems and factors affecting their site selection. **(K2)**
CO2 - Illustrate power generation using steam power plants along with the detailed review on its equipments used. **(K3)**
CO3 - Explain about the nuclear energy production, its equipments and reactors model inside the plant. **(K2)**
CO4 - Express and compare the construction, working principle of various equipments used with diesel, gas turbine and combined cycle power plants. **(K2)**
CO5 - Evaluate economic feasibility and importance of equipment selection to formulate tariff structure for power generating units.**(K4)**

UNIT I INTRODUCTION TO POWER PLANTS (9 Hrs)

Conventional and Non-Conventional Sources of Energy and their availability in India - Different Types of Power Plants - Choice of Power Generation - Basic schemes and constituents of Steam, Nuclear, Diesel and Gas Turbine power stations - Factors to be considered for selection of site - Power Plants in India.

UNIT II STEAM POWER PLANT (9 Hrs)

Layout and types of Steam Power Plants - Fuel and Ash handling systems - Dust collectors – combustion equipment for steam boilers – Economizer and Air pre heater - Mechanical stokers – Pulverizes – Electrostatic precipitator – Draughts – Steam condensers - Cooling Ponds and Cooling Towers - Pollution Controls - Methods of Feed water treatment – Generating efficiency - Power generation capacities of various plants in India.

UNIT III NUCLEAR POWER PLANTS (9 Hrs)

Nuclear energy - Fission and Fusion reaction - Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors - Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium - Uranium reactor (CANDU), Breeder Reactor, Gas Cooled and Liquid Metal Cooled Reactors - Safety measures for Nuclear Power plants - Case study: Comparison of various nuclear power plants in India.

UNIT IV DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS (9 Hrs)

Layout of Diesel power plants and components - Selection of engine – types and applications - Gas Turbine power plant – Classifications - Layout – Merits – fuels – Combined Cycle Power Plants -Integrated Gasified based Combined Cycle systems - Introduction to Energy storage – Case study: Decentralized Power technologies.

UNIT V POWER PLANT ECONOMICS (9 Hrs)

Economics of Power generation - Cost of Electrical Energy, Expression for cost of electrical energy, interest, depreciation - Power tariff - types - Load distribution parameters - Load curve - load duration Curve – Effect of load on power plant design – Load forecasting – Peak load pricing - Comparison of site selection criteria - Relative merits and demerits - Capital and Operating Cost of different power plants.

Text Books

1. El-Wakil, “Power Plant Technology”, McGraw-Hill, 1st Edition, 2010.
2. Frederick T. Morse, “Power Plant Engineering”, Affiliated East-West Press Pvt Ltd, 7th Edition, 2008.
3. R. K. Rajput, “Power Plant Engineering”, Laxmi Publications, 4th Edition, 2016.

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Reference Books

1. Leonjard L. Grigsby, “Electric Power Generation, Transmission and Distribution”, CRC Press, 3rd Edition, 2012.
2. Bernhardt G.A. Skrotzki, “Power Station Engineering and Economy”, Tata McGraw Hill, Indian Edition, 2001.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, “Standard Handbook of Power Plant Engineering”, McGraw Hill, 2nd Edition, 2012.
4. P.K. Nag, “Power plant Engineering”, Tata McGraw-Hill, 4th Edition, 2017.

Web References

1. https://swayam.gov.in/nd1_noc20_me10/preview
2. https://swayam.gov.in/nd1_noc20_me87/preview
3. https://swayam.gov.in/nd1_noc20_me40/preview
4. https://swayam.gov.in/nd1_noc20_me33/preview
5. https://swayam.gov.in/nd1_noc20_ee86/preview
6. https://sga-site.yolasite.com/resources/books/MET401-Power%20Plant%20Engineering.pdf
7. https://www.gpstrategies.com/solution/plant-training-documentation-workforce-development/
8. https://powertechreview.com/industry-4-0-for-power-industry-digitization-tool-for-engineering-for-power-epc-and-power-plants/
9. https://www.tepco.co.jp/en/challenge/energy/thermal/power-g-e.html
10. https://www.e-education.psu.edu/eme801/node/530

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3
2	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3
3	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3
4	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3
5	3	1	2	2	-	1	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20HSP301	GENERAL PROFICIENCY – I (Common to all branches except CSBS)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To enrich strong vocabulary and decoding skills through comprehension analysis.
- To advance communication and leadership skills pragmatically.
- To pronounce English sounds in isolation and in connected speech.
- To expand effective written communication skills to meet organizational goals.
- To extend knowledge on verbal aptitude and prepare for interviews

Course Outcomes

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

CO1 - Interpret meaning and apply reading strategies in technical and non-technical context. **(K2)**
CO2 - Develop interpersonal communication skills professionally.**(K3)**
CO3 - Infer the distinct speech sounds and overcome native language influence. **(K2)**
CO4 - Demonstrate various forms of formal writing. **(K2)**
CO5 - Apply the techniques of verbal aptitude in competitive exams. **(K3)**

UNIT I COMPREHENSION ANALYSIS (6 Hrs)

Listening: Listening Comprehension (IELTS based) – **Speaking**: Break the iceberg - **Reading:** Reading technical passage (IELTS based) - **Writing:** Writing Task: 1 (IELTS: Graph/ Process /Chart Description) **Vocabulary:** Synonyms (IELTS)

UNIT II PERSONALITY DEVELOPMENT (6 Hrs)

Listening: Interview Videos - **Speaking:** Extempore and Presentation (Soft Skills) - **Reading:** British and American Vocabulary, Read and review (Books, Magazines) - **Writing**: SWOT Analysis **Vocabulary:** Idioms (IELTS)

UNIT III INFERENTIAL LEARNING (6 Hrs)

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– **Speaking**: Interpersonal Interaction and Situational attribution – **Reading**: Distinguish between facts and opinions - **Writing:** Writing Conversation to different context **Vocabulary:** Phrasal Verbs (IELTS)

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING (6 Hrs)

Listening: Group Discussion videos - **Speaking:** Group Discussion Practice - **Reading:** Interpretation of data - Graph, table, chart, diagram (IELTS based) - **Writing**: Writing Task: 2 (IELTS) **Vocabulary:** Collocations (IELTS)

UNIT V APTITUDE (6 Hrs)

Language Enhancement: Articles**,** Preposition, Tenses
Verbal Ability Enhancement: Blood Relation, Completing Statements- Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(**GATE**).

Reference Books

1. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2012.
2. Mn.Taylor and Grant Taylor. "English Conversation Practice". Tata McGraw-Hill Education, 1975.
3. Bailey, Stephen. "Academic writing: A practical guide for students". Psychology Press, 2003.
4. Aggarwal, R. S. "A Modern Approach to Verbal & Non Verbal Reasoning". S. Chand, 2010.
5. Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition". S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ESP357	**DATA STRUCTURES LAB** (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the basic concepts of Data Structures.
- To learn about the concepts of Searching Techniques.
- To explore about the concepts of Sorting Techniques.
- To know about the linear Data Structures.
- To study about non-linear Data Structures.

Course Outcomes

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

CO1 - Analyze the algorithm's / program's efficiency in terms of time and space complexity.**(K3)**
CO2 - Solve the given problem by identifying the appropriate Data Structure.**(K3)**
CO3 - Solve the problems of searching and sorting techniques. **(K3)**
CO4 - Solve problems in linear Data Structures.**(K4)**
CO5 - Solve problems in non-linear Data Structures. **(K4)**

List of Exercises

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list.
   a)Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder and c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd Edition, 2019.
2. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st Edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India, 1st Edition, 2017.
4. Reema Thareja, "Data structures using C", Oxford University, 2nd Edition, 2014.
5. Tenebaum Aaron M, "Data Structures using C", Pearson Publisher, 1st Edition, 2019.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	2	1	2
2	3	2	1	1	3	-	-	-	-	-	-	-	2	1	2
3	3	2	1	1	3	-	-	-	-	-	-	-	2	1	2
4	3	2	1	1	3	-	-	-	-	-	-	-	2	1	2
5	3	2	1	1	3	-	-	-	-	-	-	-	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP306	ELECTRICAL MACHINES LAB - II	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To equip the students to test and evaluate the performance of induction and synchronous machines by conducting appropriate experiments.
- To learn different methods to predetermine the characteristics of single phase and three phase induction motors
- To get familiar with different types of speed control of three phase induction motor.
- To understand the synchronization of three phase alternator with infinite bus bar.
- To learn the assembling of different types of AC machines.

Course Outcomes

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

CO1 - Test the performance of induction and synchronous machines by conducting suitable experiments and report the results. **(K4)**

CO2 - Predetermine the different performance characteristics of single phase and three phase induction motors. **(K4)**

CO3 - Analyze the speed control techniques and electrical braking of induction motor. **(K4)**

CO4 - Experiment the synchronization of alternators and analyze the power exchange with the grid. **(K3)**

CO5 - Develop any prototype modules implementing different control techniques in Induction and Synchronous machines for various applications. **(K5)**

List of Experiments

1. Load test on single phase induction motor
2. No load and blocked rotor tests on single phase induction motor
3. Load test on three phase squirrel cage and slip ring induction motors
4. No load and blocked rotor tests on three phase induction motor and Separate its no load losses
5. Speed control of induction motor
   (i). Stator voltage control
   (ii). Rotor resistance control
6. Electrical Braking of Induction motor
   (i). Dynamic Braking
   (ii). Plugging
   (iii). Regenerative Braking
7. Load test on induction generator
8. Load test on Single phase alternator
9. Load test on three-phase alternator
10. Voltage regulation of alternator (emf, mmf, zpf)
11. Slip test on three phase salient pole alternator
12. Synchronization of three phase alternator with infinite bus bar
13. V and inverted V curves of synchronous motor
14. Performance Characteristics of Universal Motor
15. Assembling and Testing of AC machines

Reference Books

1. D. P. Kothari, B. S. Umre, “Laboratory Manual for Electrical Machines”, I.K. International Publishing House, New Delhi, 2nd Edition, 2017.
2. D.R. Kohli and S.K Jain, “A laboratory course in electrical machines”, New Chand & Bros, Roorkee, 2nd Edition, 2000.
3. Dr. D. K. Chaturvedi, “Electrical Machines Lab Manual with MATLAB Programs”, Laxmi Publications Pvt Limited, 1st Edition, 2015.

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4. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata McGraw Hill, New Delhi, 7th Edition, 2013.
5. M. G. Say, “Alternating Current Machines”, Pitman Publishing, 5th Edition, 2002.
6. P.C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 3rd Edition, 2013.
7. Alexander S. Langsdorf, “Theory of Alternating-Current Machinery”, McGraw Hill Publications, 2nd Edition, 2001.
8. Theodore Wildi, “Electrical Machines, Drives, and Power Systems”, Pearson Education, 6th Edition, 2006.

Web References

1. http://em-coep.vlabs.ac.in/
2. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
3. http://em-iitr.vlabs.ac.in/
4. http://vem-iitg.vlabs.ac.in/
5. https://nptel.ac.in/courses/108/105/108105131/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	1	-	-	-	3	-	-	1	3	3	3
2	3	3	2	3	1	-	-	-	3	-	-	1	3	3	3
3	3	3	2	3	1	-	-	-	3	-	-	1	3	3	3
4	3	3	2	3	1	-	-	-	3	-	-	1	3	3	3
5	3	3	2	3	1	-	-	-	3	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP307 **LINEAR INTEGRATED CIRCUITS LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To learn design, testing and characterizing of circuit behavior with analog ICs.
- To familiarize the AC and DC characteristics of OPAMP 741.
- To outline the design procedure of the different applications of OPAMP 741.
- To introduce the design of filters and waveform generators using OPAMP 741.
- To impart knowledge on the design and realization of multivibrator circuits using 555 Timer.

Course Outcomes

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

CO1 - Design and use the OPAMP for various applications. **(K4)**

CO2 - Design the application circuits like A/D, D/A filters using OPAMP and special ICs. **(K4)**

CO3 - Design and test various waveform generation circuits using OPAMPS and special ICs. **(K4)**

CO4 - Design and test regulator circuits for power supplies using voltage regulator ICs. **(K4)**

CO5 - Verify and demonstrate V/F, frequency multiplier and SMPS. **(K4)**

List of Experiments

1. Obtain various characteristic parameters of IC 741
2. Design and analysis of Inverting, non-inverting amplifiers, Voltage follower, Adder and subtractor using OPAMP 741
3. Design and analysis of Integrator, Differentiator, Log and Antilog amplifier using OPAMP 741.
4. Design and analysis of comparator circuits (PWM and SPWM) and instrumentation amplifier using OPAMP 741.
5. a. Design and analysis of D/A and A/D converters using OPAMP 741.
   b. Verification of A/D conversion and D/A conversion using TLC0820 and TLC7524
6. Design and analysis of schmitt trigger and filter circuit (Ist order and IInd order) using OPAMP 741.
7. Design and analysis of wein-bridge and RC phase shift oscillator.
8. Design and verification of waveform generator using OPAMP 741
9. a. Design and analysis of low and high voltage regulators using IC 723 and variable voltage regulator using IC LM317.
   b. Design and verification of power source using LM2524 IC.
10. a. Design and analysis of Monostable and Astable multivibrator using IC555.
    b. Design and verification of Monostable and Astable multivibrator using SN74AH.
11. Implementation of Frequency multiplication using 74HCT7046
12. Design and analysis of FSK MOD/DEMOD using 74HCT7046

Reference Books

1. R. M. Marston, “Op-Amp Circuits Manual”, Elsevier, 2016.
2. Ron Mancini, “Op Amps for Everyone: Design Reference”, Newnes, 2nd Edition, 2003.
3. Walt Jung, “Op Amp Applications Handbook”, Newnes, 1st Edition, 2005.
4. Ramakant A. Gayakward, “Op-amps and Linear Integrated Circuits”, Pearson Education, 5th Edition, 2015.
5. James M. Fiore, “Opamps and Linear Integrated Circuits Concepts and Applications”, Cengage learning, 1st Edition, 2010.
6. Floyd, Buchla, “Fundamentals of Analog Circuits”, Pearson Education, 2nd Edition, 2013.
7. Jacob Millman, Christos C. Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill, 2nd Edition, 2009.
8. Robert F. Coughlin, Fredrick F. Driscoll, “Op-amp and Linear ICs”, PHI Learning, 6th Edition, 2012.

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Web References

1. https://nptel.ac.in/courses/108/108/108108114/
2. http://musicfromouterspace.com/analogsynth_new/ELECTRONICS/TECHBENCH/TECHBENCH.php
3. https://www.circuitlab.com/circuit/bkg2qg/op-amp-inverting-amplifier/
4. https://electrosome.com/723-voltage-regulator/
5. https://www.electronicshub.org/how-555-timer-ic-testing-circuit-works/
6. http://www.infocobuild.com/education/audio-video-courses/electronics/op-amp-practical-applications-iisc-bangalore.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	-	-	-	3	-	-	-	3	3	3
2	3	3	3	2	1	-	-	-	3	-	-	-	3	3	3
3	3	3	3	2	1	-	-	-	3	-	-	-	3	3	3
4	3	3	3	2	1	-	-	-	3	-	-	-	3	3	3
5	3	3	3	2	1	-	-	-	3	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEC3XX	CERTIFICATION COURSE - III	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20EES302	SKILL DEVELOPMENT COURSE 2 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. TESTING OF ELECTRONICS DEVICES AND PCB BOARD DESIGNING

Course Content:

1. Identification of different component and its symbols.
2. To study and operation of multimeter, function generator and regulated power supply.
3. Testing of electronic component by CRO and their measurement by LCR bridges.
4. Identify the value and test different types of resistors, capacitors and inductors.
5. Make use of resister, capacitor, inductor in series and parallel connection
6. Identify different types of cables, connectors, fuse, switches, relays and discover their application
7. Read and interpret data sheet of various junction diodes and Transistors.
8. Measure amplitude and frequencies of different sine waveform using CRO and Function Generator.
9. Develop fabrication and mount components on PCB for Doorbell/cordless bell
10. Develop fabrication and mount components on PCB for Clapping switch and IR switch
11. Develop fabrication and mount components on PCB for Cell charger, battery charger, mobile charger
12. Develop fabrication and mount components on PCB for Fire/smoke/intruder alarm

2. DESIGN OF SOLAR POWER PLANT AND INSTALLATION

Course Content:

1. Selection of site/location and shadow analysis
2. Selection of PV module technology
3. Connection of PV Module (Series and Parallel Circuit)
4. Design and sizing of panel capacity for suitable loads
5. Preparation of single line diagram and plant array layout.
6. Design of Power converters (for ON/Off Grid)
7. Solar power plant string combiner box/ ACDB/ MDB/Metering cubical
8. Selection and sizing of AC and DC Cables
9. Selection and sizing of AC/DC side earthing along with lightning protection
10. Plant Installation and Commissioning
11. Maintenance and Troubleshooting of the solar power plant
12. Costing and Tendering of solar power plant
13. Net Metering and Introduction to Smart grid
14. Plant visit and Report Preparation

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3. DEMONSTRATION / TROUBLESHOOTING OF ELECTRICAL AND ELECTRONICS EQUIPMENTS

Course Content:

1. Demonstration of electrical safety and electricity tariff calculation for household appliances.
2. Single phase house wiring, Fuse calculation and Extension box installation
3. Demonstration of electrical measuring instruments (Ammeter, Voltmeter, CRO, DSO and Multimeter)
4. a) Electrical wiring for fan and tube light.

   b) Demonstration of coil rewinding of ceiling fan
5. Practical approach towards testing of semiconductor devices using multimeter.
6. Troubleshooting of electrical and electronic home appliances (Electric water heater, Induction stove, Iron box, Mixer, Hair dryer, Mosquito bat and Aquarium water pump)
7. Study of practical approach on audrino board.
8. Demonstration of water level indicator for domestic purpose.
9. Construction of series and parallel connection of LED for decoration purpose.
10. Design of Regulated Power Supply circuit.
11. Demonstration of coil design for specific inductance.

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U20EEM303	PHYSICAL EDUCATION	L	T	P	C	Hrs
		0	0	2	-	30

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

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U20BST430	PROBABILITY AND STATISTICS (Common to EEE and ICE)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To acquire skills in handling situation including more than one random variable.
- To familiarize the student about the continuous random variables and their applications.
- To study the basic concepts of Statistics.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling

Course Outcomes

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

CO1 - Apply the concept of probability in random variables.**(K3)**
CO2 - Apply the basic rules of continuous random variables.**(K3)**
CO3 - Understand the basic concepts of Statistics.**(K2)**
CO4 - Derive the inference for various problems using testing of hypothesis in large samples. **(K3)**
CO5 - Solve the problems related to testing of hypothesis in small samples. **(K3)**

UNIT I DISCRETE RANDOM VARIABLES (12 Hrs)

Random Variables and their event spaces – The probability mass function – Distribution functions – Binomial – Geometric – Negative Binomial and Poisson.

UNIT II CONTINUOUS RANDOM VARIABLES (12 Hrs)

Some important distributions – Exponential distribution – Gamma – Weibull – Gaussian distributions. Application of distribution – Reliability – Failure density and Hazard function.

UNIT III STATISTICS (12 Hrs)

Measures of central tendency– Arithmetic Mean, Median and Mode – Measures of dispersion and Standard deviation – Skewness and Measures of Skewness – Pearson's coefficient of skewness – Moments – Correlation – Rank correlation and regression.

UNIT IV LARGE SAMPLES (12 Hrs)

Curve fitting by the method of least squares – fitting of straight lines – second degree parabolas and more general curves – Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES (12 Hrs)

Test for single mean – Difference of means and correlations of coefficients – Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes.

Text Books

1. B.S.Grewal, "Higher Engineering Mathematics",Khanna Publishers, Paperback,3rd Edition, 2017.
2. T. Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill Education, 2008.
3. Dr. A. Singaravelu, "Probability and Statistics", Meenakshi Agency, Paperback- I, 2019.

Reference Books

1. Ravish R. Singh, Mukul Bhatt, "Engineering Mathematics", McGraw-Hill, 1st Edition, 2017.
2. William Mendenhall, Robert J. Beaver, Barbara M. Beaver: "Introduction to Probability & Statistics", Cengage Learning, 15thEdition, 2019.
3. Richard.A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
4. Vijay K. Rohatgi and A.K. Md. Ehsanes Saleh, "An Introduction to Probability and Statistics", Wiley, 2008.
5. E. Rukmangadachari, "Probability and Statistics", Pearson Education India ,2012

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Web References

1. http:// www.stat110.net
2. http://www.nptel.ac.in/courses/111105035 (R.V)
3. http:// www.probabilitycourse.com.
4. www.edx.org/Probability
5. http://www2.aueb.gr/users/demos/pro-stat.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
3	2	1	-	-	-	1	-	-	-	-	-	1	3	1	1
4	3	2	1	1	-	1	-	-	-	-	-	1	3	1	1
5	3	2	1	1	-	1	-	-	-	-	-	1	3	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EST467	PROGRAMMING IN JAVA (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, Mechatronics, CCE)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To gain and explore the knowledge of java programming
- To know the principles of inheritances, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.
- To explore database connectivity

Course Outcomes

After completion of the course, students will be able to

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams.**(K3)**
CO5 - Exemplify simple graphical user interfaces using GUI components and database programs. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (12 Hrs)

The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – operators - Control statements - Type conversion and casting. Concepts of classes and objects: Basic Concepts of OOPs, constructors, static keyword, Final with data, Access control, This key word - Garbage collection- Nested classes and inner classes - String class

UNIT II INHERITANCE, PACKAGES AND INTERFACES (12 Hrs)

Inheritance: Basic concepts - forms of inheritance - super key word – method overriding, abstract classes, dynamic method dispatch - the Object class. Packages: Defining, Creating and Accessing, importing packages. Interfaces: Defining, implementing, applying, variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING (12 Hrs)

Concepts of Exception handling, types of exceptions, creating own exception, Concepts of Multithreading, creating multiple threads, Synchronization, inter thread communication. Enumeration - Autoboxing - Generics.

UNIT IV COLLECTIONS, I/O STREAMS (12 Hrs)

Collections: List –Vector – Stack - Queue – Dequeue –Set – Sorted Set. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC (12 Hrs)

Events - Delegation event model - Event handling - Adapter classes. AWT: Concepts of components - Font class, Color class and Graphics. - Introduction to Swing – layout management - Swing Components. Java Database Connectivity- Develop real time applications.

Text Books

1. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd, 11th Edition, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018
3. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, 7th Edition, 2006.

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Reference Books

1. H.M.Dietel and P.J.Dietel, "Java How to Program", 11th Edition, Pearson Education/PHI, 2017.
2. Nageshvar rao, "Core Java and Integrated Approach", 1st Edition, Dreamtech, 2016.
3. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", Prentice Hall, 9th Edition, 2013.
4. P.J. Dietel and H.M Dietel, "Java for Programmers", Pearson Education, 9th Edition, 2011.
5. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Pearson Education, 8th Edition, 2008.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	-	-	2
2	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
3	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
4	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
5	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET411	MEASUREMENTS AND INSTRUMENTATION FOR ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To give the students an insight into the constructional details and working principles of various measuring instruments.
- To provide the use of different types of analog and digital meters for measuring electrical and physical quantities.
- To demonstrate various Bridges for the measurement of resistance, inductance and capacitance.
- To provide the procedure to calibrate an energy meter.
- To understand and apply different types of sensors for the measurement of physical quantities such as speed, torque, pressure, displacement, temperature, etc.

Course Outcomes

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

CO1 - Acquire knowledge on the characteristics of measuring instruments and their classification.**(K2)**
CO2 - Conversant in construction, working of A.C / D.C meters and their proficient use. **(K3)**
CO3 - Acquire knowledge in various methods of digital meters and its measurement. **(K3)**
CO4 - Acquire knowledge on construction and working principle of various types of display devices and bridge comparison methods for R, L and C measurement. **(K3)**
CO5 - Demonstrate the various types of transducers used for physical measurements. **(K3)**

UNIT I INTRODUCTION TO MEASUREMENT (9 Hrs)

Functional elements of Generalized measurement system - Types of measurement - Classification of instruments - Static and Dynamic characteristics of instruments - Mean, Standard deviation - error - Accuracy, Precision, Sensitivity, Linearity, Resolution, Hysteresis, Threshold, Input impedance - loading effects - Probability of errors - Errors in Measurements.

UNIT II ELECTRICAL INSTRUMENTS (9 Hrs)

Essential requirements of an instrument - Ammeter and voltmeter - Moving coil - Moving Iron - Extension of voltmeter and ammeter range - Electro dynamo meter type Wattmeter - Induction type Energy meter - Measurement of active and reactive powers in balanced and unbalanced systems - Instrument Transformers - Construction, phasor diagrams - Magnetic measurements – Determination of B-H curve and measurements of iron loss.

UNIT III DIGITAL INSTRUMENTS (9 Hrs)

Digital Volt Meter and its design - Voltage ratio measurement techniques - Digital ohmmeter, capacitance meter - impedance meters (Polar and Cartesian types) - Signal analyzers: spectrum and logic analyzers - Digital Frequency Meter - Measurement of Frequency - Study of Phasor Measurement Units (PMU).

UNIT IV BRIDGES AND DISPLAY DEVICES (9 Hrs)

Bridges: Measurement of resistances – D.C potentiometer - Wheat stone, Kelvin and Kelvin’s Double bridge - A.C bridges for measurement of L and C - Maxwell, Anderson, Hay, Wein and Schering bridges - Measurement of earth resistance**.**

Display Devices: CRT display, analog and digital CRO, LED, and LCD.

UNIT V TRANSDUCERS (9 Hrs)

Transducers - Definition and classification - Linear Displacement: Resistive Potentiometers, strain gauge, LVDT, Capacitive Piezoelectric - Rotational Displacement: magnetic, Position: synchro Transmitter and receiver – speed: Magnetic and photo electric pickup transducer - Temperature: Thermistors, thermocouple – Flow: Electromagnetic, Ultrasonic – Level: DP cell, Ultrasonic – Density: Hydrometer - Voltage, current and power: Hall Effect transducer

Text Books

1. A.K. Sawhney, “A Course in Electrical & Electronic Measurements and Instrumentation”, Dhanpat Rai and Co., New Delhi, 19th Edition, 2015.
2. J. B. Gupta, “A Course in Electronic and Electrical Measurements”, S. K. Kataria & Sons, Delhi, 12th Edition, 2009.
3. E. O. Doebelin and D. N. Manik, “Measurement Systems – Applications and Design”, Tata McGraw Hill Education Pvt. Ltd., Special Indian Edition, 2007.

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Reference Books

1. David Bell, “Electronic Instrumentation and Measurements”, Oxford University Press, 1st Edition, 2013.
2. A. J. Bouwens, “Digital Instrumentation”, Tata McGraw Hill Publications, 16th Reprint Edition, 2008.
3. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw Hill Education, 4th Edition, 2019.
4. C.S. Rangan, G.R. Sharma and V. S. V. Mani, “Instrumentation Devices and Systems”, Tata McGraw Hill Book Co., New Delhi, 1st Edition, 2004.

Web References

1. https://www.omega.de/green/pdf/CAP_LEV_MEAS.PDF
2. https://nptel.ac.in/courses/108/105/108105153/
3. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
4. http://vlabs.iitkgp.ernet.in/asnm/
5. https://www.youtube.com/watch?v=xLjk5DrScEU
6. http://www.wisegeek.com/what-are-transducers.htm-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	-		-	-	-	-	-	1	2	3	3
2	2	2	2	-	-		-	-	-			1	2	3	3
3	2	2	2	-	-		-	-	-			1	2	3	3
4	2	2	2	-	-		-	-	-			2	2	3	3
5	2	2	2	-	-		-	-	-			2	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EET412	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get familiar with basic architecture and programming techniques of microprocessor 8085.
- To learn interfacing of memory and data transfer techniques using microcontroller.
- To understand the interfacing of input/output devices required for real time applications.
- To introduce the basic concepts of embedded system design using microcontroller.
- To equip the student with ability to design PWM control for various application such as AC-DC, DC-DC converter, etc.

Course Outcomes

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

CO1 - Illustrate the architecture of microprocessor and to develop skills in writing assembly language program.**(K3)**
CO2 - Have a clear understanding of microcontroller architecture with functional details of each pin.**(K3)**
CO3 - Write and debug Assembly and C programs for 8 bit Microcontroller.**(K3)**
CO4 - Interface input/output peripheral devices and to implement the advanced communication protocol like I^2C and SPI using PIC Microcontroller. **(K4)**
CO5 - Design and develop microcontroller based real-time applications. **(K4)**

UNIT I ARCHITECTURE AND PROGRAMMING OF 8085 MICROPROCESSOR (9 Hrs)

8085 Microprocessor: Architecture, Addressing modes, Instruction set - Assembly language programs – Machine cycles and Timing diagrams. Application: Interfacing of stepper motor control with 8085 microprocessor

UNIT II INTRODUCTION TO PIC16F MICROCONTROLLER (9 Hrs)

Microprocessor and Microcontroller difference - RISC and CISC programmer's model - Criteria for selecting microcontroller - Overview of PIC family - PIC16F877A architecture, status register, Special function registers, memory organization, On-Chip peripherals - PIC16F877A pin configuration - Fuse bits of PIC

UNIT III PIC16F PROGRAMMING (9 Hrs)

Data types and assembler directives – Addressing modes – Instruction set – Bit addressability – MACROs – Intel HEX file – Programming Tools: MPLAB IDE – I/O Port Programming, Timer programming, PWM programming, External Interrupt programming, ADC programming, EEPROM programming

UNIT IV SERIAL COMMUNICATION PROTOCOLS AND ITS PROGRAMMING (9 Hrs)

Introduction to UART protocol and its programming – I2C protocol and its Programming - SPI protocol and its Programming - Serial Port programming.

UNIT V PERIPHERAL INTERFACING AND ITS PROGRAMMING (9 Hrs)

LCD and Keyboard Interfacing – Relay interfacing – Stepper and DC Motor control – RTC Interfacing – LM35 Temperature sensor interfacing – MAX7219 display controller interfacing – Ultrasonic sensors interfacing – Introduction to PIC24F and dsPIC33EV

Text Books

1. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, "PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18", Micro Digital Education, Illustrated Edition, 2017.
2. Ramesh S Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Prentice Hall of India, New Delhi, 5th Edition, 2011.

Reference Books

1. Sunil Mathur, Jeebananda Panda, "Microprocessor and microcontroller", PHI Learning Private Limited, New Delhi, 1st Edition, 2016.
2. dsPIC33EV data sheet

Web References

1. https://www.microchip.com ›
2. https://www.youtube.com/watch?v=S1QCZW92fU4
3. https://www.microchip.com/promo/explorer-8-development-board
4. https://www.mikroe.com/easymx-pro-stm32
5. https://www.microchip.com/DevelopmentTools/ProductDetails/DM240001-2#utm_source=MicroSolutions&utm_medium=Link&utm_term=FY17Q3&utm_content=MCU16&utm_campaign=Article

(DR.S. ANBUMALAR)

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	3	3	3	3
2	3	3	3	2	3	-	-	-	-	-	-	3	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	3	3	3	3
4	3	3	3	2	3	-	-	-	-	-	-	3	3	3	3
5	3	3	3	2	3	-	-	-	-	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSP402	GENERAL PROFICIENCY – II (Common to all branches except CSBS)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To examine various standardized test in English language.
- To recognize the key features of various technical writing.
- To integrate LSRW skills to endorse multifarious skill set in practical situation.
- To understand the factors that influences the usage of grammar.
- To understand the basic concepts of logical reasoning skills.

Course Outcomes

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

CO1 - Infer ideas to attend international standardized test by broadening receptive and productive skills. **(K2)**
CO2 - Interpret the types of writing in different state of affairs. **(K2)**
CO3 - Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation. **(K3)**
CO4 - Identify the rules of grammar in academic discourse settings. **(K3)**
CO5 - Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc. **(K2)**

UNIT I CAREER SKILLS (6 Hrs)

Listening: Listening at specific contexts **Speaking:** Mock interview (Personal and Telephonic) - **Reading**: Read and Review - Newspaper, Advertisement, Company Handbooks and Guidelines (IELTS based) **Writing:** Essay Writing (TOEFL) **Vocabulary:** Words at specified context (IELTS)

UNIT II CORPORATE SKILLS (6 Hrs)

Listening: Listening and replicating **Speaking**: Team Presentation (Work Place Etiquettes) **Reading:** Short texts (signs, emoticons, messages) **Writing:** E-mail writing- Hard skills - Resume Writing, Job Application Letter, Formal Letter - **Vocabulary:** Glossary (IELTS).

UNIT III FUNCTIONAL SKILLS (6 Hrs)

Listening: Listening TED Talks – **Speaking:** Brainstorming and Individual Presentation, Persuasive Communication - **Reading:** Text Completion (GRE Based) - **Writing:** Expansion of Compound Words **Vocabulary:** Expansion of vocabulary (IELTS).

UNIT IV TRANSFERABLE SKILLS (6 Hrs)

Listening: Listening Documentaries and making notes – **Speaking:** Conversation practice at formal and informal context **- Reading:** Read and transform - report, memo, notice and advertisement, **Writing:** Euphemism, Redundancy and Intensifiers **Vocabulary:** Refinement of vocabulary (IELTS).

UNIT V APTITUDE (6 Hrs)

Transformational Grammar: Phrases and Clauses, Concord, Conditional Clauses, Voice, Modals
Verbal Ability Enhancement: Letter Series, Coding and Decoding**,** Sentence Completion (GATE), Critical Reasoning and Verbal Deduction (GATE), Syllogism.

Reference Books

1. Lougheed, Lin. “Barron's Writing for the TOEFL IBT: With Audio CD”. Barron's Educational series, 2008.
2. Tulgan, Bruce**.** “Bridging the soft skills gap: How to teach the missing basics to today’s young talent”. John Wiley & Sons, 2015.
3. Sherfield, Robert M. “Cornerstone: Developing Soft Skills”. Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman**.** “The official Cambridge guide to IELTS for academic & general training”, Cambridge, 2014.
5. Ramesh, Gopalaswamy. “The ace of soft skills: attitude, communication and etiquette for success”. Pearson Education India, 2010.

Web References

1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
2	1	-	-	-	-	-	-	1	-	3	-	1	-	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
4	1	-	-	-	-	-	-	1	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ESP468

PROGRAMMING IN JAVA LAB

(Common to CSE, ECE,EEE,IT,ICE, MECH,CIVIL,BME, Mechatronics, CCE)

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To acquire programming skill in core java.
- To learn how to design java program and applications.
- To acquire object oriented skills in java.
- To develop the skill of designing applications.
- To explore database connectivity.

Course Outcomes

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

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, multithread. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Develop simple database programs. **(K3)**

List of Exercises

1. Develop simple programs using java technologies and testing tools.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Reference Books

1. E. Balaguruswamy, “Programming with Java”, TMH Publ, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL & DIETEL.
3. Herbert Schil dt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.
4. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.
5. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM’s tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
2	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
3	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
4	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2
5	3	2	1	1	3	-	-	-	-	-	-	-	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP408 MEASUREMENTS AND INSTRUMENTATION LAB

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To give the students an insight into the constructional details of various measuring instruments for better understanding of their working principles.
- To demonstrate various Bridges for the measurement of resistance, inductance and capacitance using simulation and hardware set ups.
- To understand the concept of magnetism and to determine the B-H curve for magnetic material specimen.
- To provide the procedure to calibrate an energy meter.
- To test and apply different types of sensors for the measurement of physical quantities such as speed, torque, pressure, displacement, temperature, etc. by conducting an appropriate experiment.

Course Outcomes

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

CO1 - Realize the advantages and the necessity of measurement systems in all Engineering and Scientific works. **(K2)**

CO2 - Measure Resistance, Inductance and capacitance using AC and DC bridges. **(K3)**

CO3 - Determine the magnetization characteristics and hysteresis loss of Iron specimen using BH curve. **(K3)**

CO4 - Calibrate single phase and three phase energy meters used in domestic and commercial applications. **(K3)**

CO5 - Determine the characteristics of RTD, thermostat, strain gauge and LVDT transducers and to apply for the physical quantities measurements. **(K3)**

List of Experiments

1. (a) Measurement of resistance using Wheatstone bridge
   (b) Measurement of insulation resistance.
2. (a) Measurement of capacitance and loss angle of capacitor using Schering Bridge.
   (b) Measurement of inductance and Q-factor using Maxwell Bridge.
3. Extension of voltmeter and ammeter.
4. Calibration of single phase and three phase Energy meter using loading method.
5. Determination of B-H Curve for the magnetic material specimen.
6. Calibrate Current Transformer and Potential Transformer to determine ratio error and phase errors.
7. Characteristic of Temperature transducers (LDR, thermistor and thermocouple).
8. Measurement of Displacement using transducers.
9. Measurement of Voltage, current and power using Hall Effect transducer.
10. Characteristics of Optical Transducers (LDR, Phototransistor, Photovoltaic and photoconductive cells)
11. Measurement of speed using Magnetic and photo electric pickup transducers.
12. Measurement of Position using synchro Transmitter and receiver
13. Spectrum analyser and its use for analysing frequency spectra of periodic and non-periodic signals.

Reference Books

1. A. K. Sawhney, “A course in Electrical and Electronics Measurement and Instrumentation”, Dhanpat Rai and Sons, 19^{th} Edition, 2015.
2. William D. Coopers and Albert D. Helfrick, “Modern Electronic instrumentation and Measurements Techniques”, Pearson Education India, 1^{st} Edition, 2002.
3. E. W. Golding and F. C. Widdis, “Electrical Measurements and Measuring Instruments”, Medtech Publication, 6^{th} Edition, 2019.
4. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill Education, 4^{th} Edition, 2019.
5. C. D. Johnson, “Process Control Instrumentation Technology”, Pearson Education India, 8^{th} Edition, 2015.
6. Electrical Business Magazine, (Online edition of Electrical Industry Magazine)
7. Instrumentation and Measurement, IEEE Transactions.
8. Science, Measurement and Technology, IET Journal.
9. Measurements, Elsevier Journal.

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Web References

1. https://www.omega.de/green/pdf/CAP_LEV_MEAS.PDF
2. https://nptel.ac.in/courses/108/105/108105153/
3. http://www.nptelvideos.in/2012/11/industrial-instrumentation.html
4. http://vlabs.iitkgp.ernet.in/asnm/
5. http://www.wisegeek.com/what-are-transducers.htm-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	2	-	-	-	-	-	-	-	3	2	2
2	3	2	2	-	2	-	-	-	-	-	-	-	3	2	2
3	2	2	2	-	2	-	-	-	-	-	-	-	3	2	2
4	2	2	2	-	2	-	-	-	-	-	-	-	3	2	2
5	2	2	2	-	2	-	-	-	-	-	-	-	3	2	2
6	2	2	2	-	2	-	-	-	-	-	-	-	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP409	MICROCONTROLLER AND ITS APPLICATIONS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To become familiar with architecture and instruction set for 8085.
- To provide hands-on training of interfacing external sensors and actuators with microcontroller
- To impart knowledge for on-chip peripheral programs
- To impart knowledge to generate pulses for electrical applications.
- To impart knowledge to do minor projects using microcontroller for solving real world engineering problems

Course Outcomes

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

CO1 - Develop assembly language program for microprocessor 8085. **(K3)**
CO2 - Analyze various platforms for programming by knowing the complete hardware configurations. **(K4)**
CO3 - Analyze abstract problems and apply a combination of hardware and software to address the problem. **(K4)**
CO4 - Design a control algorithm for various applications using microcontrollers. **(K3)**
CO5 - Design and generate pulses for real time electrical applications. **(K3)**

List of Experiments

Microprocessor Experiments using 8085:

1. 8 bit - Addition, Subtraction, Multiplication and Division
2. Assembly Language Programming: Subroutines, parameter passing to subroutines

Microcontroller Experiments using PIC:

3. PIC Assembly language- Programming using the PIC Instruction Set.
4. a) PIC Timer to generate accurate delay
   b) PIC Timer to generate waveforms
   c) Seven Segment Display interfacing with PIC
5. a) 16x2 LCD interfacing with PIC
   b) 4x4 matrix keyboard interfacing with PIC
6. PIC UART programming
7. PIC on-chip ADC for interfacing analog sensors

Application of Microcontroller using PIC:

8. Experimentation of DC Motor Interfacing and Speed/Direction Control with PIC
9. Stepper motor interfacing with PIC
10. Relay interfacing with PIC
11. DS1307 RTC Interfacing with PIC
12. MAX7219 LED matrix driver Interfacing with PIC using SPI protocol
13. Interface to peripherals and use of the I2C bus

Reference Books

1. Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, “The AVR Microcontroller and Embedded Systems Using Assembly and C”, Micro Digital Education, Illustrated Edition, 2017.
2. Ramesh S Gaonkar, “Microprocessor Architecture: Programming and Applications with the 8085”, Prentice Hall of India, New Delhi, 5th Edition, 2011.
3. Sunil Mathur, Jeebananda Panda, “Microprocessor and microcontroller”, PHI Learning Private Limited, New Delhi, 1st Edition, 2016.
4. dsPIC33EVdata sheet.

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Web References

1. https://www.microchip.com ›
2. https://www.youtube.com/watch?v=S1QCZW92fU4
3. https://www.microchip.com/promo/explorer-8-development-board
4. https://www.mikroe.com/easymx-pro-stm32
5. https://www.microchip.com/DevelopmentTools/ProductDetails/DM240001-2#utm_source=MicroSolutions&utm_medium=Link&utm_term=FY17Q3&utm_content=MCU16&utm_campaign=Article

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	3	2	-	-	-	-	-	-	2	2	2	3
2	2	3	3	3	2	-	-	-	-	-	-	2	2	2	3
3	2	3	3	3	2	-	-	-	-	-	-	2	2	2	3
4	2	3	3	3	2	-	-	-	-	-	-	2	2	2	3
5	2	3	3	3	2	-	-	-	-	-	-	2	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEC4XX	**CERTIFICATION COURSE - IV**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20EES403	SKILL DEVELOPMENT COURSE 3 (Choose anyone of the below three courses)	L	T	P	C	Hrs
		0	0	2	-	30

1. MOBILE PHONE SERVICING

Course Content:

1. Fundamentals of Mobile Phone Technology
2. Assembling and disassembling of various models of mobile phones.
3. Study of various tools and equipment used in mobile phone repairs.
4. Study of Printed Circuit Board (Motherboard) and various components on PCB
5. Study and testing of various parts, components and different ICs (chips) used on the motherboard.
6. Reheating and mounting of various BGA and SMD chips.
7. Detailed study of various faults arising due to corrupt software.
8. Introduction of various flasher boxes and software.
9. Flashing of various brands of handsets.
10. Procedure to remove virus from infected phones.
11. Unlocking of handsets through codes and/or software.
12. Use of various secret codes
13. Water damaged repair techniques.
14. Circuit tracing, jumper techniques and solutions.
15. Use of internet for troubleshooting faults.
16. Advanced troubleshooting techniques.

2. AUTONOMOUS ROBOTICS

Course Content:

1. Introduction, features and applications to Robotics
2. Building the PC Controlled Robot
3. Programming the PC Controlled Robot and testing it
4. Building the Line Follower Robot
5. Programming the Line Follower Robot and testing it
6. Building the Obstacle Avoiding Robot
7. Programming the Obstacle Avoiding Robot and testing it
8. Building the Pit Avoiding Robot
9. Programming the Pit Avoiding Robot and testing it
10. Building the Light Following Robot
11. Programming the Light Following Robot and testing it
12. Troubleshooting of Robotics.

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3. REPAIR AND MAINTENANCE OF POWER SUPPLY, INVERTER AND UPS

Course Content:

1. Study on use of appropriate repair tools and Equipments
2. Identify, place, solder, de-solder and test different SMD discrete components
3. Rework on PCB after identifying defects from SMD soldering and de-soldering
4. Identify different front panel controls and connectors of the given power supply.
5. Open the power supply and identify major sections and power components with heat sinks.
6. Identify various input and output sockets/ connectors of the given SMPS and measure its outputs using a multimeter
7. Identify and replace the faulty components in SMPS used in TVs and PCs
8. Identify front panel control and indicators of Inverter and also understand the use of back panel sockets and connections.
9. Testing of battery mode (Battery – Inverter – Load) in interconnected system
10. Open Top cover and identify various circuit boards in Inverter and also monitor voltages at various test points.
11. Troubleshooting of inverter
12. Identify front and back panel control, indicators, sockets and connections of UPS
13. Identify various circuit boards in UPS and monitor voltages at various test points
14. Troubleshooting of UPS

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U20EEM404	NSS / NCC	L	T	P	C	Hrs
		0	0	2	-	30

NCC/NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

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U20BST542	NUMERICAL METHODS AND OPTIMIZATION	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand the numerical technique of solving linear simultaneous equations.
- To introduce the numerical techniques of interpolation in various intervals.
- To understand the knowledge of various optimization techniques and methods of solving various types of partial differential equations.
- To acquaint the knowledge of various methods of linear programming problems.

Course Outcomes

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

CO1 - Understand the basic concepts and numerical techniques of solving algebraic and transcendental equations. **(K3)**

CO2 - Understand the knowledge of various numerical techniques of solving linear simultaneous equations. **(K3)**

CO3 - Appreciate the numerical techniques of interpolation and error approximations in various Intervals. **(K3)**

CO4 - Apply the optimization techniques for various types of partial differential equations. **(K3)**

CO5 - Analyze the optimization technique and use the simplex method to solve linear programming problems. **(K3)**

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)

Solution of algebraic and transcendental equations and Eigen value problem – The method of bisection - Method of false position - Newton Raphson method (single and system of two equations) Eigen value and Eigen vector by power method

UNIT II LINEAR SIMULTANEOUS EQUATIONS (12 Hrs)

Solution of linear simultaneous equations and matrix inversion - Gauss Elimination methods -Gauss-Jordan methods - Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT III INTERPOLATION (12 Hrs)

Interpolation: Finite Differences - Relation between operators - Interpolation by Newton’s forward and backward difference formula for equal intervals - Newton’s divided difference method and Lagrange’s method for unequal intervals - Differentiation based on finite differences - Integration by Trapezoidal and Simpson’s rules(Single integration only).

UNIT IV SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Optimization Techniques - Jacobians and their properties - Taylor’s series for functions of two variables - Maxima and minima - Lagrange’s method of undetermined multipliers.

UNIT V LINEAR PROGRAMMING PROBLEMS (12 Hrs)

Introduction to Linear Programming - Graphical Method - Simplex Method - Maximization and minimization.

Text Books

1. Atul Goyal, Madhuchanda Rakshit Suchet Kumar, “Numerical Methods”, New India publishing Agency, 1st Edition, 2019.
2. Steven C. Chapra, Raymond P. Canale, “Numerical Methods for Engineers”, McGraw Hill, 8th Edition, 2020.
3. T. Veerarajan, “Operation Research”, McGraw Hill, 1st Edition, 2018.

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Reference Books

1. Sia, “Numerical Methods”, Sia Publishers and Distributors Pvt. Ltd., 1st Edition, 2018.
2. Rajesh Kumar Gupta, “Numerical Methods - Fundamental and Applications”, Cambridge University Press, 1st Edition, 2019.
3. A. Ravi Ravindran, “Operations Research Methodologies”, Taylor and Francis, 1st Edition, 2019.
4. Kevin J. Hastings, “Introduction to the Mathematics of Operations Research with Mathematica”, Taylor and Francis, 2nd Edition, 2019.
5. P. K. Gupta, D. S. Hira, “Operations Research”, S. Chand, 5th Edition, 2018

Web References

1. https://nptel.ac.in/courses/111/106/111106101/
2. https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00
3. http://freecomputerbooks.com/Numerical-Methods-with-Applications.html
4. http://www.pphmj.com/journals/IJNMA.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	1	-	-	-	-	-	-	1	1	1
2	3	3	3	2	-	1	-	-	-	-	-	-	1	1	1
3	3	3	3	2	-	1	-	-	-	-	-	-	1	1	1
4	3	3	1	-	-	-	-	-	-	-	-	-	1	1	1
5	3	3	1	-	-	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20EET513	POWER ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To explain about the operations, switching characteristics of power semiconductor devices
- To study the operations and performance parameters of controlled Rectifiers.
- To analyze the operation and performance of dc to dc converters.
- To impart knowledge on different control techniques for inverters.
- To familiarize the principle of operation of AC voltage controllers and cyclo converters

Course Outcomes

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

CO1 - Discriminate the switching characteristics of power devices and to use for power conversion. **(K2)**
CO2 - Inspect the performance of control rectifiers in continuous and discontinuous modes. **(K2)**
CO3 - Acquire knowledge on operation and analysis of DC to DC converters **(K2)**
CO4 - Outline the operating principles of various types of inverters. **(K2)**
CO5 - Gain knowledge on the operation of AC to AC converters and its applications **(K2)**

UNIT I POWER SEMI-CONDUCTOR DEVICES (9 Hrs)

Study of switching characteristics of MOSFET, IGBT and SCRand TRIAC. Turn on and Turn off methods of SCR – Protection circuits – Triggering circuits.

UNIT II PHASE-CONTROLLED CONVERTERS (9 Hrs)

Operation and analysis of single and three phase controlled rectifiers – half and fully controlled Converters with R, RL and RLE loads – Effect of source inductance on controlled rectifiers – Power factor and harmonic improvement methods - series converter, twelve pulse converter, Dual converter- circulating and non-circulating current mode.

UNIT III DC TO DC CONVERTERS (9 Hrs)

Principles of step down and step up chopper – Class A, B, C, D and E chopper, voltage commutated, current commutated chopper, multi-phase chopper, principle of operation of buck, boost and buck boost regulators – switching schemes.

UNIT IV INVERTERS (9 Hrs)

Single phase and three phase voltage source inverters – Voltage and harmonic control techniques – Capacitor commutated current source inverter and auto sequential current source inverter.

UNIT V AC CHOPPER AND CYCLO CONVERETERS (9 Hrs)

Single phase and Three-phase AC voltage controllers – Control strategy – Single phase step-up/step-down midpoint type and bridge type cyclo-converters – Three phase cyclo-converters. Applications – regulated power supply, UPS, solid-state motor starter.

Text Books

1. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, 6th Edition, 2018.
2. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, New Delhi, 4th Edition, 2017.

Reference Books

1. Ned Mohan, M. Underland, William P. Robbins, “Power Electronics Converters, applications and design”, JohnWiley & sons, Singapore, 2001.
2. M. D. Singh, K. B. Khanchandani, “Power Electronics”, Tata McGraw Hill, New Delhi, 2007.
3. Cyril W. Lander, “Power Electronics”, McGraw Hill Book Company, Singapore, 1993.
4. Williams B.W., “Power Electronics Devices, drivers, applications and passive components”, McMillan Press Ltd., London, 1992.

Web References

1. https://www.tutorialspoint.com/power_electronics/index.htm
2. https://www.allaboutcircuits.com/technical-articles/a-review-on-power-semiconductor-devices/
3. https://www.electrical4u.com/concept-of-power-electronics/
4. https://nptel.ac.in/courses/108/101/108101038/
5. https://nptel.ac.in/courses/108/102/108102145/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	2	1	-	-	-	-	-	1	3	3	3
2	3	2	3	3	2	1	-	-	-	-	-	1	3	3	3
3	3	2	3	3	2	1	-	-	-	-	-	1	3	3	3
4	3	2	3	3	2	1	-	-	-	-	-	1	3	3	3
5	3	2	3	3	2	1	-	-	-	-	-	1	3	3	3

Correlation Level: 1 – Low, 2 – Medium, 3 – High

(DR.S. ANBUMALAR)

U20EET514	CONTROL SYSTEMS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To provide the use of transfer function models for analysis of physical systems.
- To provide adequate knowledge in the time response of systems and error analysis.
- To provide basic knowledge for obtaining the open loop and closed-loop frequency responses of systems.
- To get an exposure in the design of P/I/D controllers.
- To introduce about the state variable representation and stability analysis.

Course Outcomes

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

CO1 - Develop the transfer function for the block diagram / signal flow graph model of electrical / mechanical / electro-mechanical systems. **(K3)**
CO2 - Analyze the performance of control system using time-domain approach. **(K4)**
CO3 - Analyze performance characteristics of system using Frequency response methods. **(K3)**
CO4 - Design P/I/D controllers for the System in order to meet design specifications. **(K4)**
CO5 - Express the control systems into state space models and analyze the performance of the system. **(K2)**

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEMS (12 Hrs)

Control systems - Open loop and Closed loop – Transfer functions – Feedback control system characteristics - Mathematical modeling of Electrical, Mechanical and Electro-Mechanical systems - electrical analogues systems - Block diagrams reduction techniques - Signal flow graphs.

UNIT II TIME DOMAIN ANALYSIS (12 Hrs)

Standard test signals – Transient analysis of first and second order systems using step input - Time responses – Time domain specifications – Error Analysis - Stability analysis - Concept of stability – Routh Hurwitz stability criterion - Root locus Techniques - Effect of adding poles and zeros.

UNIT III FREQUENCY DOMAIN ANALYSIS (12 Hrs)

Frequency response analysis – Correlation between frequency response and time-response analysis - frequency domain specifications - Bode plot - Polar plot - Nyquist stability criterion.

UNIT IV CONTROLLER DESIGN (12 Hrs)

Introduction to controllers - P-I-D controllers - Tuning methods - Ziegler-Nichol’s Tuning - Performance criteria – Compensator design - Lead, Lag, Lead-Lag compensation using Bode Plot.

UNIT V STATE VARIABLE ANALYSIS (12 Hrs)

State Space Representation, Concept of state variables – State models for linear and time invariant Systems – Controllable, Observable, Jordan Canonical Forms - Solution of State Equation, State Transition Matrix – controllability and observability – Transfer function to State space model.

Text Books

1. I. J. Nagarath and M. Gopal, “Control Systems Engineering”, New Age International Publishers, 6th Edition (Multi colour Edition), 2018.
2. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 5th Edition, 2015.

Reference Books

1. Richard C. Dorf and Robert. H. Bishop, “Modern Control Systems”, Pearson Education, 12th Edition, 2011.
2. John J. D’Azzo, Constantine H. Houpis and Sttuart N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor and Francis Reprint, 6th Edition, 2014.
3. Benjamin C. Kuo, “Automatic Control Systems”, PHI Learning Private Ltd, 9th Edition 2014.

Web References

1. https://www.tutorialspoint.com/control_systems/control_systems_useful_resources.html
2. http://www.controlsystemsacademy.com/
3. https://nptel.ac.in/courses/108/102/108102043/
4. https://www.isa.org/technical-topics/control-systems/
5. https://nptel.ac.in/courses/108/106/108106098/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	3	3	2	-	-	-	-	-	-	1	3	3	3
2	2	3	3	3	2	-	-	-	-	-	-	1	3	3	3
3	2	3	3	3	2	-	-	-	-	-	-	1	3	3	3
4	2	3	3	3	2	-	-	-	-	-	-	1	3	3	3
5	2	3	3	3	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20EET515	TRANSMISSION AND DISTRIBUTION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide the structure of the electrical power system with various types of A.C/D.C Transmission and distribution systems
- To explain about the classification of transmission lines and their technical parameters.
- To understand the concept of transmission line models and its performance.
- To understand the necessity and importance of various insulators and cables used in power system.
- To have an overview of the modern electrification schemes and recent technologies in Transmission and Distribution systems

Course Outcomes

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

CO1 - Summarize the structure of Generation, Transmission and Distribution with real time connection schemes. **(K2)**
CO2 - Calculate the line parameters in the transmission system and their effects in the overhead lines.**(K3)**
CO3 - Analyze on different types of transmission lines (short, medium, long) and its performance. **(K2)**
CO4 - Choose the adaptable types of insulators and cables for transmission and distribution systems. **(K3)**
CO5 - Compare various schemes of electrification and gain knowledge on High Voltage AC / DC systems **(K2)**

UNIT I DISTRIBUTION SYSTEMS (9 Hrs)

Structure of electric power systems - Single Line Diagram of Generation, Transmission and Distribution Systems - Comparison of distribution systems – Radial and Ring main – DC two wire, AC single phase and three phase systems – Selection of Feeders and Distributors – secondary distribution system - Kelvin's law and its limitations.

UNIT II LINE PARAMETERS AND EFFECTS ON TRANSMISSION SYSTEM (9 Hrs)

Resistance, inductance and capacitance of single and three phase transmission lines - symmetrical and unsymmetrical spacing – transposition - single and double circuits - stranded and bundled conductors - application of self and mutual GMD–Skin, Proximity and Corona effect - inductive and radio interference - Computation of line parameters.

UNIT III PERFORMANCE ANALYSIS ON TRANSMISSION SYSTEMS (9 Hrs)

Development of equivalent circuits for short, medium and long lines – Calculation of efficiency and voltage regulation – Tuned power lines - Power circle diagrams for sending and receiving ends - transmission capacity, steady state stability limit – voltage control of lines.

UNIT IV INSULATORS AND CABLES FOR DISTRIBUTION SYSTEMS (9 Hrs)

Insulators: types and comparison – voltage distribution in string insulator – string efficiency – Methods of improving string efficiency – Stress and sag calculations – effect of wind and ice – supports at different levels. Cables: types – capacitance of cables – insulation resistance - dielectric stress and grading - dielectric loss - thermal characteristics - capacitance of three core cables.

UNIT V RECENT TRENDS IN TRANSMISSION (9 Hrs)

Design of Rural distribution, planning and design of town electrification schemes – Need for power system interconnections systems – Components of a HVDC system - Types of DC links –– Modern trends in DC Transmission systems – Comparison of HVDC and HVAC Transmission systems – Introduction to FACTS - FACTS controllers – Shunt and Series – Grounding methods in power stations.

Text Books

1. C.L.Wadhwa, Electrical Power Sytems, 6th edition, New Age International (P) Limited, New Delhi, 2018.
2. V. K. Metha and Rohit Metha, "Principles of Power System", S. Chand, 3rd Edition, 2005.
3. R. Padiyar, "HVDC Power Transmission Systems – Technology and System Interactions", New Age International Publishers, 2012.
4. A. K. Theraja and B. L. Theraja, "Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization", S. Chand, 23rd Edition, 2004.

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Reference Books

1. Hadi Saadat, 'Power System Analysis,' PSA Publishing; Third Edition, 2010.
2. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes, Fourth Edition, 2012.
3. Luces M.Fualken berry Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.

Web References

1. https://swayam.gov.in/nd1_noc20_ee39/preview
2. https://swayam.gov.in/nd1_noc20_ee86/preview
3. https://www.eei.org/ourissues/ElectricityTransmission/Documents/
4. https://www.osha.gov/SLTC/etools/electric_power/illustrated_glossary/index.html
5. http://solareis.anl.gov/documents/docs/APT_61117_EVS_TM_08_4.pdf

COs / POs and PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	2	-	-	-	-	-	-	3	3	2	3
2	3	3	3	-	2	-	-	-	-	-	-	3	3	2	3
3	3	3	3	-	2	-	-	-	-	-	-	3	3	2	3
4	3	3	3	-	2	-	-	-	-	-	-	3	3	2	3
5	3	3	3	-	2	-	-	-	-	-	-	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20BSP543	NUMERICAL METHODS AND OPTIMIZATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn the techniques of solving non-linear equation.
- To find the solutions of simultaneous equations.
- To introduce the iterative methods.
- To know the numerical interpolation.
- To study about the numerical integration.

Course Outcomes

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

CO1 - Solve polynomial equation. **(K3)**
CO2 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO3 - Know the applications of interpolation. **(K1)**
CO4 - Apply the Trapezoidal formula. **(K3)**
CO5 - Evaluate the integrals using simpson's formula. **(K5)**

List of Experiments

1. Roots of non-linear equation using bisection method.
2. Roots of non-linear equation using Newton's method.
3. Solve the system of linear equations using Gauss - elimination method.
4. Solve the system of linear equations using Gauss - Seidal iteration method
5. Solve the system of linear equations using Gauss - Jordan method.
6. To find the largest Eigen value of a matrix by power - method.
7. Interpolation by Lagrange Polynomial
8. Interpolation by Newton Polynomial
9. Find the area by using trapezoidal rule.
10. Find the area by using Simpson's rules.
11. Optimization by using Interpolation Method.
12. Optimization by using Graphical Method.

Reference Books

1. Atul Goyal, Madhuchanda Rakshit Suchet Kumar, "Numerical Methods", New India publishing Agency, 1st Edition, 2019.
2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", McGraw Hill, 8th Edition, 2020.
3. T. Veerarajan, "Operation Research", McGraw Hill, 1st Edition, 2018.
4. Sia, "Numerical Methods", Sia Publishers and Distributors Pvt. Ltd., 1st Edition, 2018.
5. Rajesh Kumar Gupta, "Numerical Methods - Fundamental and Applications", Cambridge University Press, 1st Edition, 2019.
6. A. Ravi Ravindran, "Operations Research Methodologies", Taylor and Francis, 1st Edition, 2019.
7. Kevin J. Hastings, "Introduction to the Mathematics of Operations Research with Mathematica", Taylor and Francis, 2nd Edition, 2019.
8. P. K. Gupta, D. S. Hira, "Operations Research", S. Chand, 5th Edition, 2018

Web References

1. https://nptel.ac.in/courses/111/106/111106101/
2. https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00
3. http://freecomputerbooks.com/Numerical-Methods-with-Applications.html
4. http://www.pphmj.com/journals/IJNMA.htm

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	1	1	-	1	2	2	2
2	3	2	2	-	-	-	-	-	1	1	-	1	2	2	2
3	3	2	2	-	-	-	-	-	1	1	-	1	2	2	2
4	3	2	2	-	-	-	-	-	1	1	-	1	2	2	2
5	3	2	2	-	-	-	-	-	1	1	-	1	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20EEP510	POWER ELECTRONICS AND DRIVES LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To introduce the concepts involved in power semiconductor devices and its characteristics and to understand the basics of triggering circuits.
- To analyze the basic Power electronic circuit topologies including AC-DC, DC-DC, DC-AC and AC-AC converters.
- To enable the students to do simulation of Converter circuits and experimentally verify the results.
- To study and analyze the operation of the DC and AC drives.
- To introduce the industrial control of power electronic circuits as well as safe electrical connection and measurement practices.

Course Outcomes

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

CO1 - Analyze the fundamental operations of power semiconductor devices and its characteristics. **(K3)**
CO2 - Demonstrate the operation of various power converters circuits. **(K4)**
CO3 - Illustrate the operating characteristics of AC and DC Drives. **(K4)**
CO4 - Acquire knowledge on design and implementation of Microcontroller based control schemes for electrical drives**. (K5)**
CO5 - Design and implement the closed loop controllers for converters. **(K5)**

List of Experiments

1. Characteristics of SCR and TRIAC,
2. Characteristics of MOSFET and IGBT.
3. Single phase half and fully controlled converter
4. Three phase half and fully controlled converter.
5. Step Down chopper, Step up Chopper and Multi-quadrant chopper
6. Single phase AC voltage controller
7. Single phase step up and step down cycloconverter
8. Single phase and three phase IGBT based PWM inverter
9. Converter/ Chopper fed DC motor.
10. Speed control of Inverter fed Induction motor.
11. Multilevel inverter using PIC microcontroller.
12. Study of microcontroller based BLDC Motor Drive.
13. Study of voltage regulation of DC buck converter

Reference Books

1. G. K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, 2nd Edition, 2010.
2. M. H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, PHI, New Delhi, 4th Edition, 2017
3. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, New Delhi, 6th Edition, 2018.
4. M. D. Singh and K. B. Khachandani, “Power Electronics”, McGraw-Hill Education, 2nd Edition, 2017.
5. R .Krishnan, “Electric Motor Drives - Modeling, Analysis, and Control”, Pearson Education India, 1st Edition, 2015.
6. John F. Wakerly, “Digital Design Principles and Practices”, Pearson prentice hall, 4th Edition, 2009.

Web References

1. https://nptel.ac.in/courses/108/105/108105066/
2. http://www.smpstech.com/websites.htm
3. http://www.electronics-tutorials.ws/
4. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/
5. https://ndl.iitkgp.ac.in/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	1	-	-	2	2	-	1	3	2	3
2	3	3	2	2	3	1	-	-	2	2	-	1	3	2	3
3	3	3	2	2	3	1	-	-	2	2	-	1	3	2	3
4	3	3	2	2	3	1	-	-	2	2	-	1	3	2	3
5	3	3	2	2	3	1	-	-	2	2	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U20EEP511	**CONTROL SYSTEMS LAB**	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To provide the concepts of modeling and simulation of physical systems.
- To provide adequate knowledge in time response of systems and error analysis.
- To give basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To understand the concept of stability and its analysis.
- To get adequate knowledge about practical tuning of P/I/D controllers for motors/converters.

Course Outcomes

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

CO1 - Interpret different electrical and mechanical systems with its modeling. **(K2)**
CO2 - Use the time domain analysis, to predict stability of a system performance of the system. **(K3)**
CO3 - Demonstrate frequency domain analysis of a system. **(K3)**
CO4 - Familiarize with the tuning procedure of P/I/D controllers for converter/motor applications. **(K4)**
CO5 - Design a controller for any system to meet the desired performance. **(K4)**

List of Experiments

1. Mathematical modeling and simulation of physical systems
   - Mechanical
   - Electrical
2. Implementation of a RC lead/lag compensating network for the given specifications and to obtain its frequency response.
3. Determination of Transfer function of a separately excited DC Motor.
4. Implementation of open loop and closed loop control of DC buck converter
5. Design and implementation of PID controller for DC motor
6. Stability analysis of a system using Root Locus
7. Determination of transfer functions of a physical system using frequency response and Bode's asymptotes.
8. Position and speed control of DC servo motor
9. Design of Lead/Lag/Lead-Lag Compensator for DC Motor
10. Stability analysis using routh- hurwitz method
11. Time domain analysis of first order and second order system
12. Simulation of Controllability and Observability of a system
13. Implementation of open loop and closed loop speed control of 3 phase induction motor.

Reference Books

1. Hasan Saeed, "Automatic Control Systems (With MATLAB Programs)", S. K. Kataria & Son, 1st Edition, 2010.
2. I. J. Nagarath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 6th Edition, 2018.
3. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 5th Edition, 2015.
4. Benjamin C. Kuo, "Automatic Control Systems", PHI Learning Private Ltd, 9th Edition, 2014.

Web References

1. http://saadat.us/control_systems_labs.html
2. https://www.quanser.com/solution/control-systems/
3. http://ncr.mae.ufl.edu/papers/te02.pdf
4. https://futureengineering.in/control-system-lab/
5. http://vlabs.iitb.ac.in/vlab/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	1	-	-	3	2	-	1	2	2	3
2	3	3	3	3	3	1	-	-	3	2	-	1	2	2	3
3	3	3	3	3	3	1	-	-	3	2	-	1	2	2	3
4	3	3	3	3	3	1	-	-	3	2	-	1	2	2	3
5	3	3	3	3	3	1	-	-	3	2	-	1	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEC5XX	**CERTIFICATION COURSE – V**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

(DR.S. ANBUMALAR)

U20EES504	SKILL DEVELOPMENT COURSE 4 (Foreign Language / IELTS – I)	L	T	P	C	Hrs
		0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

(DR.S. ANBUMALAR)

U20EES505	SKILL DEVELOPMENT COURSE 5 (Presentation Skills using ICT)	L	T	P	C	Hrs
		0	0	2	-	30

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

Communication Technology (CT) skills

a. Understand ICT workflow in cloud computing.
b. Manage multitasking.
c. Deal with main issues using technology in class.
d. Record, edit and deliver audio and video.
e. Automate assessments and results.

Teaching tools

f. Different ways to create audio-visual activities.
g. Handle audio-visual editors.
h. Collaborative working.
i. Individualize learning experience.
j. Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained for this course is not considered for CGPA calculation.

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U20EEM505	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
- To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
- To channelize students thinking towards basic understanding of the legal concepts and its implications for engineers.
- To acquaint students with latest intellectual property rights and innovation environment with related regulatory framework.
- To make students learn about role of engineering in business organizations and e-governance.

Course Outcomes

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

CO1 - Identify and explore the basic features and modalities about Indian constitution.
CO2 - Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
CO3 - Differentiate different aspects of Indian Legal System and its related bodies.
CO4 - Discover and apply different laws and regulations related to engineering practices.
CO5 - Correlate the role of engineers with different organizations and governance models

UNIT I INDIAN CONSTITUTION (6 Hrs)

Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties

UNIT II PARLIAMENTRY SYSTEM (6 Hrs)

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker

UNIT III THE JUDICIARY (6 Hrs)

Organization and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT IV STATE GOVERNMENTS (6 Hrs)

Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature

UNIT V LOCAL GOVERNMENTS (6 Hrs)

73^{rd} and 74^{th} Constitutional Amendments – Federalism - Center – State Relations

Text Books

1. Basu D.D,” Introduction to Indian Constitution”, Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, “Indian Government and Politics”, Vikas Publishing House, New Delhi, 2010.

Reference Books

1. Pylee M.V, “Introduction to the Constitution of India”, Vikas Publishing House, New Delhi, 2011.
2. Kashyap S, “Our Constitution”, National Book Trust, New Delhi, 2010

Web References

1. https://legislative.gov.in/constitution-of-india
2. https://www.constitutionofindia.net/constitution_of_india
3. https://www.india.gov.in/my-government/constitution-india
4. https://www.clearias.com/constitution-of-india/
5. https://www.servat.unibe.ch/icl/in00000_.html

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U20EET616	EMBEDDED SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the fundamentals of embedded systems and its communication protocols.
- To understand the architectural features of ARM processor.
- To learn about the different programming techniques for ARM processor
- To impart knowledge on ARM processor peripherals with device driver and its interface circuits
- To provide a platform for the student to design, implement, integrate, and develop software and hardware applications with the real time system.

Course Outcomes

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

CO1 - Explain the basic building process of embedded system.**(K2)**
CO2 - Analyze any type of Microcontroller Architecture in detail.**(K4)**
CO3 - Apply the instruction sets to program ARM processor using Embedded C in KEIL software/ Micro C.**(K3)**
CO4 - Provides the experience to integrate hardware and software for any microprocessor / microcontroller for product designing such as smart-phones, microcomputers etc. **(K4)**
CO5 - Impart the concepts of RTOS in accessing shared resources for optimized CPU performance, timing based operations, video streaming and audio streaming etc. **(K3)**

UNIT I OVERVIEW OF EMBEDDED SYSTEMS (9 Hrs)

Basics of Embedded Systems – I/O Devices: Types and Examples – Synchronous, ISO- Synchronous and Asynchronous Communication – Serial Communication devices and Protocols: I^2C, SPI, UART - Parallel Device Ports.

UNIT II ARM ARCHITECTURE (9 Hrs)

ARM Programmer's model - Registers – Processor modes - Pipeline - Interrupts – ARM organization - ARM processor families – Instruction sets – Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions – ARM Memory Management Unit.

UNIT III ARM PROCESSOR PROGRAMMING (9 Hrs)

Writing and optimizing the embedded C Code – Profiling and Cycle Counting – Instruction Scheduling –Register Allocation – Conditional Execution – Looping Constructs – Bit Manipulation - Timers and counters - Watchdog timer. Programming Tools: IDE and Programmer Interface.

UNIT IV ARM PROCESSOR PERIPHERALS (9 Hrs)

Clocking and Power Management – I/O handling - SPI and I^2C – UART – Analog to Digital conversion – temperature sensor – light sensor– accelerometer - Digital to Analog conversion

UNIT V RTOS FOR EMBEDDED SYSTEMS (9 Hrs)

Introduction to RTOS - Task and Task Scheduler - Scheduling policies – Interrupt Service Routines – Inter process communication mechanisms – Design issues- Introduction to Microcontroller/ Operating System.

Text books

1. Agus Kurniawan, "Getting Started With STM32 Nucleo Development", Agus Kurni, 1st Edition, 2016.
2. Sepehr Naimi, Sarmad Naimi, Muhammad Ali Mazidi, "The STM32F103 Arm Microcontroller and Embedded Systems-Using Assembly and C", Microdigitaled, 1st Edition, 2020.
3. Brian Amos, "Hands-On RTOS with Microcontrollers: Building Real-time Embedded Systems Using FreeRTOS, STM32 MCUs, and SEGGER Debug Tools", Thomas Learning, 1st Edition, 2020.
4. Geoffrey Brown, "Discovering the STM32 Microcontroller", Indiana University, Free Edition, 2016.

Reference books

1. Yifeng Zhu, "Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language", E-Man Press LLC, 2nd Edition, 2016.
2. Elicia White, "Making Embedded Systems", O' Reilly Series, 1st Edition, 2011.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guides - Designing and Optimizing System Software", Elsevier, 2008.
4. Peckol, "Embedded system Design", John Wiley and Sons, 2nd Edition, 2010.
5. Frank Vahid, "Embedded System Design–A Unified Hardware and Software Introduction", John Wiley, 1st Edition, 2002.

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Web References

1. https://www.tutorialspoint.com/embedded_systems/es_overview.htm
2. https://developer.arm.com/architectures/learn-the-architecture/introducing-the-arm-architecture/single-page
3. https://www.coursera.org/lecture/iot/lecture-1-1-what-are-embedded-systems-Gah7g
4. https://nptel.ac.in/courses/108102045/
5. https://www.eeweb.com/app-notes/tags/arm
6. https://en.wikibooks.org/wiki/Embedded_Systems/Real-Time_Operating_Systems

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	3	3	2	-	-	-	-	-	2	3	3	3
2	3	2	3	3	3	2	-	-	-	-	-	2	3	3	3
3	3	2	3	3	3	2	-	-	-	-	-	2	3	3	3
4	3	2	3	3	3	2	-	-	-	-	-	2	3	3	3
5	3	2	3	3	3	2	-	-	-	-	-	2	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EECM01	**RENEWABLE ENERGY SOURCES** (Common to EEE and ICE)	**L**	**T**	**P**	**C**	**Hrs.**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To impart knowledge on renewable energy sources and technologies.
- To gain adequate knowledge on variety of issues in harnessing renewable energy sources.
- To outline about the alternate renewable energy sources for both domestics and industrial applications.
- To provide knowledge about grid connectivity in renewable energy systems.
- To provide in-depth knowledge in the key concepts of energy policies.

Course Outcomes

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

CO1 - Analyze the national and international energy scenario of renewable energy Sources. **(K2)**
CO2 - Design the aerodynamics of wind turbines and calculate their energy production. **(K3)**
CO3 - Analyze electrical power generation from biomass, geothermal, tidal, wave etc. **(K2)**
CO4 - Analyze technical and sustainability issues involved in the integration of renewable energy systems. **(K2)**
CO5 - Compare the cost economics of using renewable energy sources with non-renewable energy sources. **(K2)**

UNIT I SOLAR ENERGY (9 Hrs)

Overview - Limitations of conventional energy resource - Importance of renewable sources - Types - Present Indian and international energy scenario. Solar Energy: solar thermal power and its energy conversion - solar collectors - types and applications. Photovoltaic (PV) technology - photovoltaic effect - efficiency of solar cells - Design Concept of solar PV system - standards and applications.

UNIT II WIND AND HYDRO POWER ENERGY (9 Hrs)

Wind Energy: wind data – properties - speed and power relation - wind turbines and electric generators - horizontal and vertical wind mills - wind energy farms - off-shore plants- Selection factors. Hydro Energy: small, mini and micro hydro power plants and their resource assessment - plant layout with major components -selection factors-application.

UNIT III ALTERNATE ENERGY SOURCES (9 Hrs)

Biomass: Photosynthesis and origin of biomass energy – terms and definitions – pyrolysis, thermo-chemical biomass conversion to energy, Geothermal: resources, hot spring, steam system, site selection, challenges. Ocean and Tidal energy: principle of OTEC – wave energy conversion machines – fundamentals of tidal power, conversion systems and limitations – Introduction to fuel cells.

UNIT IV GRID INTEGRATION (9 Hrs)

Wind power interconnection requirement - low-voltage ride through (LVRT), ramp-rate limitations, supply of ancillary services for frequency and voltage control - load and reserve requirement – issues in interconnection - steady - state and dynamic performance of power system – interfacing solar system with grid - protective relaying, islanding, Power quality issues.

UNIT V RENEWABLE ENERGY POLICY (9 Hrs)

Renewable energy policies: Five Year Plan programmes - Feed-in tariffs - portfolio standards - policy targets, tax incentives – bio-fuels mandates - International policies for climate change and energy security - Economic analysis and comparisons - Life cycle analysis - financial analysis - cost of conserved energy and externalities - Cost assessment of supply technologies versus energy – Efficiency - Renewable Energy Certification – Carbon contents.

Text Books

1. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Resources: Basic Principle and Application", Alpha Science International Ltd, New Edition, 2005.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill, 2nd Edition, 2009.
3. R. Loulou, P. R. Shukla and A. Kanudia, "Energy and Environment Policies for a sustainable Future", Allied Publishers Ltd, New Delhi, 1997.

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Reference Books

1. Solanki Chetan Singh, “Solar Photovoltaic - Fundamentals, Technologies and Applications”, PHI, New Delhi, 3rd Edition, 2015.
2. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, New York, 2nd Edition, 2011.
3. D. P. Kothari, K. C Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt. Ltd, New Delhi, 2nd Edition, 2013.
4. John Twidell and Tony Weir, “Renewable Energy Resources”, Routledge publication, 3rd Edition, 2015.
5. Godfrey Boyle, “Renewable Energy: Power for a Sustainable Future”, Oxford University Press, 3rd Edition, 2014.
6. A. K. Mukerjee and Nivedita Thakur, “Photovoltaic Systems: Analysis and Design”, PHI Learning Private Limited, New Delhi, 2011.
7. Ali Keyhani, “Design of Smart Power Grid Renewable Energy Systems”, Wiley Publication, 1st Edition, 2011.

Web References

1. https://nptel.ac.in/courses/103/107/103107157/
2. www.renewableenergyworld.com/rea/tech/home
3. www.eschooltoday.com/energy/renewable-energy
4. https://www.chetansinghsolanki.in/course.php
5. https://nptel.ac.in/courses/108/108/108108078/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	3	-	2	3	-	-	-	-	2	3	2	2
2	3	2	2	3	1	2	3	-	-	-	-	2	3	2	2
3	3	2	2	3	1	2	3	-	-	-	-	2	3	2	2
4	3	2	2	3	1	2	3	-	-	-	-	2	3	2	2
5	3	2	2	3	1	2	3	-	-	-	-	2	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET618	POWER SYSTEM ANALYSIS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To create computational models for power system using per unit analysis.
- To perform load flow analysis using Gauss Seidal and Newton-Raphson methods.
- To analyze the sequence network using symmetrical components.
- To import the knowledge about symmetrical and unsymmetrical faults in power system.
- To demonstrate different methods and factors influencing on power system stability

Course Outcomes

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

CO1 - Compute the reactance diagram and network matrices. **(K4)**
CO2 - Apply the iterative techniques to solve the power flow analysis used in power system planning. **(K3)**
CO3 - Analyze the Sequence networks using positive, negative and zero sequence network. **(K4)**
CO4 - Carry out short circuit studies to design the circuit breaker ratings in power system **(K4)**
CO5 - Analyze stability problems in power system during pre-fault and post-fault conditions **(K4)**

UNIT I MODELING OF POWER SYSTEM COMPONENTS (12 Hrs)

Need for system planning and operational studies - Power system components – Representation - Single line diagram - Per unit quantities - P.U. impedance / reactance diagram - Formulation of network matrices for the power systems - Bus impedance and bus admittance matrices - Reduction techniques on network matrices for network changes - Z bus Building algorithm.

UNIT II LOAD FLOW STUDIES (12 Hrs)

Classification of buses - formulation of load flow problem - Load flow solution by Gauss - Seidal, Newton - Raphson and Fast Decoupled Load Flow (FDLF) Analysis - Comparison - Computation of slack bus power, transmission loss and line flow - Voltage Control Methods - Tap-changing and phase - shifting transformers.

UNIT III SYMMETRICAL COMPONENTS AND SEQUENCE NETWORKS (12 Hrs)

Symmetrical components – Simple problems to calculate symmetrical voltages and currents - Sequence networks - positive, negative and zero sequence networks - Sequence networks of Series impedance, loads and Rotating machines – Advantages and Limitations.

UNIT IV FAULT ANALYSIS (12 Hrs)

Need for fault analysis - Types of faults - Symmetrical fault analysis through bus impedance matrix - Analysis of unsymmetrical faults- LG, LL and LLG - Analysis of simultaneous unbalanced short circuit and open conductor faults in power systems – short circuit capacity – circuit breaker selection - Representation of various types of faults in sequence networks.

UNIT V STABILITY STUDIES (12 Hrs)

Definition - Importance of stability analysis- classifications - Steady state and transient stability - Angle and voltage stability - Single Machine Infinite Bus (SMIB) system - swing equation – Swing Curve - Numerical integration methods - Equal area criterion - Critical clearing angle and time - Factors affecting stability - Methods of improving transient stability. Introduction to automatic voltage regulator systems.

Text Books

1. P. Kundur, “Power System Stability and Control”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th Reprint, 2013.
2. D. P. Kothari and I. J. Nagrath, “Power System Engineering”, Tata McGraw-Hill Education, 3rd Edition, 2019.
3. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st Reprint, 2010.

(DR.S. ANBUMALAR)

Reference Books

1. M. A. Pai, "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2012.
2. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, "Power System Analysis and Design", Cengage Learning, 5th Edition, 2016.
3. John J. Grainger, Jr. William D. Stevenson, "Power System Analysis", McGraw Hill Education (India) Private Limited, New Delhi, 2nd Edition, 2015.

Web References

1. https://nptel.ac.in/courses/108/105/108105067/
2. https://nptel.ac.in/courses/108/107/108107127/
3. https://pserc.wisc.edu/webinars/systems_webinars.aspx
4. https://www.classcentral.com/course/swayam-power-system-analysis-14243

COs/POs/PSOs Mapping

COs	Program Outcomes(POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	1	-	-	-	-	-	1	3	2	2
2	3	2	2	2	3	1	-	-	-	-	-	1	3	2	2
3	3	3	2	2	3	1	-	-	-	-	-	1	3	2	2
4	3	3	2	2	3	1	-	-	-	-	-	1	3	2	2
5	3	3	2	2	3	1	-	-	-	-	-	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EET619	ELECTRICAL MACHINE DESIGN	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the design considerations, thermal rating, insulation requirements and magnetic circuit calculations of static and rotating electrical machines.
- The course refreshes the construction details and design aspects of various parts of DC machines.
- To provide the knowledge on the design aspects of transformer with minimum cost.
- The course refreshes the construction details and design aspects of various parts of induction motor.
- To equip the students with construction details and design aspects of synchronous machines and BLDC motor.

Course Outcomes

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

CO1 - Design the machines with proper thermal rating and insulation requirements.**(K3)**
CO2 - Analyze and evaluate the various design parameters of a DC machine for variable speed motor applications in industry.**(K4)**
CO3 - Analyze the various parameters of transformer and to design distribution and power transformers for real time applications. **(K4)**
CO4 - Analyze and formulate the suitable design for three phase induction motor.**(K4)**
CO5 - Apply the design concepts of Synchronous machines and BLDC motors. **(K3)**

UNIT I INTRODUCTION (12 Hrs)

Design Factors and Limitations – Modern Trends - Major considerations in Electrical Machine Design – Biot Savart law - soft magnetic materials, Electrical steel sheets, Classification of insulating materials – Design of Magnetic circuits – Magnetizing current – Flux leakage – real and apparent flux densities -, heating and cooling curves – rating of electric machines- calculation of effective magnetic flux in a motor- Magnetic circuit and reluctance calculation with two different materials.

UNIT II DESIGN OF DC MACHINES (12 Hrs)

Construction - Output Equation – Main Dimensions – Choice of specific loadings –Selection of number of poles – Dimensions of yoke, main pole and air gap - Estimation of ampere turns for the magnetic circuits - Design of lap winding and wave winding – Design of Armature – Design of Commutator and brushes – Design of shunt and series field system - reduction of eddy current in conductors in rotating machine.

UNIT III DESIGN OF TRANSFORMERS (12 Hrs)

Construction – Output Equation (1-ϕ and 3-ϕ) – Expression for volts/ turn, estimation of no. of turns – choice of specific loadings – Overall dimensions -design of yoke, core and winding for core and shell type transformers – Estimation of No load current and Voltage regulation– Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers – Expression for the leakage reactance of core type transformer with concentric coils.

UNIT IV DESIGN OF THREE PHASE INDUCTION MOTORS (12 Hrs)

Construction - Output equation– Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor - Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and end Ring. Magnetic leakage calculations – Operating characteristics: Magnetizing current - Short circuit current.

UNIT V DESIGN OF SYNCHRONOUS MACHINES (12 Hrs)

Construction - Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of salient and non-salient pole rotors – Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators.
Computer Aided Design: Design of DC machines, Design of single phase Transformer

Text Books

1. A. K. Sawhney “A Course in Electrical Machine Design”, Dhanpat Rai & Sons, New Delhi, 6th Edition, 2016.
2. M. V. Deshpande, “Design and Testing of Electrical Machines”, PHI learning Pvt. Ltd, 3rd Edition, 2010.
3. S. K. Sen, “Principles of Electrical Machine Designs with Computer Programmes”, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2nd Edition, 2009.

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Reference Books

1. A. Shanmugasundaram, G. Gangadharan, R. Palani, "Electrical Machine Design Data Book", New Age International Pvt. Ltd., 1st Edition, 2011.
2. A.Nagoor kani, "A Simplified text in Electrical Machine Design", RBA publications, Second Edition, 2013.
3. Thomas A. Lipo, "Introduction to AC Machine Design", John wiley & sons inc., 1st Edition, 2017.
4. K. M. Vishnumurthy, "Computer aided design of electrical machines", B S Publications, 1st Edition, 2015.

Web References

1. http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/2.php.
2. https://nptel.ac.in/courses/108/106/108106023.
3. https://www.windings.com/technical-reference/basic-motor-design-tutorial.
4. https://ndl.iitkgp.ac.in/homestudy/engineering.
5. http://electrical-engineering-portal.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	2	2	1	1	-	-	-	-	1	3	2	2
2	3	2	2	3	2	1	1	-	-	-	-	1	3	2	3
3	3	3	2	3	2	1	1	-	-	-	-	1	3	3	3
4	3	3	3	3	2	1	1	-	-	-	-	1	3	2	3
5	3	3	3	2	2	1	1	-	-	-	-	1	2	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP612	EMBEDDED SYSTEM LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study and Identify hardware and software components to build an embedded system.
- To demonstrate the interfacing of peripherals with ARM7 Processor.
- To understand the key concepts of embedded systems such as I/O, timers, interrupts and interaction with peripheral devices.
- To gain knowledge and design of microcontroller based embedded system.
- To create a real-time system for particular applications.

Course Outcomes

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

CO1 - Explain the working of ARM Processor, FPGA and raspberry pi. **(K3)**

CO2 - Interface ARM7 Processor, FPGA and raspberry pi Microcontrollers with external Peripheral devices. **(K4)**

CO3 - Handle interrupts for real time control applications using ARM Processor. **(K4)**

CO4 - Generate PWM signals for motor control applications. **(K4)**

CO5 - Design and develop interface between controller and device. **(K4)**

LIST OF EXPERIMENTS

1. Study on ARM Cortex M series Controller starter kit

   Conduction of following experiments using ARM Cortex M series Controller

2. Interfacing ADC and DAC
3. Interfacing real time clock
4. Interfacing Keyboard and LCD
5. Interfacing of stepper motor
6. Interfacing of PWM based LED lighting board
7. Interfacing DC motor
8. Interfacing temperature sensor
9. Interfacing with PC via UART interface
10. Interfacing EEPROM via I2C
11. Study on FPGA developer board for PWM generation
12. Study on Raspberry pi for IoT application
13. Study on Real Time Operating Systems

Reference Books

1. Agus Kurniawan, “Getting Started With STM32 Nucleo Development”, Agus Kurni, 1st Edition, 2016.
2. Sepehr Naimi, Sarmad Naimi, Muhammad Ali Mazidi, “The STM32F103 Arm Microcontroller and Embedded Systems-Using Assembly and C”, Microdigitaled, 1st Edition, 2020.
3. Brian Amos, “Hands-On RTOS with Microcontrollers: Building Real-time Embedded Systems Using FreeRTOS, STM32 MCUs, and SEGGER Debug Tools”, Thomas Learning, 1st Edition, 2020.
4. Geoffrey Brown, “Discovering the STM32 Microcontroller”, Indiana University, Free Edition, 2016.
5. Raj Kamal, “Embedded Systems-Architecture, Programming and Design”, Tata McGraw Hill, 3rd Edition, 2017.
6. Lyla B. Das, “Embedded Systems-an integrated approach”, Pearson Education, 1st Edition, 2013.
7. K.V. Shibu, “Introduction to Embedded Systems”, Tata McGraw Hill, 2nd Edition, 2016.
8. Michael J. Pont, “Embedded C”, Addison Wesley, 1st Edition, 2002.
9. David E. Simon, “An Embedded Software Primer”, Pearson Education, 1st Edition, 2012.

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Web References

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://nptel.ac.in/courses/106/105/106105193/
3. https://nptel.ac.in/courses/108/105/108105057/
4. https://nptel.ac.in/courses/117/106/117106112/
5. https://nptel.ac.in/courses/106/103/106103182/
6. https://developer.arm.com/architectures/learn-the-architecture/introducing-the-arm-architecture/single-page
7. https://www.eeweb.com/app-notes/tags/arm
8. https://www.tutorialspoint.com/embedded_systems/es_overview.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	2	-	-	2	2	-	2	3	2	3
2	3	3	2	2	3	2	-	-	2	2	-	2	3	2	3
3	3	3	2	2	3	2	-	-	2	2	-	2	3	2	3
4	3	3	2	2	3	2	-	-	2	2	-	2	3	2	3
5	3	3	2	2	3	2	-	-	2	2	-	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP613 **RENEWABLE ENERGY LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To provide awareness on Renewable Energy Sources and recent technologies.
- To provide adequate knowledge on the issues in harnessing Renewable Energy.
- To provide knowledge about various power converters used for Renewable energy sources.
- To provide exposure and hands-on-practice on various aspects of renewable energy Technologies.
- To study about the types of intelligent controllers.

Course Outcomes

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

CO1 - Familiarize with the parameters that affect the performance of renewable energy systems. **(K2)**
CO2 - Analyze the variety of issues in harnessing Renewable Energy. **(K2)**
CO3 - Simulate and predict the performance of various energy utilities. (**K3)**
CO4 - Model and simulate the various generators used in renewable energy conversion. **(K3)**
CO5 - Design the Intelligent Controllers for the various renewable energy conversion systems. **(K3)**

List of Experiments

1. Simulation and analysis of Solar PV Energy System
   (i) Modeling of batteries
   (ii) Modeling of PV panel
2. Simulation and analysis of PV system with different MPPT algorithms
3. Modeling and analysis of DC-DC converters for voltage regulation / current regulation
4. Modeling and analysis of DFIG
5. Modeling and analysis of PMSG
6. Experiment on V-I characteristics and efficiency of Solar PV system.
7. Experiment on Shadowing effect and diode based solution in Solar PV System..
8. Simulation and analysis of induction generation based wind energy conversion system.
9. Experiment on Performance assessment of micro Wind Energy Generator.
10. Simulation and analysis of Hybrid (Solar-Wind) Power System.
11. Simulation study on Hydel Power.
12. Experiment on Performance Assessment of Fuel Cell.
13. Simulation study on Intelligent Controllers for Hybrid Systems.

Reference Books

1. Chuck Ammond, Albert F. Cutter, "The Complete Lab Manual for Renewable Energy", Cengage Learning, 1st Edition, 2015.
2. Lindsay Porter, "The Renewable Energy Home Manual", Veloce Publishing Ltd, 1st Edition, 2015.
3. Ali Keyhani, "Design of Smart Power Grid Renewable Energy Systems: Solutions Manual", Willey-Blackwell, 1st Edition, 2012.
4. Franzis Verlag GmBH, "50 Experiments with Renewable Energy Kit & Manual", Franziz, 1st Edition, 2014.
5. I. Dincer, C. Zamfirescu, "Sustainable Energy Systems and Applications", Springer, 1st Edition, 2012.
6. D. P. Kothari, D. K. Sharma, "Energy Engineering: Theory and Practice", S. Chand Publisher, 1st Edition, 2000.
7. William. J. Palm III, "Introduction to MATLAB for Engineers", McGraw-Hill Education, 3rd Edition, 2010

Web References

1. http://www.ee.iitkgp.ac.in/faci_es.php
2. http://www.ee.iitkgp.ac.in/TeachingLabs/EnergySys/es1.pdf
3. http://www.ee.iitkgp.ac.in/TeachingLabs/EnergySys/es6.pdf
4. http://www.ee.iitkgp.ac.in/TeachingLabs/EnergySys/solar_sim.pdf
5. http://www.ee.iitkgp.ac.in/TeachingLabs/EnergySys/es8.pdf
6. http://www.ee.iitkgp.ac.in/TeachingLabs/EnergySys/solar_pv_plant.pdf
7. http://downloads.hindawi.com/journals/ijp/2014/895271.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	2	2	3	2	3	1	3	2	1	2	3	3	2
2	1	3	2	2	3	2	3	1	3	2	1	2	3	3	2
3	1	3	2	2	3	2	3	1	3	2	1	2	3	3	2
4	1	3	2	2	3	2	3	1	3	2	1	2	3	3	2
5	1	3	2	2	3	2	3	1	3	2	1	2	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP614	POWER SYSTEM ANALYSIS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To analyze the electrical power system using per unit analysis.
- To apply iterative techniques for power flow analysis of power system.
- To carry out short circuit studies and Economic load dispatch on power system.
- To analyze Load curve and Load duration curve.
- To model and analyze the voltage and frequency control loops in power system.

Course Outcomes

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

CO1 - Calculate the reactance values of power system components
CO2 - Formulate Bus Admittance and Impedance matrices, used in power flow analysis.
CO3 - Analyze the voltage and power flow condition of power system using Gauss Seidal and Newton Raphson methods.
CO4 - Analyze Symmetrical and Unsymmetrical faults in power system used to design relays and circuit breakers.
CO5 - Develop the load and load duration curves for calculating average load, unit generated load factor, etc.

List of Experiments

1. Computation of power system components in per units.
2. Modeling and Computation of Transmission Line Parameters
3. Formulation of a bus impedance matrix and admittance Matrix
4. Symmetrical components for different case studies
5. Short circuit studies of Power System.
6. Analysis of power-flow problem using Gauss-Seidel method.
7. Analysis of power-flow problem using Newton Raphson method.
8. Analysis of power-flow problem using Fast Decoupled Load Flow method.
9. Analysis of Economic load dispatch in power system.
10. Load curve and load duration curve
11. Numerical Integration of Swing equation
12. Modeling and Analysis of Automatic Voltage Regulator system
13. Stability analysis of SMIB System

Reference Books

1. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st Reprint, 2010.
2. M. A. Pai, “Computer Techniques in Power System Analysis”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2012.
3. P. Kundur, “Power System Stability and Control”, Tata McGraw Hill Education Pvt.Ltd., New Delhi, 10th Reprint, 2010

Web References

1. https://nptel.ac.in/courses/108/105/108105067/
2. https://nptel.ac.in/courses/108/107/108107127/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	3	2	2	1	1	-	-	3	2	1	2	3	2	2
2	1	3	2	2	1	1	-	-	3	2	1	2	3	2	2
3	1	3	2	2	1	1	-	-	3	2	1	2	3	2	2
4	1	3	2	2	1	1	-	-	3	2	1	2	3	2	2
5	1	3	2	2	1	1	-	-	3	2	1	2	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEC6XX	CERTIFICATION COURSE – VI	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20EES606	SKILL DEVELOPMENT COURSE 6 (Foreign Language / IELTS – II)	L	T	P	C	Hrs
		0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

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U20EES607

SKILL DEVELOPMENT COURSE 7

(Technical Seminar)

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over -head projectors, power point presentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.
CO2 - Face the placement interviews.

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluated based on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

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		L	T	P	C	Hrs
U20EES608	**SKILL DEVELOPMENT COURSE 8** (NPTEL / MOOC - I)	**0**	**0**	**0**	**-**	**30**

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

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U20EEM606	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To make the students to understand the various Religion and Philosophy
- To familiarize with the Fine Arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

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

CO1 - Familiarize with the philosophy of Indian culture. **(K1)**
CO2 - Distinguish the Indian languages and literature. **(K2)**
CO3 - Learn the philosophy of ancient, medieval and modern India. **(K1)**
CO4 - Acquire the information about the fine arts in India. **(K1)**
CO5 - Know the contribution of scientists of different eras. **(K1)**

UNIT I INTRODUCTION TO CULTURE (6 Hrs)

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT II INDIAN LANGUAGES, CULTURE AND LITERATURE (6 Hrs)

Indian Languages and Literature - I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT III RELIGION AND PHILOSOPHY (6 Hrs)

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY AND ENGINEERING) (6 Hrs)

Indian Painting, Indian handicrafts, Music, divisions of Indian classical music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA (6 Hrs)

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Reference Books

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

Web References

1. https://nptel.ac.in/courses/109/104/109104102/
2. https://nptel.ac.in/courses/101/104/101104065/
3. https://nptel.ac.in/courses/109/108/109108158/
4. https://nptel.ac.in/courses/109/106/109106059/
5. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ae01/

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U20EET720	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To apprehend the basic architecture of Industrial automation system.
- To study about the components used in PLC.
- To practice the ladder logic programming of PLC.
- To learn about the building blocks of SCADA.
- To brief about the communication protocols.

Course Outcomes

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

CO1 - Analyze the type of Automation system and its architecture in detail.**(K3)**
CO2 - Discuss the history of PLC, main parts and its functions**. (K3)**
CO3 - Illustrate the operation of Relays, contactors, Motor Starters, Switched, Sensors, Output Control Devices, etc., **(K3)**
CO4 - Acquire knowledge about the operation of SCADA and its sub-systems. **(K3)**
CO5 - Demonstrate the fundamentals of Human-Machine Interface. **(K3)**

UNIT I INTRODUCTION TO AUTOMATION (9 Hrs)

Automation overview – requirement of automation systems – architecture of industrial automation system – Levels of Automation-basic elements of an automated system – industrial bus systems: modbus and profibus.

UNIT II PROGRAMMABLE LOGIC CONTROLLERS (9 Hrs)

Introduction to PLC, Principles of Operation - Size and Application. Hardware Components: I/O Section, Discrete /Analog I/O Modules, Special I/O Modules, CPU, Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data - Processor Memory Organization, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions.

UNIT III LADDER LOGIC PROGRAMMING (9 Hrs)

PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manual/Mechanical Operated Switches, Sensors, Output Control Devices, Seal-in Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Programming Timers: Mechanical Timing Relays, Timer Instructions, On-Delay /Off-Delay Timer Instruction, Retentive Timer, Cascading Timers.

UNIT IV SCADA FUNDAMENTALS (9 Hrs)

Introduction, Open system: Need and advantages, Building blocks of SCADA systems, RTU-Evolution, Components, Communication, Logic, Termination and Testing and HMI subsystem - Power supplies, Advanced RTU functionalities, IEDs, Data concentrators and merging units.
Master Station: Software /Hardware components, Server systems in the master station, Small, medium, and large master stations, GPS.

UNIT V HUMAN-MACHINE AND M2M INTERFACE (9 Hrs)

HMI components, software functionalities, Situational awareness, Intelligent alarm filtering - Techniques, Operator needs and requirements- Machine – Machine communication-Introduction-Features-Architecture-Applications – Introduction to IoT.

Text Books

1. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, 4th Edition , 2011
2. Mini S. Thomas, “Power System SCADA and Smart Grids”, CRC Press;3rd edition April 2015.
3. S. Mukhopadhyay, S. Sen and A. K. Deb, “Industrial Instrumentation, Control and Automation”, Jaico Publishing House, 1st Edition, 2013.

Reference Books

1. Gary Dunning, “Introduction to Programmable Logic Controllers”, Cengage Learning, 3rd India Edition, 2007.
2. Frank lamb, “Industrial Automation: Hands On”, McGraw-Hill Education, 1st Edition, 2013.
3. T. Huges, “Programmable Logic Controllers”, ISA press, 1994.
4. William T. Shaw, “Cybersecurity for SCADA systems”, Penn Well Books, 2006.

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Web References

1. https://electrical-engineering-portal.com/download-center/books-and-guides/automation-control/plc-ladder-sequential-programming
2. https://www.beckhoff.com/english.asp?start/?pk_campaign=AdWords-AdWordsSearch-IndustrialAutomationEN&pk_kwd=industrial%20automation
3. https://www.advantech.com/solutions/ifactory
4. https://www.plantautomation-technology.com/articles/an-overview-of-distributed-control-systems-dcs
5. https://www.controleng.com/articles/scada-remains-relevant-for-industrial-automation/
6. https://sw.aveva.com/monitor-and-control/scada

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
2	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EECM02	ELECTRIC VEHICLE TECHNOLOGY (Common to EEE, ECE, MECH and MCTR)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize with the fundamental concept of electric vehicle
- To determine various electric drives suitable for electric vehicles.
- To understand the various sensor and sensorless control in electric vehicle
- To understand the concept of hybrid vehicle design and sizing of components.
- To overview the energy storage technologies used for electric and hybrid vehicle.

Course Outcomes

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

CO1 - Summarize the basics of electric vehicle and its working principle. **(K2)**
CO2 - Review the working of different configurations of electric drives and its concepts **(K2)**
CO3 - Analyze the different sensor and sensorless control in electric vehicle **(K4)**
CO4 - Describe the working of different configurations of hybrid vehicles. **(K2)**
CO5 - Combine the different energy storage technologies and its implementation in hybrid vehicle. **(K2)**

UNIT I INTRODUCTION TO ELECTRIC VEHICLE (9 Hrs)

History of electric vehicles - social and environmental importance - impact of modern drive - trains on energy supplies - Fundamentals of vehicle propulsion and Braking: Dynamic Equation - Power train tractive effort - Vehicle Power Plant and Transmission Characteristics - Vehicle Performance.

UNIT II ELECTRIC VEHICLE DRIVE SYSTEMS (9 Hrs)

Electric drives and its Configurations in EV: Induction motor drives - DC motor drives - Permanent magnet motor drives - SRM Drives - EV transmission configuration: Transmission components - gear ratio - EV motor sizing - EV market

UNIT III SENSOR AND SENSORLESS CONTROL IN ELECTRIC VEHICLE (9 Hrs)

Sensors - Autonomous EV cars, Self drive Cars, Hacking; Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.

UNIT IV HYBRID VEHICLE (9 Hrs)

Classification - Series and Parallel HEVs - Series-Parallel Combination - Advantages and disadvantages Internal Combustion Engines: Reciprocating Engines - Gas Turbine Engine- Design of an HEV: Hybrid Drive train - Sizing of Components - power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT V ELECTRIC VEHICLE STORAGE TECHNOLOGY (9 Hrs)

Battery Types - Parameters - Technical characteristics – modelling and equivalent circuit - Methods of battery charging - Fuel cells: Types - Fuel cell electric vehicle – Ultra capacitors - Hydrogen storage systems – Flywheel technology.

Text Books

1. Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 3rd Edition, 2019.
2. Iqbal Hussain, "Electric and Hybrid Vehicles – Design Fundamentals", CRC Press, 2nd Edition, 2011.

Reference Books

1. K. T. Chau, "Electric vehicle machines and drives: Design, analysis and application", John Willey and Sons Singapore pte. ltd., 1st Edition, 2015.
2. J. Larminie and J. Lowry, "Electric vehicle technology explained", John Willey & Son ltd., 2nd Edition, 2012.

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Web References

1. https://nptel.ac.in/courses/108103009/
2. https://www.evgo.com/why-evs/types-of-electric-vehicles/
3. https://www.electrichybridvehicletechnology.com/
4. http://www.ieahev.org/
5. https://www.sae.org/learn/content/acad06/
6. https://www.intechopen.com/books/electric-vehicles-modelling-and-simulations

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	3	-	-	-	-	1	2	3	2
2	2	3	3	3	-	-	3	-	-	-	-	1	2	3	2
3	3	3	2	2	-	-	3	-	-	-	-	1	2	3	2
4	3	3	3	2	-	-	3	-	-	-	-	1	2	3	2
5	2	3	3	2	-	-	3	-	-	-	-	1	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSP703	BUSINESS BASICS FOR ENTREPRENEUR	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To develop a clear understanding on Business Plans and their significance.
- To be familiar with various forms of business appropriate for an individual entrepreneur
- To understand various ways of judging a successful opportunity for an entrepreneur
- To know the ways to formulate a successful Operation Plan
- To be aware of things to know to prepare effective financial and marketing plans

Course Outcomes

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

CO1 - Impact comprehensive knowledge of an entrepreneurial ecosystem**. (K6)**

CO2 - Understand the need and significance of Business Plan in the success of an Enterprise. **(K2)**

CO3 - Understand the ways to judge the economic and business viability of proposed venture. **(K2)**

CO4 - Utilize the elements of success of entrepreneurial ventures. **(K3)**

CO5 - Evaluate the effectiveness of different entrepreneurial strategies. **(K5)**

UNIT I THE ENTREPRENEURIAL PERSPECTIVE (10 Hrs)

Entrepreneurship and Family Business Management, Entrepreneurship theory and practice, The Nature and Importance of Entrepreneurs, The Entrepreneurial and Intrapreneurial Mind, The Individual Entrepreneur, International Entrepreneurship Opportunities

UNIT II CREATING AND STARTING THE VENTURE (10 Hrs)

Creativity and the Business Idea, Legal Issues for the Entrepreneur, the Business Plan, the Marketing Plan, the Financial Plan, the Organizational Plan

UNIT III FINANCING THE VENTURE (10 Hrs)

Raising Finance, scaling up the venture, NDA'S and term sheet, Sources of the Capital, Informal Risk Capital and Venture Capital

Report Submission:

- Grooming Entrepreneurial Mind-set
- Interaction with Business Leaders/Bankers/Venture Capitalists
- Finding and evaluating an idea
- Develop a business plan
- Financing for a company start-up
- Setting up a company-legal entity
- Entrepreneurial development and employment creation
- Effects of creativity and innovation on the entrepreneurial performance of family business

Text Books

1. G. Friend & S. Zehle, "Guide to business planning", Profile Books Limited, 2004.
2. Lasher, W. (2010). The Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business. Broadway Books.
3. Arjun Kakkar. (2009). Small Business Management: Concepts and Techniques for improving Decisions. Global India Publications.

Reference Books

1. Alexander Osterwalder and Yves Pigneur – Business Model Generation.
2. Arthur R. DeThomas – Writing a Convincing Business Plan.
3. Ben Horowitz – The Hard Thing About Hard Things.
4. Guy Kawasaki – The Art of Start 2.0
5. Hal Shelton – The Secrets to Writing a Successful Business Plan.

Web References

1. https://www.waveapps.com/blog/entrepreneurship/importance-of-a-business-plan
2. https://www.entrepreneur.com/article/200516
3. https://smallbusinessbc.ca/article/how-to-use-viability-to-test-if-you-should-invest-in-your-business/
4. https://www.infoentrepreneurs.org/en/guides/strategic-planning/
5. http://www.marketingmo.com/strategic-planning/marketing-plans-budgets/
6. https://www.mbda.gov/page/loan-documentation

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	1	2	2	2	2	2	3	3	3	2	1	2	2	2	1
3	1	2	2	1	2	2	3	3	3	3	2	3	1	2	3
4	1	3	2	2	2	2	3	3	3	3	2	3	1	2	2
5	1	3	2	2	2	2	3	3	3	2	2	3	1	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEP715	INDUSTRIAL AUTOMATION AND CONTROL LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To gain practical knowledge regarding the automation components.
- To perform delay operations using the PLC.
- To gain practical knowledge on interfacing of different sensors, counter, timer, RTD using PLC.
- To equip the students to provide the solution for real time industrial applications.
- To equip the students to develop a fault monitoring system using SCADA.

Course Outcomes

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

CO1 - Analyze the ladder logic programs and components used for process control.**(K2)**
CO2 - Design PLC-relay logic for the real time applications **(K3)**
CO3 - Implement Industrial processing system. **(K3)**
CO4 - Design a SCADA monitoring system for real time applications.**(K3)**
CO5 - Diagnose the fault in Power generation and distribution networks, etc. **(K3)**

List of Experiments

Programmable Logic Controller

1. Implementation of Latching and Unlatching concepts in PLC
2. Interfacing of lamp and button with PLC for ON/OFF operation.
3. Perform Delayed Operation of Lamp using Push Button.
4. Combination of Counter and Timer for Lamp ON/OFF operation.
5. PLC program for Sequential Motor Control.
6. PLC based automated car parking system or elevator system.
7. DOL and Star Delta Starter operation for Three Phase Induction Motor using PLC.
8. PLC program for Forward and Reverse Control of Motors
9. PLC based Stair case lighting control system
10. PLC based Traffic Light Control system
11. Design and development of solar tracking control system using PLC
12. PLC program for speed control of DC motor.

SCADA

1. PLC interface with SCADA and status read / Command Transfer operation
2. Alarm annunciation using SCADA
3. Experiments on Transmission Module
    a. Local Mode
    b. Simulation of Faults

Internet of Things IoT:

1. IoT – based Street light monitoring and control
2. IoT-based Industrial pollution monitoring system.

Reference Books

1. S. Mukhopadhyay, S. Sen and A. K. Deb, “Industrial Instrumentation, Control and Automation”, Jaico Publishing House, 1st Edition, 2013.
2. Gary Dunning, “Introduction to Programmable Logic Controllers”, Cengage Learning, 3rd India Edition, 2007.
3. Frank lamb, “Industrial Automation: Hands On”, McGraw-Hill Education, 1st Edition, 2013.
4. T. Huges, “Programmable Logic Controllers”, ISA press, 1994.
5. R. Krishnan, “Electric Motor Drives, Modelling, Analysis and Control”, Pearson Education India, 1st Edition, 2015.
6. Viswanandham, “Performance Modeling of Automated Manufacturing Systems”, PHI, 1st Edition, 2009.
7. Jose A. Romagnoli, Ahmet Palazoglu, “Introduction to Process control”, CRC Taylor and Francis group, 3rd Edition, 2020.

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Web References

1. https://electrical-engineering-portal.com/download-center/books-and-guides/automation-control/plc-ladder-sequential-programming
2. https://www.beckhoff.com/english.asp?start/?pk_campaign=AdWords-AdWordsSearch-IndustrialAutomationEN&pk_kwd=industrial%20automation
3. https://www.advantech.com/solutions/ifactory
4. https://www.plantautomation-technology.com/articles/an-overview-of-distributed-control-systems-dcs
5. https://www.controleng.com/articles/scada-remains-relevant-for-industrial-automation/
6. https://sw.aveva.com/monitor-and-control/scada

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	3	2	-	1	3	3	3
2	3	3	3	2	3	-	-	-	3	2	-	1	3	3	3
3	3	3	3	2	3	-	-	-	3	2	-	1	3	3	3
4	3	3	3	2	3	-	-	-	3	2	-	1	3	3	3
5	3	3	3	2	3	-	-	-	3	2	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP716 **ELECTRIC AND HYBRID VEHICLE LAB**

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

- To determine and explain a comprehension detail of hybrid and electrical vehicle
- To equip the students to test and evaluate the performance of hybrid and electrical vehicle.
- To equip with the implementation of plug-in hybrid technology concept for two-wheeler.
- To familiarize with the software skill required for modeling of Hybrid electrical vehicle.
- To demonstrate the different configurations of electric vehicles, components and energy storage systems.

Course Outcomes

After completion of the course, the students will be able to
CO1 - Estimate electrical motor power requirement for hybrid electrical vehicle. **(K4)**
CO2 - Design and analyze the performance electric and hybrid vehicle.**(K4)**
CO3 - Analyze the performance of Battery in charging and discharging intervals. **(K4)**
CO4 - Troubleshoot and test the control circuits, sensors, actuators used in an E-Vehicle**(K4)**
CO5 - Evaluate the electric vehicle performance by mathematical modeling using software. **(K4)**

List of Experiments

1. Study of various components of electric vehicle.
2. Demonstration of wiring layout of electric vehicle.
3. Mathematical modelling of Electric Vehicle.
4. Mathematical modelling of hybrid Electric Vehicle: Calculation of steady state force, Dynamic force, Power train tractive effort, Vehicle acceleration, IC engine power requirement, Sizing of motor for electric vehicles.
5. Speed control of BLDC motor in two wheeler.
6. Speed control of SRM motor in two wheeler.
7. Testing of Sensor and Actuators used in an Electric Vehicle.
8. Design a Control Circuit and power module for BLDC.
9. Design a charging circuit for battery.
10. Mathematical modeling of Lithium ion (Battery charging and discharging calculation) using software.

Reference Books

1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles”, CRC Press, 3rd Edition, 2019.
2. Iqbal Hussain, “Electric and Hybrid Vehicles – Design Fundamentals”, CRC Press, 2nd Edition, 2011.
3. Wei Liu, “Hybrid Electric Vehicle System Modeling and Control”, John Wiley and Sons, 2nd Edition, 2017.
4. James Larminie, “Electric Vehicle Technology Explained”, John Wiley and Sons, 1st Edition, 2003.
5. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 1st Edition, 2000.

Web References

1. https://nptel.ac.in/courses/108103009/
2. https://www.evgo.com/why-evs/types-of-electric-vehicles/
3. https://www.electrichybridvehicletechnology.com/
4. https://www.ieahev.org/
5. https://www.sae.org/learn/content/acad06/
6. https://www.intechopen.com/books/electric-vehicles-modelling-and-simulations

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
2	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
3	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
4	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
5	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP717	ELECTRICAL SOFTWARE SIMULATION LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To approach and analyze the Engineering problems using different Simulation software.
- To practice the commands and tools of 2D, 3D drawing, design and drafting of circuit components**.**
- To design and analyze the leakage reactance and flux linkage in a single phase transformer in simulation.
- To practice and explore in electrical simulation software.
- To provide a foundation of Simulation Softwares for project works.

Course Outcomes

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

CO1 - Draft the interior and exterior machine models / components in 2D and 3D using simulation software.**(K3)**
CO2 - Design, analyze and optimize the electromagnetic parameters of all the Electrical machines using software. **(K4)**
CO3 - Model and integrate the micro grid system.**(K4)**
CO4 - Determine the transmission line parameters by simulation software.**(K4)**
CO5 - Simulate and analyze the electrical, electronic circuits using appropriate simulation software. **(K3)**

List of Experiments

1. Design of 2D/3D modeling of Simple Sensors and Actuators.
2. Simulation to find leakage reactance of two single phase transformer and determine its leakage reactance ratio.
3. Simulation of flux linkage ratio in the single phase and three phase transformer.
4. Simulation of Three phase thyristor converter.
5. Design of DC Motor Speed controller.
6. Harmonic analysis of non-sinusoidal waveforms.
7. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum
8. Modeling of Micro grid System.
9. Simulation of distributed generation and distributed energy resources to integrate with the micro grid.
10. Simulation of Series and Parallel resonance circuit.
11. Simulation of Fly back DC – DC Converter.
12. Comparison of Frequency Response of a Buck-Boost Converter in CCM and DCM.
13. Switching Characteristics of MOSFET and Diode in a Power-Pole.
14. Simulation of Reactive Power and Power Factor Correction in AC Circuits.
15. Modeling and determination of Transmission Line parameters using simulation software.

Reference Books

1. George Omura, “Mastering AutoCAD 2019 and AutoCAD LT 2019”, SYBEX, 4th Edition, 2019.
2. C. L. Wadhwa, “Electrical Power Systems”, New Age International Pub. Co., 6th Edition, 2018.
3. Peter Campbell, “Permanent Magnet Materials and their Application”, Cambridge University Press, online Edition, 2012.
4. Sulaymon Eshkabilov, “Beginning MATLAB and Simulink: From Novice to Professional”, Apress, 2nd Edition, 2019.
5. R. Ramshaw and D. Sehauman, “PSpice Simulation of power electronics circuits”, ITP publications, 4th Edition, 2001.
6. Randy H. Shih, “AutoCAD 2019 Tutorial Second Level 3D modeling”, SDC publications, 3rd Edition, 2019.
7. Craig Muller, “PSCAD Power Systems Computer Aided Design”, User manual Manitoba HVDC Research centre, 2010.

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Web References

1. https://www.autodesk.in/solutions/cad-software
2. https://thesourcecad.com/how-to-make-2d-from-3d-drawing-in-autocad-using-flatshot/
3. https://www.mentor.com/products/mechanical/magnet/magnet/
4. https://in.mathworks.com/matlabcentral/fileexchange/?s_tid=gn_mlc_fx
5. https://www.mathworks.com/academia/books.html
6. https://www.homerenergy.com/products/pro/index.html
7. https://ece.uwaterloo.ca/~pwr_elec/
8. https://www.orcad.com/pspice-free-trial
9. https://elec-engg.com/pscad-software/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
2	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
3	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
4	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3
5	3	3	3	3	3	–	–	–	3	2	–	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEW701	PROJECT PHASE - I	L	T	P	C	Hrs
		0	0	4	2	60

Course Objectivise

- To develop the skills to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop students innovative ideas for the prototype design.
- To encourage the students to work as a team to solve the engineering problem
- To train the students for the preparation of project reports.
- To train the students to defend reviews and viva voce examination.

Course Outcomes

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

CO1 - Identify the problem statement for the proposed work through the literature survey. **(K3)**
CO2 - Choose the proper components as per the requirements of the design/system**. (K2)**
CO3 - Apply the acquainted skills to develop final model/system**. (K2)**
CO4 - Estimate, plan and execute the project as a team**. (K3)**
CO5 - Defend the finding and conclude with oral/written reports**. (K2)**

Course Description

A Project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The End Semester Examination for the project work shall consist of an evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted by a committee consisting of the external examiner and an internal examiner.

Each team is expected to present their work at National/International conferences. Team that has come out with novel contribution will be encouraged to publish their work in any referred journals.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	3	3	-	1	1	2	1
2	3	3	3	2	2	2	2	2	3	3	3	1	2	1	1
3	3	2	2	1	-	2	-	-	3	3	3	1	3	3	3
4	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3
5	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEW702	INTERNSHIP/ INPLANT TRAINING	L	T	P	C	Hrs
		-	-	-	2	-

Students may undergo training or internship during summer / winter vacation at Industry/ Research organization / University (after due approval from the Mentor, Class advisor and Departmental Consultative Committee (DCC)). In such cases, the internship/training should be undergone continuously (without break) in one organization. Normally no extension of time is allowed. However, DCC may provide relaxation based on the exceptional case. The students are allowed to undergo three to four weeks internship in established industry / Esteemed institution during vacation period. An Evaluation committee formed by the Head of the Department will review and recommend the grade 100% Continuous Assessment pattern as follows: Internship / Inplant training Report (50 %), Presentation (25 %) and oral Examination (25 %).

(DR.S. ANBUMALAR)

U20EEM707	PROFESSIONAL ETHICS	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human Values,
- To instill Moral, Social Values and Loyalty and to appreciate the rights of others.
- To develop a firm ethical base.
- To make the students to realize the significance of ethics in professional environment.
- To acquaint students with latest intellectual property rights

Course Outcomes

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

CO1 - Apply ethics in society. **(K3)**
CO2 - Discuss the ethical issues related to engineering. **(K2)**
CO3 - Act as a responsible Experimenter and to follow the codes of Ethics. **(K3)**
CO4 - Realize the responsibilities and rights in the society. **(K2)**
CO5 - Familiarize with the Multinational Corporations and its Social Responsibility. **(K3)**

UNIT I HUMAN VALUES (6 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self- confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS (6 Hrs)

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (6 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS SAFETY (6 Hrs)

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES (6 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

Reference 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, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility", Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
8. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.

(DR.S. ANBUMALAR)

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

(DR.S. ANBUMALAR)

U20EET822	PROTECTION AND SWITCHGEAR	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the different protection zones and protection schemes in power system.
- To impart knowledge on various types of relays including Distance and differential protection schemes.
- To impart knowledge on protection schemes for generator, transformer, motor, feeder and transmission lines
- To acquire knowledge on various circuit breakers (AC and DC) used in power systems.
- To acquaint the various types of surge protection and earthing.

Course Outcomes

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

CO1 - Identify the equipment's for protection scheme on Power Systems.**(K2)**
CO2 - Analyze the different applications of the relays in power system.**(K2)**
CO3 - Interpret the protection of transformer, Bus bar and transmission line.**(K3)**
CO4 - Comprehend the various circuit breakers (AC and DC) used in power system.**(K2)**
CO5 - Analyze the protection against over voltages and working of lightning arrester.**(K2)**

UNIT I PROTECTION SCHEMES (9 Hrs)

Principles and need for protective schemes – Nature and causes of faults – Types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – CTs and PTs and their applications.

UNIT II RELAYS (9 Hrs)

Operating Principles of the Relay - Classification of Relays - Universal relay – Torque equation – R-X diagram. Electromagnetic Relays – Over current, IDMT, Directional, Distance, Differential, Negative sequence and under frequency relays, Introduction to static relays, Phase, Amplitude, Comparators – Synthesis of various relays using Static comparators. Microprocessor relay - Applications

UNIT III APPARATUS AND LINE PROTECTION (9 Hrs)

Generator Capability Curve – Short circuit Calculations – Ground fault and unbalanced current Protection – Over excitation and Abnormal Frequency Protection - Field winding Protection – Loss of Synchronism – Motor Protection, Transformer Protection – Differential, Inrush and Over Current - Bus zone Protection - Protection of Transmission Lines – Concept of Wide Area Monitoring and Protection.

UNIT IV CIRCUIT BREAKERS (9 Hrs)

Functions of switchgear - Principles of arc extinction - Arc control devices - Fuses: types – selection - discrimination – Resistance switching - Recovery voltage and restriking voltage - current chopping and capacitance current breaking – Oil circuit breakers, air break, air blast, and sulphur Hexafluoride and vacuum circuit breakers – HVDC breakers – Rating of Circuit Breaker.

UNIT V SURGE PROTECTION AND EARTHING (9 Hrs)

Causes of overvoltage - Lightning phenomenon – Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers – Current limiting reactor - Insulation coordination. Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers - Earth wires - Introduction to Indian Electricity rules.

Text Books

1. Sunil S. Rao, "Switch Gear Protections", Khanna Publications, Delhi, 14th Edition, 2019.
2. Bhuvanesh A. Oza, N. C. Nair, R. P. Mehta, V.H. Makwana, "Power System Protection and Switchgear", Tata McGraw - Hill, New Delhi, 1st Edition, 2017.
3. A. Wright, C. Christopoulos, "Electrical Power System Protection", Springer, 2nd Edition, 2013.

Reference Books

1. T. S. Madhav Rao, "Power system protection static relays with microprocessor Applications", Tata McGraw hill Publication, 15th Edition, 2015.
2. Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc Graw Hill, 2nd Edition, 2013.
3. P. M. Anderson, "Power System Protection", Wiley-IEEE publication, 1999.
4. E.T.A. Teta, "Power System Protection, 4 Volumes Set", SBA/IET, 2010.
5. V. K. Mehta, Rohit Mehta, "Principles of Power System" by S. Chand, 4th Revised Edition, 2008.

(DR.S. ANBUMALAR)

Web References

1. https://swayam.gov.in/nd1_noc20_ee80/preview.
2. https://nptel.ac.in/courses/108/107/108107167/
3. https://www.youtube.com/watch?v=_0T2Osgxdxs
4. https://ieeexplore.ieee.org/document/4111891.
5. https://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber
6. https://www.ieee-pes.org/ieee-transactions-on-power-delivery.
7. https://digital-library.theiet.org/content/journals/iet-epa

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	3	3	-	-	-	-	-	-	-	1	3	1	2
2	3	3	3	3	-	-	-	-	-	-	-	1	2	2	2
3	3	3	3	3	-	-	-	-	-	-	-	1	2	2	3
4	3	3	3	3	-	-	-	-	-	-	-	1	3	1	2
5	3	3	3	3	-	-	-	-	-	-	-	1	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20HSP804	ENTREPRENEURSHIP MANAGEMENT	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To develop an ability to identify the critical challenges hindering growth of entrepreneurs
- To understand the significance of Finance Skills, Branding, and Sales Skills for an Entrepreneur
- To be aware of various Government Schemes and Subsidies available for Entrepreneurs

Course Outcomes

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

CO1 - Develop and demonstrate the business models. **(K2)**
CO2 - Practice cash management, brand building and enhancing turnover. **(K6)**
CO3 - Understand various schemes and subsidies that are offered by various Government agencies. **(K2)**
CO4 - Effectively tackle growth challenges of their venture. **(K5)**
CO5 - Manage and grow their business in terms of expansion and look for partnerships. **(K3)**

UNIT I ENTRPRENEURIAL SKILLS 1 (10 Hrs)

Introduction to Business Model Generation, Developing Lean Business Model for the Business Idea, Developing Prototype and Evaluating assumptions in Business Model using prototype cheaply, Presentation of Business Model, Business Fair

UNIT II ENTREPRENEURIAL SKILLS 2 (10 Hrs)

Financial Skills – Cash Management – Problems of Poor Cash Management – Learning to be Frugal. Branding – Building a 'niche' follower for your product/service – Developing and Establishing a Brand, Sales skills – KPI of Success of Entrepreneurship – Ensuring Growth in Turnover

UNIT III ENTREPRENEURIAL OPPORTUNITIES (10 Hrs)

Awareness of Government Schemes and Subsidies for various Entrepreneurial Categories – Special Schemes for Women Entrepreneurs – Understanding the Procedure and Documentation Process for availing the Government Schemes – Venture Capital – Crowd funding – Angel Investors.

Report Submission:

- How can I get first 100 customers to pay for my products/services?
- Information technology as a resource
- Marketing skill and promotion for entrepreneurs
- Assessment of factors affecting performance of women entrepreneurs
- Entrepreneurship as a tool for sustainable employment
- Examination of problem facing small scale business
- Survival strategies in small business
- The role of insurance in minimizing business risk

Text Books

1. Storey, D. J., & Greene, F. J. (2010). Small business and entrepreneurship. Financial Times/Prentice Hall.
2. N. M. Scarborough, (2011). Essentials of entrepreneurship and small business management. Prentice Hall
3. Gupta C.B., & Srinivasan N.P. (2020). Entrepreneurial Development. Sultan Chand and Sons

Reference Books

1. Brian Tracy – The Psychology of Selling.
2. Dale Carnegie – How to Win Friends & Influence People.
3. Robert Kiyosaki and Sharon Lechter – Rich Dad, Poor Dad.
4. Reid Hoffman – The Startup of You: Adapt to the Future, Invest in Yourself, and Transform Your Career.
5. Michael E. Gerber – The E-Myth Revisited.
6. Chris Guillebeau – The Art of Non-Conformity.
7. Eric Ries – The Lean Startup.
8. Kevin D. Johnson – The Entrepreneur Mind.

(DR.S. ANBUMALAR)

Web References

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://bscdesigner.com/8-entrepreneurial-kpis.htm
3. https://www.inc.com/ilya-pozin/5-problems-most-entrepreneurs-face.html
4. https://www.inc.com/jessica-stillman/how-to-network-with-super-successful-people.html
5. https://www.entrepreneur.com/article/251603
6. https://seraf-investor.com/compass/article/understanding-crowdfunding

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	2	-	-	-	-	3	3	-	1	1	2	1
2	3	3	3	2	2	2	2	2	3	3	3	1	2	1	1
3	3	2	2	1	-	2	-	-	3	3	3	1	3	3	3
4	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3
5	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEP818	COMPREHENSIVE VIVA	L	T	P	C	Hrs
		0	0	2	1	30

Students will prepare for objective type questions in all core courses during the semester. The viva/exercise shall normally cover the core courses taught in all the semesters of B. Tech Programme. The internal marks for the students are awarded based on the average of all the components conducted for the entire semester. The students are required to take-up an end semester examination and to obtain a minimum mark for grading the required credit. This end semester examination will be conducted to evaluate the critical thinking of the students and at the standard of national level competitive examinations.

(DR.S. ANBUMALAR)

U20EEW803	PROJECT PHASE - II	L	T	P	C	Hrs
		0	0	16	8	240

Course Objectivise

- To develop the skills to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop students innovative ideas for the prototype design.
- To encourage the students to work as a team to solve the engineering problem
- To train the students for the preparation of project reports.
- To train the students to defend reviews and viva voce examination.

Course Outcomes

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

CO1 - Identify the problem statement for the project work through the literature survey. **(K3)**
CO2 - Choose the proper components as per the requirements of the design/system.**(K2)**
CO3 - Apply the acquainted skills to develop final model/system.**(K2)**
CO4 - Estimate, plan and execute the project as a team.**(K3)**
CO5 - Defend the finding and conclude with oral/written reports.**(K2)**

Course Description

A Project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. The End Semester Examination for the project work shall consist of an evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted by a committee consisting of the external examiner and an internal examiner.

Each team is expected to present their work at National/International conferences. Team that has come out with novel contribution will be encouraged to publish their work in any referred journals.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	-	-	-	3	3	-	1	1	2	1
2	3	3	3	2	2	2	2	2	3	3	3	1	2	1	1
3	3	2	2	1	-	2	-	-	3	3	3	1	3	3	3
4	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3
5	2	3	3	1	-	-	2	2	3	3	1	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EES809	SKILL DEVELOPMENT COURSE 9: (NPTEL / MOOC - II)	L	T	P	C	Hrs
		0	0	0	-	-

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

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ELECTIVE PAPERS

U20EEE401	ELECTRICAL SAFETY ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize the Indian Electricity Rules and Act related with electrical safety.
- To provide a knowledge about electrical shocks and safety precautions.
- To create awareness of the electrical safety associated with installation of electrical equipment.
- To analyze different Hazardous areas for electrical safety.
- To expose knowledge about necessity of safety policy and safety management.

Course Outcomes

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

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety.**(K1)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances. **(K2)**
CO3 - Evaluate the safety aspects during installation of plant and equipment. **(K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places. **(K1)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems. **(K2)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

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Text Books

1. John Cadick, Mary Capelli Schellpfeffer, Dennis Neitzel, Al Winfield, “Electrical Safety Handbook”, McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, “Electrical Safety and the Law: A Guide to Compliance”, Wiley publications, 4th Edition, 2002.
3. Mohamed A. El-Sharkawi, “Electric Safety: Practice and Standards”, CRC Press; 1st Edition, 2013.

Reference Books

1. Rob Zachariason, “Electrical Safety”, Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland, “Principles of Electrical Safety”, Wiley-IEEE Press; 1st Edition, 2014.

Web References

1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	2	-	-	-	-	-	-	-	-	3	2	3
2	3	3	-	2	-	-	-	-	-	-	-	-	3	2	3
3	3	3	-	2	-	-	-	-	-	-	-	-	3	2	3
4	3	3	3	2	-	-	-	-	-	-	-	-	3	2	3
5	3	3	-	2	-	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE402	COMPUTER AIDED DESIGN FOR ELECTRICAL APPARATUS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the basic concepts of MagNet software for the design of Electrical Machine.
- To get familiar with various design procedure and type of solver used in MagNet software.
- To acquire the knowledge about design procedure of core type and shell type transformer using MagNet software.
- To equip the students with design procedure and analysis of DC Machines using MagNet software.
- To educate the design procedure and analysis of induction machine using MagNet software.

Course Outcomes

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

CO1 - Illustrate the purpose and various components of MagNet software in the design of electrical machines.**(K3)**
CO2 - Develop a basic FEM model, 1D, 2D, 3D using MagNet software. **(K4)**
CO3 - Analyze the various characteristic of DC Machines in magnet software under different loading condition. **(K4)**
CO4 - Evaluate the performance of the core type and shell type transformer design using MagNet software. **(K4)**
CO5 - Interpret and validate the performance characteristic of induction machine using MagNet software. **(K4)**

UNIT I INTRODUCTION TO FINITE ELEMENT ANALYSIS (FEA) (9 Hrs)

History – Purpose of FEA – Discretization model – Mesh refinement – Types of Finite elements Boundary condition – General procedure for FEA (Preprocessing, solution, post processing) – Application of FEA

UNIT II BASICS OF MAGNET SOFTWARE (9 Hrs)

Introduction – Design of Object – Elements – Nodes – Make component in a line – One dimension design of line – Two dimension design of Cylinder, rectangular, cube – three dimension design of fan, wheel, spanner – Initial 2D mesh – Types of solvers.

UNIT III DC MACHINE (9 Hrs)

Principle – EMF equation – speed torque equation – Electrical/Mechanical characteristics starters – Applications – Design of series DC motor: Wireframe model – Solid model – Transient 2D with motion analysis.

UNIT IV TRANSFORMER (9 Hrs)

Principle and operation – EMF equation – Phasor diagram, equivalent circuit – Application – Design of core and shell type transformer: Wireframe model – Solid model – Static analysis.

UNIT V THREE PHASE INDUCTION MOTOR (9 Hrs)

Three phase Induction Motor types and constructional features – Torque equation – Star delta and DOL starter – Applications, design of Squirrel cage Motor: Wireframe model – Solid model Transient 2D with motion analysis.

Text Books

1. J. N. Reddy, “An introduction to the Finite Element Method”, Tata McGraw Hill, 3rd Edition, 2005.
2. P. Seshu, “Test book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 10th Edition, 2012.
3. Dr. P. S. Bhimbra, “Electrical Machinery”, Khanna Publications, 7th Edition, 2007.
4. I. J. Nagrath and D. P. Kothari, “Electrical Machines”, Tata McGraw Hill Education, 4th Edition, 2010.
5. M. G. Say, “Performance and design of Alternating Current Machines”, John Wiley and Sons Publications, 3rd Edition, 1983.

Reference Books

1. S. S. Rao, “The Finite Element Method in Engineering”, Butterworth Heinemann, 3rd Edition, 2004.
2. D. L. Logan, “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.
3. Arthur Eugene Fitzgerald and Charles Kingsley, “Electric Machinery”, Tata McGraw Hill Education Publications, 6th Edition, 2002.
4. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice hall Publications, 2nd Edition, 2003.
5. N. N. Parkar Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributers, 9th Edition 1984.

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Web References

1. https://elearn.univ-ouargla.dz/2013-2014/courses/MET302/document/8178001462 Computer.pdf?cidReq=MET302
2. https://nptel.ac.in/courses/108/101/108101167/
3. https://nptel.ac.in/courses/108/101/108101090/
4. http://www.nptelvideos.in/2012/12/finite-element-method.html
5. http://www.motor-engineer.net/engineering-center/learn/tutorial-electric-machine-design-hendershot/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3
2	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3
3	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3
4	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3
5	3	3	3	2	3	-	-	-	-	-	-	-	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE403	SENSORS AND TRANSDUCERS FOR ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course objectives

- To expose the students to various sensors and transducers for measuring physical quantities
- To identify the various resistance based transducers for the measurement of pressure, force, vibration etc.,
- To study about various types of inductive and capacitive transducer for the measurement of strain, motion, position and light
- To study about Sensors used to measure viscosity, humidity, moisture and temperature in industrial applications

Course outcomes

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

CO1 - Familiarize with the fundamentals of Sensors and transducers. **(K2)**
CO2 - Design the signal conditioning circuits using resistive transducers. **(K4)**
CO3 - Identify a specific measurement application for measurement of strain, motion, position and light. **(K3)**
CO4 - Study the electro-chemical sensors and transducers used for density and viscosity measurement. **(K2)**
CO5 - Classify and describe the resistive, inductive and capacitive transducers which are used for measuring various parameters like displacement, temperature, humidity etc., **(K3)**

UNIT I INTRODUCTION (9 Hrs)

General concepts and terminology of measurement systems, general input - output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data – Definition - principle of sensing - classification Mechanical and Electromechanical sensors - Transducers and sensors, classification, emerging fields of sensor technologies.

UNIT II RESISTIVE TRANSDUCERS (9 Hrs)

Resistive transducers: Principle of operation, construction details, characteristics and application of resistance potentiometer, strain gauge and its signal conditioning circuits, strain gauge applications: Load and torque measurement, Resistance temperature detector (RTD), design of LDR, thermistor, hot-wire anemometer and humidity sensor.

UNIT III INDUCTIVE AND CAPACITIVE TRANSDUCERS (9 Hrs)

Induction potentiometer - Variable reluctance transducers - LVDT - tacho generators and stroboscope, Proximity transducers - Capacitive transducer and types - Capacitor 14 microphone – capacitive thickness Transducers, capacitive strain transducers. Piezoelectric transducer, magnetostrictive transducer - Digital transducers - Fiber optic transducer - Hall Effect transducer - Photo electric transducer - I/P and P/I transducer-Points to be considered for selecting a transducer

UNIT IV DIGITAL AND SEMICONDUCTOR SENSORS (9 Hrs)

Sensors Based On Semiconductor Junctions - Sensors Based On MOSFET Transistors – Charge - Coupled And CMOS Image Sensors, Fiber-Optic Sensors, Ultrasonic Based Sensors, Biosensors - Proximity Sensors: Typical Sensor Characteristics, Technologies For Proximity Sensing, Electro-Optical Sensors, Capacitive Sensors, Magnetic Sensors - real time capacitive senor for automatically measuring liquid level-Current sensor Heading Sensors-MEMS and Nano Sensors, LASER sensors-Tactile sensors- Smart sensors.

UNIT V SPECIAL TRANSDUCER (9 Hrs)

Viscosity: Saybolt viscometer – Rotameter type and Torque type viscometers, Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers Moisture: Different methods of moisture measurements – Microwave, IR and NMR sensors, Application of moisture measurement – Moisture measurement in solids - Temperature sensor selection, Installation and Calibration - humidity measurement using capacitive sensor

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Text Books

1. D.Patranabis, „Sensors and Transducers‟, Prentice Hall of India, 2nd Edition, 2004.
2. S. Ranganathan, „Transducer Engineering‟, Allied Publishers Pvt. Ltd., 1st Edition, 2003.
3. D.V.S. Murthy, „Transducers and Instrumentation‟, Prentice Hall of India, 2nd Edition, 2011.

Reference Books

1. Ramon Pallas & John G. Webster, "Sensors and Signal Conditioning", John Wiley & Sons, 2nd Edition, 2001.
2. S.M. Sze, “Semiconductor sensors”, John Wiley & Sons Inc., 3rd Edition, 2006.
3. John P. Bentley, “Principles of Measurement Systems”, Pearson Education, 4th Edition, 2005.

Web References

1. https://swayam.gov.in/nd1_noc19_ee41/preview
2. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
3. https://nptel.ac.in/courses/108/108/108108147/
4. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.475.1721&rep=rep1&type=pdf
5. https://www.researchgate.net/journal/1726-5479_Sensors_and_Transducers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	2	2	-	-	-	-	-	3	3	3
2	3	3	3	2	1	2	2	-	-	-	-	-	3	3	3
3	3	3	3	2	1	2	2	-	-	-	-	-	3	3	3
4	3	3	3	2	1	2	2	-	-	-	-	-	3	3	3
5	3	3	3	2	2	2	2	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE404	FINITE ELEMENT ANALYSIS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide the basic principles of finite element analysis.
- To gain knowledge on the methods for solving field equations.
- To derive the system equations in one and two dimensions using finite element methods.
- To compute the basic electrical quantities using FEM analysis.
- To provide the basic skills to design and analyze the electrical apparatus using FEM software.

Course Outcomes

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

CO1 - Formulate and compute Electromagnetic Fields from Maxwell's equations.**(K3)**
CO2 - Apply the various solution methods to solve field equations.**(K3)**
CO3 - Apply finite element formulations to solve one and two dimensional problems.**(K3)**
CO4 - Compute the basic quantities like flux and torque using FEM packages. **(K4)**
CO5 - Design and analyze the performance of electrical apparatus by Finite Element Method.**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Review of basic field theory – Maxwell's equations – Constitutive relationships and Continuity equations – Laplace – Poisson and Helmholtz equation – principle of energy conversion –force/torque calculation.

UNIT II BASIC SOLUTION METHODS FOR FIELD EQUATIONS (9 Hrs)

Limitations of the conventional design procedure – need for the field analysis based design problem definition – boundary conditions – Solution by analytical methods: direct integration method –variable separable method – method of images – solution by numerical methods – solution for matrix equations – finite difference method.

UNIT III FORMULATION OF FINITE ELEMENT METHOD (9 Hrs)

Variational formulation – energy minimization – discretisation – shape functions – stiffness matrix –1D and 2D planar and axial symmetry problems – mesh generation in 2D – axi-symmetric applications.

UNIT IV COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES (9 Hrs)

Basic quantities – energy stored in electric field – capacitance – magnetic field – linked flux – inductance – force – torque – skin effect – resistance – computation of electric field, magnetic field intensity.

UNIT V DESIGN APPLICATIONS (9 Hrs)

Introduction to software packages of finite element analysis – applications to magnetic circuit design – modeling and design of insulators – magnetic actuators – transformers – rotating machines.

Text Books

1. J. N. Reddy, "An Introduction to the Finite Element Method", Tata McGraw-Hill, 3rd Edition, 2005.
2. P. Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., 10th Edition, 2012.

Reference Books

1. Matthew. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 4th Edition 2007.
2. Charles W. Steels, "Numerical Computation of Electric and Magnetic fields", Van Nostrand Reinhold Company, 2nd Edition, 2012.
3. Silvester and Ferrari, "Finite Elements for Electrical Engineers", Cambridge University press, 3rd Edition, 1996.
4. S. J. Salon, "Finite Element Analysis of Electrical Machines", Kluwer Academic Publishers, 1st Edition, 1995.
5. Nicola Biyanchi, "Electrical Machine analysis using Finite Elements", Taylor and Francis Group, CRC Publishers, 1st Edition, 2005.

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Web References

1. https://nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/108/106/108106152
3. https://nptel.ac.in/courses/108/101/108101090
4. https://www.youtube.com/watch?v=4c-sPXolD0w
5. https://nptel.ac.in/courses/112/104/112104116/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE405	ENERGY STORAGE TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the purpose of energy storage systems.
- To learn the different energy storage techniques.
- To learn about the different types of batteries available for energy storage.
- To impart knowledge regarding on the advanced energy storage systems.
- To learn about the different vehicular energy storage schemes.

Course Outcomes

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

CO1 - Familiarize the need for energy storing.**(K2)**

CO2 - Analyze the various energy storage techniques in the form of electrical, magnetic and chemical systems. **(K3)**

CO3 - Analyze the different batteries and its characteristics used for storing the energy in electric vehicles, nano-tubes etc.**(K4)**

CO4 - Impart the concepts of Superconducting Magnet Energy Storage Systems and super-capacitors in digital cameras, PC cards, electric vehicles, medical applications etc.**(K3)**

CO5 - Analyze the various energy storage techniques used in Electric vehicles and its hybridization concepts, power grid stabilization, rail-system power models etc.**(K4)**

UNIT I ENERGY STORAGE NEEDS (9 Hrs)

Energy Storage Need of energy storage - Different modes of Energy Storage - Potential energy - Pumped hydro storage - Kinetic Energy and Compressed gas system - Flywheel storage, compressed air energy storage - Environmental and sustainability issues.

UNIT II ENERGY STORAGE TYPES (9 Hrs)

Electrical and Magnetic energy storage, Capacitors, electromagnets - Chemical Energy storage - Thermo-chemical, fossil fuels and synthetic fuels - Hydrogen for energy storage, Solar Ponds for energy storage. Electrochemical Energy Storage Systems, Case study on perovskite solar cell.

UNIT III BATTERIES (9 Hrs)

Batteries - Primary, Secondary, Lithium, Solid-state and molten solvent batteries - Lead acid batteries - Nickel Cadmium Batteries - Advanced Batteries - Role of carbon nano-tubes in electrodes - Flow battery operation - Flexible fiber battery- air batteries

UNIT IV SUPERCONDUCTING MAGNET ENERGY STORAGE SYSTEMS (9 Hrs)

Superconducting Magnet Energy Storage(SMES) systems - Capacitor and Batteries: Comparison and application - Super capacitor - Electrochemical Double Layer Capacitor (EDLC), principle of working, structure, performance and application, role of activated carbon and carbon nano-tube - Super Capacitors - power calculation – operation and design.

UNIT V VEHICULAR ENERGY STORAGE SYSTEMS (9 Hrs)

Energy storage technologies in hybrid vehicles – flywheel, hydraulic, fuel cell and hybrid fuel cell energy storage system – ultra capacitors – comparison – battery charging control

Text Books

1. Jiujun Zhang, Lei Zhang, Hansan Liu, Andy Sun, Ru-Shi Liu, “Electrochemical Technologies for Energy Storage and Conversion-2 Volume set”, John Wiley and Sons, 1st Edition, 2011.
2. Detlef Stolten, “Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications”, Wiley, 1st Edition, 2010.
3. Robert Huggins, “Energy Storage: Fundamentals, Materials and Applications”, Springer, 2nd Edition, 2016.
4. Andrei G. Ter-Gazarian, “Energy Storage for Power Systems”, Institution of Engineering and Technology, 3rd Edition, 2020.

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Reference Books

1. Francois Beguin and Elzbieta Frackowiak, "Super capacitors: Materials, Systems and Applications", Wiley-VCH, 1st Edition, 2013.
2. Doughty Liaw, Narayan and Srinivasan, "Batteries for Renewable Energy Storage", The Electrochemical Society, New Jersy, 2010.
3. Ali Emadi, Mehrdad Ehsani, John M. Miller, "Vehicular Electric Power Systems: Land, Sea, Air and Space Vehicles", CRC Press, 1st Edition, 2003.
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley, 1st Edition, 2011.

Web References

1. https://www.azocleantech.com/article.aspx?ArticleID=593
2. https://energystorage.org/why-energy-storage/technologies/
3. https://www.renewableenergyworld.com/2019/10/22/which-new-energy-storage-technologies-might-outcompete-lithiumion-in-the-2020s/
4. https://www.sciencedirect.com/topics/engineering/energy-storage-technology
5. https://en.wikipedia.org/wiki/Energy_storage
6. https://www.energy.gov/oe/activities/technology-development/energy-storage

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3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
4	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
5	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE506	UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To design optimized illumination system for domestic and industrial applications.
- To acquire knowledge about the different types of heating and welding.
- To make awareness in the usage of refrigeration and air conditioning system.
- To familiarize with the construction and working of traction systems.
- To impart the knowledge on electroplating techniques and operations of batteries.

Course Outcomes

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

CO1 - Develop a clear idea on lighting requirement for domestic and industrial needs in an efficient way. **(K3)**
CO2 - Analysis the different types of heating and welding schemes used in the industries**(K4)**
CO3 - Repair the minor faults that occurs in refrigerator and in air conditioning system**(K4)**
CO4 - Analyze the speed-time characteristics and performance of the electric traction. **(K4)**
CO5 - Calculate the power requirement and efficiency of domestic appliances.**(K4)**

UNIT I ILLUMINATION (9 Hrs)

Introduction – basic terminologies – laws of illumination – polar curves – Rousseau's construction – electrical lamps – Basic principles of light control – Types – Design of lighting – illumination calculation (residential, industrial, street, flood lighting) – bureau of energy efficiency star rating for lamps.

UNIT II ELECTRIC HEATING AND WELDING (9 Hrs)

Role of electric heating for industrial applications – Types of Heating – Resistance – Induction - Arc furnace – Dielectric - solar – heating of building, domestic water heater, Electric oven. Welding methods – Resistance – Arc - Laser – Ultrasonic - Power supply equipment's for welding.

UNIT III REFRIGERATION AND AIR CONDITIONING (9 Hrs)

Electrical Circuit of Refrigerator – Trouble shooting of Refrigerator – Air conditioning types and their applications – smart air conditioning systems – Trouble shooting of air conditioning.

UNIT IV ELECTRIC TRACTION (9 Hrs)

Traction system – Power supply – Traction drives – braking – Tractive effort calculations – speed-time characteristics. Locomotives and train – Tram ways and Trolley bus – Recent trends – Metro and Mono rail systems.

UNIT V ELECTROLYSIS AND DOMESTIC APPLIANCES (9 Hrs)

Electrolysis- Laws of Electrolysis, power supply, Efficiency – Electro Plating. Batteries-Types – Components, rating of batteries – Methods of charging and maintenance. Domestic appliances: Washing Machine, Water heater – Introduction to Green Building Concept and energy auditing.

Text Books

1. J. B. Gupta, "Utilization of Electrical Power and Traction", Kataria Publications, Reprint Edition, 2020
2. R. K. Rajput, "Utilization of Electrical Power", Lakshmi publications, 2nd Edition, 2016.
3. E. Openhshaw Taylor and V. V. L. Rao, "Utilization of Electric Energy", Orient Longman, New Delhi, 2nd Edition, 2007.

Reference Books

1. S. K. Sahdev, "Utilization of electrical energy and electric traction", New Age International Publisher, 1st Edition, 2016.
2. H. Partap, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Sons, Delhi, 2nd Edition, 2015.
3. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Publishers, 4th Edition, 2017.
4. Pradip Kumar Sadhu, Soumya Das, "Modern utilization of Electric Power" CBS Publisher, 1st Edition, 2018.

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Web References
1. https://nptel.ac.in/courses/108/105/108105060/
2. https://nptel.ac.in/courses/112/107/112107090/
3. https://nptel.ac.in/courses/112/105/112105129/
4. https://nptel.ac.in/courses/103/108/103108162/
5. https://beeindia.gov.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
2	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
3	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
4	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
5	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE507 **ELECTRIC TRACTION**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the Traction systems and its mechanics for train movement.
- To identify the power supply equipment suited for traction systems and differentiates AC and DC traction drives.
- To analyze various types of equipment used in protection of locomotive system
- To familiarize about various systems of track electrification and power supply system.
- To understand the working of various railway signaling system.

Course Outcomes

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

CO1 - Familiarize the basics of Electric Traction System and its mechanics for train movements. **(K1)**
CO2 - Outline about the different Traction Drives and controlling techniques. **(K2)**
CO3 - Differentiate the best suited protection system for Electric Locomotive**. (K2)**
CO4 - Design the Electric Traction Sub-Systems. **(K3)**
CO5 - Apply the solid state interlocking principle in railway signaling system. **(K2)**

UNIT I NTRODUCTION OF ELECTRIC TRACTION (9 Hrs)

Indian Scenario of Electric traction, Advantages of Electric Traction over other systems of traction, selection of traction system - Electric and Diesel-Electric. Mechanics of train movement- Speed - time curve for train movement - Requirement of tractive effort and T-N curve of a typical train load, Specific energy consumption and Coefficient of adhesion- Suspension and mechanism of torque transmission Concept of Weight Transfer & Effect of un-sprung mass and wheel diameter.

UNIT II TRACTION MOTOR DRIVES (9 Hrs)

Type of traction motor – characteristics - Optimization of design and construction features - Tractive Effort and Drive Ratings - Important Features of Traction Drives - conventional DC and AC Traction drives - Converter Controlled Drives - DC Traction using Chopper Controlled Drives - Poly phase AC /DC Traction Motors - Traction control of DC locomotives and EMU's - Traction control system of AC locomotives - Control gear.

UNIT III PROTECTION OF LOCOMOTIVE EQUIPMENT AND CIRCUITS (9 Hrs)

Broad strategy for protection, Surge protection, Overload protection of main power circuits, Earth fault protection of power auxiliary circuits - Protection from over-voltage and under-voltage, Differential protection of traction circuits - Protection against high and low air pressure in the compressed air circuit - Temperature monitoring, Protection of transformer by buchholz relay - Protection against accidental contact with HT equipment Protection against fires.

UNIT IV ELECTRIC TRACTION SUB-SYSTEMS (OVERHEAD EQUIPMENT) (9 Hrs)

Overhead Equipment (OHE), Sectionalizing, Bonding of Rails and Masts, Materials Employed in OHE Electric Traction Sub-Systems - Power Supply Installations - Layout design of Traction Substation/ Protection, Booster Transformers and Return Conductor- SCADA System.

UNIT V RAILWAY SIGNALLING (9 Hrs)

Block Section Concept - Track Circuits, Interlocking Principle - Train speed and signaling - Solid state Interlocking - Automatic Warning Systems.

Text Books

1. Upadhayay J, Mahindra S.N, “Electric Traction”, Allied Publishers Ltd., 1st Edition, 2000.
2. Andreas Steimel, “Electric Traction-Motive Power and Energy Supply, Deutscher Industrieverlag publishers, 2nd Edition, 2014.
3. A.T. D over, “Electric Traction”, Pitman Publishing, 4th Edition, 1965.

Reference Books

1. P.S. Rao, “Principle of 25 KV Overhead Equipments”, Printpack Pvt. Ltd., 1st Edition, 2000.
2. Gopal K Dubey, “Fundamentals of Electric Drives”, Narosa Publishing, 2nd Edition, 2010.
3. H. Partab, “Modern Electric Traction”, Dhanpat Rai & Sons, 2017.
4. C. L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International, 3rd Edition, 2015.

(DR.S. ANBUMALAR)

5. J.B. Gupta, “Utilization of Electrical Power and Electric Traction”, S. K. Kataria & Sons publications, 10th Edition, 2019.
6. R. B. Brooks, “Electric Traction Hand Book”, Sir Isaac Pitman and sons Ltd, London, 1st Edition, 1954.

Web References

1. https://epd.wisc.edu/courses/fundamentals-of-traction-power-systems-and-overhead-contact-systems/
2. http://www.railsystem.net/electric-traction-systems/
3. http://hellowbookeas.cf/0271002417-electric-traction-on-the-pennsylvania-railroad-1895-1968.htm
4. http://www.vssut.ac.in/lecture_notes/lecture1424084684.pdf
5. https://Electric-Traction-Upadhyay-S-N-Mahendra/dp/8177640054

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	3	3	1	-	-	-	-	-	-	1	3	2	3
2	3	2	3	3	1	-	-	-	-	-	-	1	3	2	3
3	3	2	3	3	1	-	-	-	-	-	-	1	3	2	3
4	3	2	3	3	1	-	-	-	-	-	-	1	3	2	3
5	3	2	3	3	1	-	-	-	-	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE508	ELECTRICAL ENERGY AUDIT AND CONSERVATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the necessity of conservation of energy.
- To understand the energy management schemes in motors.
- To understand the energy management methods in lighting schemes.
- To illustrate the metering schemes for energy management.
- To learn economic analysis and management techniques.

Course Outcomes

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

CO1 - Outline about the energy audit process and instruments. **(K2)**
CO2 - Apply the energy efficient methods for improving efficiency of electric motors. **(K2)**
CO3 - Develop good illumination systems and analyze the power factor. **(K3)**
CO4 - Acquire knowledge on various meters used for energy management. **(K2)**
CO5 - Analyze and evaluate cost effective model in electrical equipment. **(K5)**

UNIT I INTRODUCTION (9 Hrs)

Basics of energy – need for energy management – energy accounting – energy monitoring – targeting and reporting – energy audit – definitions – types of energy audit – audit instruments – audit of process industry – Case studies.

UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION (9 Hrs)

Energy management for electric motors: energy efficient controls and starting efficiency – motor efficiency and load analysis – selection of motors – energy efficient motors. Energy management by cogeneration: forms of cogeneration – electrical interconnection.

UNIT III LIGHTING SYSTEMS (9 Hrs)

Energy management in lighting systems: task and the working space – light sources – ballasts – lighting controls – optimizing lighting energy – reactive power management – capacitor sizing – degree of compensation – capacitor losses –effect of harmonics – lighting and energy standards.

UNIT IV METERING FOR ENERGY MANAGEMENT (9 Hrs)

Metering for energy management: units of measure – utility meters – demand meters – paralleling of current transformers – instrument transformer burdens – multi tasking solid state meters – metering location vs requirements – power analyzer – metering techniques and practical examples.

UNIT V ECONOMIC ANALYSIS AND MODELS (9 Hrs)

Power system tariffs – Economic analysis: cash flow model – Time value of money – pay-back method – utility rate structures – cost of electricity – loss evaluation – load management – demand control techniques – utility monitoring and control system – economic analysis of HVAC systems.

Text Books

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, “Guide to Energy Management”, The Fairmont Press, Inc., 5th Edition, 2006.
2. Frank Kreith, D. Yogi Goswami, “Energy Management and Conservation Handbook”, CRC Press, 2nd Edition, 2016.
3. Wayne C. Turner, “Energy Management Handbook”, The Fairmont Press, 4th Edition, 2001.

References Books

1. P. Venkataseshaiah K.V. Sharma, “Energy Management and Conservation”, Dreamtech Press, 1stEdition, 2020.
2. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 1st Edition, 2003.
3. ICAI, “Electricity in buildings good practice guide”, McGraw-Hill Education, 1st Edition, 2017.

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Web References

1. https://nptel.ac.in/courses/108/106/108106022/
2. https://www.youtube.com/watch?v=onIhwmbL8CA
3. https://www.youtube.com/watch?v=CTt4y8bokWs
4. https://ieeexplore.ieee.org/document/7977655
5. https://ieeexplore.ieee.org/document/993185
6. https://ieeexplore.ieee.org/document/6450335

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	-	-	-	-	-	-	-	-	1	1	1	1
2	3	2	3	-	-	-	-	-	-	-	-	1	3	2	3
3	3	2	3	-	-	-	-	-	-	-	-	1	3	2	3
4	3	2	2	-	-	-	-	-	-	-	-	1	2	1	2
5	2	2	3	-	-	-	-	-	-	-	-	1	2	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE509	AUTOMOTIVE ELECTRONICS FOR ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basics of emission controls and its importance in automobiles.
- To provide adequate knowledge on ignition and injection systems.
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems.
- To impart the knowledge on chassis and safety systems.

Course Outcomes

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

CO1 - Acquire knowledge on control elements, emission norms and standards in automobiles.**(K2)**
CO2 - Classify the electronic fuel injection/ignition components and their functions. **(K2)**
CO3 - Interface automotive sensors and actuators with microcontrollers. **(K2)**
CO4 - Diagnose electronic engine control system problems with appropriate diagnostic tools. **(K3)**
CO5 - Analyse the chassis management system and safety system provided in the vehicles. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Evolution of electronics in automobiles – Emission laws – Emission norms and Standards, Charging systems-Working - design –Types, D.C. and AC dynamo, flywheel magneto charging system and Alternators - controlling and regulator system: Relay/cut-out, voltage and current regulator, electronic regulator, characteristics. Drive for Charging system – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEMS (9 Hrs)

Ignition systems: Ignition fundamentals - Requirements. Types- Ballast Resistance, Ignition coil characteristics, Cam angle and contact angle gap, spark advance mechanism, spark plug, ignition timing, multi-cylinder distributor, Distributor (contact breaker ignition system), limitations - spark plug: characteristics, material, types, plug fouling - Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – carburetor – Petrol and diesel fuel injection.

UNIT III SENSOR AND ACTUATORS (9 Hrs)

Airflow rate, Engine crankshaft angular position, Throttle angle, exhaust gas oxygen sensors, Instrument Cluster panel, fuel gauges, oil temperature gauge, warning light sensors, coolant temperature gauge, speedometer, Odometer, tachometer, trip meter, oil level indicator, parking brake indicator, direction indicators – exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS (9 Hrs)

Control modes for fuel control-engine control subsystems – ignition control methodologies – Engine management system – Block diagram - different engine control units (ECU's). Vehicle networks: Controller Area Network (CAN) standard – Diagnostics systems in modern automobiles. Digital Engine control system – Development of Motor and Generator Model.

UNIT V CHASSIS AND SAFETY SYSTEMS (9 Hrs)

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system - Steering - power steering, collapsible and tiltable steering column – steer by wire – Airbag : working, role of Micro Electro-Mechanical Systems – centralized door locking system – climate control in Vehicle - Vision enhancement, road recognition system, Anti-theft technologies, smart key system,

Text Books

1. Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers, 5th Edition, 2018.
2. William B. Ribbens, "Understanding Automotive Electronics", Newnes Publishing, 8th Edition, 2017.
3. P. L. Kholi, "Automotive Electrical Equipment", Tata McGraw Hill Co., Ltd., New Delhi, 2001.

(DR.S. ANBUMALAR)

References Books

1. Barry Hollembeak, "Automotive Electricity, Electronics and Computer Controls", Delmar Publishers, 1st Edition, 2001.
2. Check-chart, Kalton C. Lahue and Alan Harold Ahlstrand, "Fuel System and Emission controls", Good Year Books, 3rd Edition, 2000.
3. Ronald. K. Jurgen, "Automotive Electronics Handbook", McGraw-Hill, 1st Edition, 1999.
4. Robert Bosch Gmbh, "Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive", John Wiley and Sons Inc., 5th Edition, 2007.

Web References

1. https://www.autotrainingcentre.com/blog/4-types-fuel-injection-systems-auto-parts-specialists/
2. https://www.bosch-mobility-solutions.com/en/products-and-services
3. https://www.oreilly.com/library/view/understanding-automotive-electronics/
4. https://clr.es/blog/en/sensors-and-actuators-for-safer-driving/
5. https://www.te.com/usa-en/industries/sensor-solutions/applications/automotive-sensors.html
6. https://www.renesas.com/us/en/solutions/automotive/chassis.html
7. https://www.st.com/en/applications/chassis-and-safety.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	2	-	-	-	-	-	-	-	2	2	3	2
2	3	-	3	2	-	-	-	-	-	-	-	2	2	3	2
3	3	-	3	2	-	-	-	-	-	-	-	2	2	3	2
4	3	-	3	2	-	-	-	-	-	-	-	2	2	3	2
5	3	-	3	2	-	-	-	-	-	-	-	2	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE510	INDUSTRIAL ELECTRICAL SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To import basic ideas on electrical control components and electrical safety practices
- To provide the electrical wiring for residential and commercial buildings.
- To study on various illumination systems for commercial applications.
- To explain about the various components used for installation purpose.
- To import knowledge on modern techniques used for the monitoring and control.

Course Outcomes

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

CO1 - Acquire knowledge on electrical components used in industries. **(K2)**
CO2 - Design residential and commercial wiring connection. **(K4)**
CO3 - Design the different illumination systems for industries. **(K3)**
CO4 - Acquire knowledge on selection of installation components for industries. **(K3)**
CO5 - Apply the PLC and SCADA system for the automation of industries. **(K3)**

UNIT I ELECTRICAL CONTROL COMPONENTS (9 Hrs)

LT system wiring components - selection of cables – wires – switches - distribution box - metering system - Tariff structure - protection components – Fuse – MCB – MCCB – ELCB - inverse current characteristics – symbols - single line diagram (SLD) of a wiring system – Contactor - Isolator – Relays – MPCB - Electric shock and Electrical safety practices.

UNIT II WIRING SYSTEMS (9 Hrs)

Types of residential and commercial wiring - general rules and guidelines for installation – load calculation and sizing of wire - rating of main switch - distribution board and protection devices - earthing systems - requirements of commercial installation - lighting schemes - selection - sizing of components.

UNIT III ILLUMINATION SYSTEMS (9 Hrs)

Light – lumen – intensity - candle power - lamp efficiency - specific consumption – glare - space to height ratio-waste light factor - depreciation factor - various illumination schemes - Incandescent lamps and modern luminaries like CFL - LED and their operation - energy saving in illumination systems - design of a lighting scheme - flood lighting.

UNIT IV INDUSTRIAL INSTALLATION COMPONENTS (9 Hrs)

HT connection - industrial substation - Transformer selection - Industrial loads - motors - Cable and Switchgear selection - Lightning Protection - Earthing design - Power factor correction – kVAR calculations - type of compensation - Introduction to PCC- MCC panels. Specifications of LT Breakers - MCB and other LT panel components. DG (Diesel Generator) Systems - Electrical Systems for the elevator - Battery banks - Sizing the DG - UPS System - Online and OFF line UPS - Battery Banks- Selection of UPS and Battery Banks.

UNIT V INDUSTRIAL AUTOMATION (9 Hrs)

Study of basic PLC - Role of automation-advantages of process automation - PLC based control system design - Panel Metering - Introduction to distributed control system (DCS) and SCADA system for distribution automation.

Text Books

1. H. Partab , “Art and Science of Utilization of Electrical Energy”, 2nd Edition, Dhanpat Rai and Co., 2017
2. B. P. Patil, M. A. Chaudhari, “Industrial Electrical Systems - I”, 2nd Edition, Nirali Prakashan publications, 2015
3. R. K. Rajput, “Utilization of Electrical Power”, Laxmi Publications., 2nd Edition, 2016.

References Books

1. Frank Lamb, “Industrial Automation: Hands On”, McGraw-Hill Professional, 1st Edition, 2013.
2. C. L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International, 4th Edition, 2017.
3. H.Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.
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Web References

1. https://nptel.ac.in/courses/108/105/108105091/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-061-introduction-to-electric-power-systems-spring-2011/
3. https://nptel.ac.in/courses/108/108/108108077/
4. https://nptel.ac.in/courses/108/105/108105088/
5. https://nptel.ac.in/courses/108/105/108105062/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	2	-	-	-	-	-	2	1	2	3
2	2	2	1	-	-	2	-	-	-	-	-	1	1	1	1
3	2	2	1	-	-	2	-	-	-	-	-	1	1	1	3
4	2	2	1	-	-	2	-	-	-	-	-	1	2	2	2
5	2	2	2	-	-.	2	-	-	-	-	-	2	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ICCM02	VIRTUAL INSTRUMENTATION (Common to EEE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquaint the students with the basics of virtual instrumentation.
- To acquire knowledge on basic Programming
- To provide knowledge in Hardware Interfacing by VI tools.
- To study the various graphical programming environment in virtual instrumentation.
- To illustrate few applications in virtual instrumentation.

Course Outcomes

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

CO1 - Explain the concepts of virtual instruments. **(K2)**
CO2 - Apply the Programming concepts in VI. **(K2)**
CO3 - Familiarize in the concepts of instrument interfacing by VI tools. **(K2)**
CO4 - Acquaint the various instrument control interfaces. **(K2)**
CO5 - Elucidate the concepts of VI in real time applications. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Evolution of LabVIEW - Block diagram and architecture of a virtual instrument - Graphical programming and comparison with conventional programming - Controls and indicators- Labels and Text –Shape, size and color – Data type, Format, Precision and representation – Data types – Data flow programming-Editing – Debugging and Running a Virtual Instrument.

UNIT II PROGRAMMING STRUCTURE (9 Hrs)

Front panel - Block diagram - VIS and sub-VIS, Loops: For Loops, While Loops, arrays, clusters, Charts and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III DATA ACQUISITION (9 Hrs)

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT IV INSTRUMENT CONTROL (9 Hrs)

Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office and Industrial applications, VISA and IVI.

UNIT V APPLICATIONS (9 Hrs)

Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Text Books

1. Gupta , Virtual Instrumentation Using Lab view 2nd Edition, Tata McGraw-Hill Education, 2010
2. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Learning Pvt. Ltd., 2010

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Reference Books

1. Gary Jonson, “Labview Graphical Programming”, Fourth Edition, McGraw Hill, New York, 2012
2. Gupta.S., Gupta.J.P., “PC interfacing for Data Acquisition and Process Control”, Second Edition, Instrument Society of America, 2012.
3. Sokoloff; “Basic concepts of Labview 4”, Prentice Hall Inc., New Jersey 2013.

Web References

1. https://www.ni.com/
2. https://www.youtube.com/user/Labview/playlists

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	2	-	-	-	2	2	3	2	1	2
2	3	3	3	2	3	2	-	-	-	2	3	3	1	1	2
3	3	2	3	2	3	2	-	-	-	3	2	3	1	1	3
4	2	3	2	2	2	2	-	-	-	3	2	3	2	1	3
5	3	2	3	3	2	2	-	-	-	2	2	2	2	1	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20EEE612	HIGH VOLTAGE ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the causes of over voltages and their effects on power system
- To familiarize the Breakdown phenomenon in Gas, Liquid, Solid Dielectrics.
- To analyze the characteristics of high voltage, current and impulse voltage generator.
- To apply suitable methods to measure high voltage, current and impulse voltage
- To test the power apparatus as per Indian Standard Specification.

Course Outcomes

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

CO1 - Demonstrate the causes and effects of over voltages, currents on power system and also discuss the insulation coordination. **(K2)**

CO2 - Analyze the various breakdown processes in solid, liquid and gaseous insulating materials. **(K4)**

CO3 - Explain the different methods for generation of high voltages and currents. **(K2)**

CO4 - Apply the methods of measurement for high voltages and currents in electrical apparatus. **(K3)**

CO5 - Test and evaluate the performance of high voltage equipment. **(K4)**

UNIT I OVER VOLTAGE PHENOMENON AND INSULATION COORDINATION (9 Hrs)

Causes of over voltages and their effects on power system Lightning, switching and temporary over voltages - Protection against over voltages - Bewley lattice diagram - Insulation Coordination: estimation and control of electric stress, Coordination between insulation and protection level.

UNIT II ELECTRICAL BREAKDOWN OF SOLID, LIQUID AND GAS (9 Hrs)

Solids dielectrics: Intrinsic, electromechanical and thermal breakdown composite dielectrics – Liquids dielectrics: Conduction and breakdown in pure and commercial liquids, suspended particle theory, cavitations and bubble theory, stressed oil volume theory. Gases dielectrics: Ionization process, Townsend's current growth equations and criterion for breakdown. Streamer theory of breakdown, Paschen's law, breakdown in non-uniform fields and corona discharges.

UNIT III GENERATION OF HIGH VOLTAGES AND CURRENTS (9 Hrs)

Generation of high DC voltages: Rectifier and Voltage doubler circuits, Cockroft Walton voltage multiplier, Vande - Graff Generator. Generation of high AC voltages: cascaded transformers, Resonant Transformer, Tesla coils. Generation of impulse and switching surges: Marx circuit - Generation of high impulse current - Tripping and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND CURRENTS (9 Hrs)

HVDC measurement: Series resistance micro-ammeter, Resistance Potential divider, Generating Voltmeter. Power frequency A.C voltage measurement: Series Impedance Ammeter, Potential divider, Potential transformer, Electrostatic Voltmeters. Impulse voltage measurements: sphere gaps, Digital techniques in high voltage measurement. Impulse current measurement: current transformer, Rogowski coil, pure resistive shunt method.

UNIT V HIGH VOLTAGE TESTING (9 Hrs)

Indian Standards / IEC specification for testing - correction factor - testing of insulators, isolators, bushing, circuit breakers, cables, power transformers and surge arresters - radio interference measurement - High voltage laboratory testing facility - safety precautions in H. V. Labs.

Text Books

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill Private Limited, 5th Edition, 2013.
2. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering: Fundamentals", Elsevier, 2nd Edition, 2000.
3. C. L. Wadhwa, "High Voltage Engineering", New age international, 3rd Edition, 2014.

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Reference Books

1. RavindraArora, Wolfgang Mosch, “High Voltage and Electrical Insulation Engineering”, John Wiley and Sons, 2011.
2. L. L. Alston, “High Voltage Technology”, Oxford University Press, New Delhi, 1st Indian Edition, 2008.
3. E. Kuffel and M. Abdullah, “High Voltage Engineering”, Pergamon Press, 2013.
4. D. V. Razevig and M. P. Chourasia, “High Voltage Engineering”, Khanna Publishers, 2nd Edition, 2011.

Web References

1. https://nptel.ac.in/courses/108/104/108104048/
2. https://digital-library.theiet.org/content/journals/hve
3. https://mtcsuk.com/mtcs-online/high-voltage/
4. https://electrical-engineering-portal.com/download-center/books-and-guides/electricity-generation-t-d/lecture-notes-hv-engineering
5. http://www.gcebargur.ac.in/sites/gcebargur.ac.in/files/lectures_desk/FALLSEM2013-14_CP1489_TB02_High-Voltage-Engineering-Kamaraju-and-Naidu_0.PDF

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	1	-	-	-	-	-	1	3	1	2
2	3	3	2	1	1	1	-	-	-	-	-	1	2	1	2
3	3	3	3	1	1	1	-	-	-	-	-	1	2	1	2
4	3	3	3	1	1	1	-	-	-	-	-	1	3	2	2
5	3	3	3	1	1	1	-	-	-	-	-	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE613	ELECTRIC DRIVES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To have a knowledge about types of drives and its characteristics.
- To design and analyze the operation of controlled rectifier fed dc drives
- To provide knowledge on chopper fed dc drives.
- To Comprehend the control techniques applied for inverter fed induction motor drives
- To impart knowledge on design and operations of synchronous motor drives.

Course Outcomes

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

CO1 - Describe the component of electrical drives and its operating characteristics in various quadrants **(K2)**
CO2 - Design driver, firing circuits and analyze the performance of controlled converter fed drives **(K3)**
CO3 - Implement the closed loop control for chopper fed drives. **(K3)**
CO4 - Model and analyze the behavior of Inverter fed induction Motor drives. **(K3)**
CO5 - Apply the concept of vector control to Synchronous motor drives. **(K2)**

UNIT I DRIVE CHARACTERISTICS (9 Hrs)

Electric Drives - Drive classifications - Advantage of Electric Drives – components of Electrical drives - Equations governing motor load dynamics – Speed-torque characteristics and multi quadrant operations - Components of Load Torques – Classes of duty, heating and cooling – Control of Electric Drives: Current limit, closed loop torque and speed control - Selection of Motor rating - constant HP and constant torque operations.

UNIT II CONVERTER FED DC DRIVE (9 Hrs)

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – Single quadrant, Two quadrant and Four quadrant operation. Design of single phase converter for the Motor load – selection of switching devices – Design of Driver circuits – firing circuits – power supply for the driver circuits – closed loop control - design of speed and current controller.

UNIT III CHOPPER FED DC DRIVE (9 Hrs)

Performance analysis of chopper fed separately excited dc motor drive – Class A, B, C, D and E – Design of two quadrant chopper circuit – Selection of switching devices – Design of Driver circuit – Triggering circuits – Power supply for the driver circuits – Closed loop control – Design of speed and current controller.

UNIT IV INDUCTION MOTOR DRIVE (9 Hrs)

Stator voltage control – V/F control – Rotor Resistance control – Slip power recovery schemes: kramer and scherbius drive – Vector Control. Design of single phase/ three phase inverter circuit – selection of switching devices – Design of driver circuit – triggering circuit – PWM generator and SPWM generator – Design of Power supply for the driver circuits.

UNIT V SYNCHRONOUS MOTOR DRIVE (9 Hrs)

V/f control and self-control of synchronous motor: Margin angle control and power factor control- Three phase voltage/current source fed synchronous motor Drives – Vector control. Design of power converter for synchronous motor drive – Selection of switching devices – Design of triggering circuit – controller design.

Text Books

1. R. Krishnan, “Electric Motor Drives - Modeling, Analysis, and Control”, Pearson Education India, 1st Edition, 2015.
2. Bimal K. Bose “Modern power electronics and AC drives”, Pearson Education, Asia, 1st Edition, 2016.
3. G. K. Dubey, “Power semiconductor control drives”, Prentice Hall, New Jersey, 1989.

Reference Books

1. S. B. Dewan, G. R. Slemon, A. Strauvhen, “Power semiconductor drives”, John Wiley and sons, 1987.
2. Dr. P. S. Bimbra, “Power electronics”, Khanna publishers, 6th Edition, 2018.
3. J. M. D. Murphy, “Thyristor control of AC drives”, Papermon Press, 1973.

(DR.S. ANBUMALAR)

4. N. K. De, P. K. Sen, “Electric drives”, Prentice Hall of India, 9th Edition, 2006.
5. S. K. Pillai, “A first course on electric drives”, New age publisher, 3rd Edition, 2012.
6. Vedam Subrahmanyam, “Electric Drives”, Mc Graw Hill Education, New Delhi, 2nd Edition, 2017.
7. W. Shepherd, L. N. Hulley and D. T. Liang, “Power Electronics and motor control”, Cambridge University Press, 2nd Edition, 1995.

Web References

1. https://nptel.ac.in/courses/108/105/108105066/
2. http://www.smpstech.com/websites.htm
3. http://www.electronics-tutorials.ws/
4. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/
5. https://ndl.iitkgp.ac.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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3	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
4	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
5	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE614	DIGITAL SIGNAL PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the idea of signals and systems in time and frequency domain.
- To introduce fundamental principles and applications of signals and filters.
- To provide applications of signal processing.
- To make understand the basic concepts of signal filter techniques.
- To give basic ideas on implementation of DFT and FFT.

Course Outcomes

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

CO1 - Analyze the classifications of signals and systems in the time and frequency domains. **(K3)**
CO2 - Perform the stability analysis of discrete time system.**(K3)**
CO3 - Acquire knowledge on spectral analysis of signals.**(K3)**
CO4 - Design, analyze and compare digital filters for processing of discrete time signals.**(K3)**
CO5 - Acquire knowledge on DSP architecture and implement DFT and FFT Algorithms in DSP.**(K4)**

UNIT I SIGNALS AND SYSTEM (9 Hrs)

Need and benefits of Digital Signal Processing – Analog signal - Digital signal representation - classification of signals: continuous and discrete - energy and power; mathematical representation of signals - spectral density; Classification of systems: linear- causal – stable – dynamic – recursive - time variance; sampling techniques – quantization - quantization error - Nyquist rate - aliasing effect - Analog to digital conversion.

UNIT II DISCRETE TIME SYSTEM ANALYSIS (9 Hrs)

Z-transform and its properties - inverse z-transforms - methods; difference equation – Solution by z transform - application to discrete systems - Stability analysis - frequency response – Convolution linear - circular – Discrete Time Fourier transform - magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM (9 Hrs)

Discrete Fourier Transform - properties - relationship between z- transform - DTFT and DFT Frequency analysis of signal using DFT. FFT algorithms - advantages over discrete computation of DFT – radix-2 algorithms - Decimation In Time-Decimation In Frequency - Computation of IDFT using FFT.

UNIT IV DESIGN OF DIGITAL FILTER (9 Hrs)

FIR and IIR filter realization – Parallel and cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR Filters -Analog filter design – Butterworth and Chebyshev approximations; digital filter design using impulse invariant and bilinear transformation Warping- pre-warping – Structures for IIR systems - direct form – parallel - cascade and ladder structures.

UNIT V PROGRAMMABLE DSP CHIPS (9 Hrs)

Architecture and features of signal processor - Representation of Basic signals- Linear and circular convolution of two sequences - Implementation of DFT and FFT.

Text Books

1. Ramesh Babu, "Digital Signal Processing", SciTech Publications (India) Pvt. Ltd., 7th Edition, 2018.
2. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, 4th Edition, 2007.
3. A. V. Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", PHI, 3rd Edition, 2014.
4. Umesh Gupta R.S. Kaler, M. Kulkarni, A Textbook of Digital Signal Processing, Dreamtech Press, 1st Edition, 2019.

Reference Books

1. Sanjit K. Mitra, "Digital Signal Processing, A Computer based Approach", Tata McGraw-Hill, 4th Edition, 2017.
2. Rafel Gonzales and Richard Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2018.
3. Richard Woods, "Digital Image Processing with MATLAB", Pearson Education, 3rd Edition, 2020.
4. Li Tan, "Digital Signal Processing – Fundamentals and Applications", Academic Press, 2nd Edition, 2013.

(DR.S. ANBUMALAR)

Web References

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/108/105/108105055/
3. https://nptel.ac.in/courses/117/104/117104070/
4. https://nptel.ac.in/courses/108/106/108106151/
5. http://www.nptelvideos.in/2012/12/digital-signal-processing.html

COs/POs/PSOs Mapping

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1	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
2	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
3	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
4	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3
5	3	2	3	3	1	1	-	-	-	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ECCM02	ROBOTICS AND AUTOMATION (Common to ECE,EEE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce basic components required for Robot
- To analyze different control mechanism applied for Robotics
- To understand the concept of path planning in Robotics
- To Manipulate forward and inverse kinematics
- To understand application of robots in various fields

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 – Describe the components required for robotics **(K2)**
CO2 - Demonstrate control mechanism required for Robotics **(K3)**
CO3 - Explain path planning of Robotics **(K2)**
CO4 - Demonstrate forward and inverse kinematics **(K3)**
CO5 - Demonstrate application of Robots in industrial and other application **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magnetostrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors –ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems – Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT II ROBOT CONTROL (9 Hrs)

Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.

UNIT III END EFFECTORS (9 Hrs)

End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation- continuous path motion interpolated motion- straight line motion.

UNIT IV ROBOT MOTION ANALYSIS (9 Hrs)

Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates- Homogeneous transformations and rotations and Robot dynamics.

UNIT V ROBOT APPLICATIONS (9 Hrs)

Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Text Books

1. Mikel P. Grover, 'Industrial Robots – Technology Programming and Applications', second edition, McGraw Hill, 2012
2. Robert J.Schilling 'Fundamentals of Robotics-Analysis and Control', PHI, 2015,
3 R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

Reference Books

1. K.S.Fu,R.C.Gonzalez, CSG. Lee, "Robotics, Control sensing vision and Intelligence", Tata Mcgraw-Hill, Indian edition, 2008.
2. JohnJ.Craig, "Introduction to Robotics Mechanics and Control", Third edition, Pearson Education 2009.

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3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, “Industrial Robotics”, McGraw-Hill, Singapore, 2007
4. Ashitava Ghoshal, “Robotics-Fundamental Concepts and Analysis”, Oxford University Press, Sixth impression, 2010
5. B.K.Ghosh, “Control in Robotics and Automation: Sensor Based Integration”, Allied Publishers, Chennai,

Web References

1. https://robotics.nasa.gov/links/resources.php
2. https://hackernoon.com/16-best-resources-to-learn-robotics-and-iot-development-in-2019-847bb93c9bd9
3. https://www.robotics.org/Online-Store
4. https://nptel.ac.in/courses/112/107/112107289/
5. https://www.mheducation.co.in/robotics-and-control-9780070482937-india

COs / POs / PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	-	-	-	-	-	-	1	3	2	1
2	3	2	1	-	-	-	-	-	-	-	-	1	3	2	1
3	3	2	1	-	-	-	-	-	-	-	-	1	3	2	1
4	3	2	1	-	-	-	-	-	-	-	-	1	3	2	1
5	3	2	1	-	-	-	-	-	-	-	-	1	3	2	1

Correlation Level: 1-Low, 2-Medium, 3-High

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U20EEE716	DISTRIBUTED GENERATION AND MICROGRIDS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the concepts of Distributed Generation and Microgrid.
- To learn about the standards for interconnection.
- To analyze the impact of grid integration.
- To study and analyse the issues in the Microgrid.
- To learn about scenario of renewable energy scenario.

Course Outcomes

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

CO1 - Attain knowledge on the various schemes of conventional and nonconventional power generation.**(K2)**
CO2 - Have knowledge on the topologies and energy sources of distributed generation.**(K2)**
CO3 - Learn about the requirements for Microgrid interconnection and its impact. **(K2)**
CO4 - Familiarize with the techniques of control and operation of microgrid.**(K2)**
CO5 - Comprehend the standards and regulations of distributed generation, microgrid and grid integration. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Distributed generation - overview and technology trends. Working principle, architecture and application of renewable based DG technologies - Non-conventional technology based DGs.

UNIT II DISTRIBUTED GENERATIONS (9 Hrs)

Concept of distributed generations-topologies-selection of sources- regulatory standards/framework- Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes- security issues in DG implementations - Energy storage elements: Batteries- ultra-capacitors- flywheels- Captive power plants

UNIT III MICROGRID AND IMPACT OF GRID INTEGRATION (9 Hrs)

Concept and definition -microgrid drivers and benefits- review of sources of microgrids- typical structure and configuration - AC and DC microgrids- Power Electronics interfaces - Requirements for grid interconnection, limits on operational parameters: voltage, frequency- THD- islanding issues- Impact of grid integration with NCE sources on existing power system: reliability-stability.

UNIT IV OPERATION AND CONTROL OF MICROGRID (9 Hrs)

Modes of operation and control of microgrid: grid connected and islanded mode- Active and reactive power control- protection issues, anti-islanding schemes - microgrid communication infrastructure - regulatory standards- Microgrid economics- Introduction to smart microgrids

UNIT V POWER QUALITY ISSUES (9 Hrs)

Introduction, Power quality disturbances -Transients, Voltage sags and swells, Over-voltages and under-voltages, Outage, Harmonic distortion, Voltage notching, Flicker, Electrical noise. Power quality sensitive customers, power quality improvement technologies.

Text Books

1. Nick Jenkins, Janaka Ekanayake, Goran Strbac, “Distributed Generation”, Institution of Engineering and Technology, London, UK, 2010.
2. S. Chowdhury, S.P. Chowdhury and P. Crossley, “Microgrids and Active Distribution Networks”, The Institution of Engineering and Technology, London, United Kingdom, 2009.
3. Math H. Bollen, Fainan Hassan, “Integration of Distributed Generation in the Power System”, John Wiley & Sons, New Jersey, 2011.

Reference Books

1. Zobaa, Ahmed F., and Ramesh C.Bansal, “Handbook of renewable energy Technology”, World Scientific, 2011.
2. Godfrey Boyle, “Renewable Energy-Power for a sustainable future”, Oxford University Press, 3rd Edition, 2013.
3. Nikos Hatziargyriou, “Microgrids: Architectures and Control”, Wiley-IEEE Press, 2013

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Web References

1. https://www.youtube.com/watch?v=kP4nEJ7fUJI&list=PLImNQubhYtnC-5ULfC_am8NMt-uzW__jW
2. https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts
3. https://www.energy.gov/eere/solar/solar-integration-distributed-energy-resources-and-microgrids
4. https://certs.lbl.gov/research-areas/distributed-energy-resource-0
5. https://www.elsevier.com/books/distributed-energy-resources-in-microgrids/chauhan/978-0-12-817774-7

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1	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
2	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE717	ADVANCED CONTROL SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To outline the concept of state space analysis and to design the state controller and observers.
- To analyze the stability of non-linear systems by phase plane method
- To analyze the system behavior and Lyapounov's method for stability.
- To analyze z-transform Spectrum analysis of sampling process.
- To analyze stability of time-invariant, discrete-time control systems.

Course Outcomes

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

CO1 - Design pole placement and the state observer using state space and state feedback system in modern control systems (**K3)**

CO2 - Analyze the nonlinear system behavior by phase plane and describing function methods **(K3)**

CO3 - Analyze Stability by describing function method and Lyapounov's method for stability **(K4)**

CO4 - Analyze the Z transform analysis of sampled data control systems. **(K4)**

CO5 - Analyze discrete-time models using z domain to know the concept of sampling process that is used in digital control system. **(K4)**

UNIT I STATE VARIABLE DESIGN (9 Hrs)

Introduction - concepts of state variables and state model - Effect of state feedback - Pole placement design - Necessary and sufficient condition for arbitrary pole placement-State regulator design - Design of state observers Separation principle - State feedback with integral control-State space controller for DC motor with feedback control.

UNIT II NON-LINEAR SYSTEMS - I (9 Hrs)

Introduction - nonlinearities - Phase plane method: concepts, singular points, stability of nonlinear systems - Construction of phase trajectories system analysis by phase plane method

UNIT III NON-LINEAR SYSTEMS - II (9 Hrs)

Stability analysis by describing function method - Jump resonance - Lyapounov's method for stability study, concept of Limit Cycle. Nonlinear modeling and identification of a DC motor

UNIT IV SAMPLED DATA ANALYSIS - I (9 Hrs)

Introduction - Spectrum analysis of sampling process signal reconstruction difference equations - Z transform function, Inverse Z transform function - Response of Linear discrete system

UNIT V SAMPLED DATA ANALYSIS - II (9 Hrs)

Response between sampling instants - Corelation between Z and S domain - Pulse transfer function-State equation - Stability analysis – Schur Cohn stability, Jury's Test and compensation techniques - Digital filter design techniques.

Text Books

1. M. Gopal, "Digital Control and State Variable Methods", Mc Graw Hill India, 4th Edition, 2012.
2. K. Ogata, "Modern Control Engineering", Pearson, 5th Edition, 2014.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2nd Edition, 2016.

Reference Books

1. M. Gopal, Modern Control System Theory, New Age International Publishers, 3rd Edition, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Taylor and Franci Group, 2nd Edition, 2017.
3. Ashish Tewari, "Modern Control Design with MATLAB and SIMULINK", John Wiley,1st Edition 2002.
4. T. Glad and L. Ljung, "Control Theory–Multivariable and Non-Linear Methods", Taylor and Francis, 1st Edition, 2009.
5. D. S. Naidu, "Optimal Control Systems", CRC Press, 1st Edition, 2002.

Web References

1. https://nptel.ac.in/courses/Adavanced Control systems
2. https://www.mathworks.com/products/control.html/Control system tool box
3. https://www.tutorialspoint.com/control_systems_state_space_analysis.html
4. http://web.mit.edu/www/Handouts/StateSpace.pdf
5. https://www.tutorialspoint.com/ control systems steady state errors.html
6. https://www.mathworks.com/ optimal-and-robust-control-.html
7. https://arc.aiaa.org/doi/pdf/10.2514/6.2002-4635

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE719	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about different types of load, load and security aspects of the power system.
- To understand the real power-frequency relationship and the mathematical model of Load Frequency Control Loop for single area systems.
- To familiarize with reactive power-voltage relationship and the necessity of voltage compensation in power system operation and control.
- To introduce the power system optimization problems such as unit commitment.
- To have an overview of economic load dispatch for power generation planning and control.

Course Outcomes

After completion of the course, students will be able to

CO1 - Analyze the performance and security aspects of power system under various load conditions.**(K2)**
CO2 - Construct the state variable model of frequency control loop for isolated and grid connected system.**(K3)**
CO3 - Analyze the transfer function model of excitation system and classify the system level control schemes. **(K4)**
CO4 - Forecast the load and gain knowledge on the constraints of unit commitment. **(K3)**
CO5 - Analyze the Economic load dispatch equations without loss and with loss. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Structure of power system – National and Regional load dispatching centers, Power scenario in Indian grid – Load curves – Load duration curve – Important terms and factors - Power system security – Factors affecting system security – Operating states of power system, P-f and Q-V loops – Need for voltage and frequency regulation in power system - Energy control center Functions.

UNIT II REAL POWER CONTROL (9 Hrs)

Fundamentals of speed governing mechanism and modeling – Speed-load characteristics – Load sharing between two synchronous machines in parallel, Concept of control area – LFC control of a single area system: Static and dynamic analysis of uncontrolled and controlled cases – Introduction to Multi-area systems

UNIT III REACTIVE POWER CONTROL (9 Hrs)

Reactive power control – Generation and absorption of reactive power – Typical excitation system – Modeling – Static and dynamic analysis – Stability compensation – Generation and absorption of reactive power, Methods of voltage control: shunt reactors – Shunt capacitors – Series Capacitors – Synchronous condensers – Static VAR systems – Tap-changing transformer

UNIT IV LOAD FORECASTING AND UNIT COMMITMENT (9 Hrs)

Load forecasting – Components of system load – Forecasting of the base load by method of least square fit - Unit Commitment – Constraints: spinning reserve – Thermal unit constraints – Hydro constraints – Fuel constraints and other constraints – methods.

UNIT V ECONOMIC DISPATCH (9 Hrs)

Economic dispatch: Incremental cost curve – Co-ordination equations without loss and with loss – Solution by λ-iteration method – Base point and participation factors – Economic dispatch controller added to LFC.

Text Books

1. Olle I. Elgerad, "Electric Energy System Theory and Introduction", Tata McGraw Hill, 2nd Edition, 2004.
2. Allen J. Wood, Bruce F. Wollen berg, "Power Generation, operation and control", John Wiley and sons, 2nd Edition, 2008.
3. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis Operation and Control", PHI learning Pvt. Ltd., 3rd Edition, 2010.

(DR.S. ANBUMALAR)

Reference Books

1. D. P. Kothar and I. J. Nagrath, “Modern Power System Analysis”, Tata McGraw Hill, 4th Edition, 2011.
2. Prabha Kundur, “Power System Stability and Control”, Tata McGraw Hill, 5th Edition, 2014.
3. A. K. Mahalanbias, D. P. Kothari and S. I. Ahson, “Computer Aided Power System Analysis and Control”, Tata McGraw Hill, 1990.
4. P.S.R. Murty, “Operation and Control in Power Systems”, BS Publications, 2nd Edition, 2011.
5. Carson. W. Taylor, “Power System Voltage Stability”, Taylor-McGraw Hill, 2000.

Web References

1. https://nptel.ac.in/courses/108/101/108101040/
2. http://www.nptelvideos.in/2012/12/power-system-operations-and-control.html
3. https://nptel.ac.in/courses/108/105/108105067/
4. https://nptel.ac.in/courses/108/107/108107028/
5. https://nptel.ac.in/courses/108/107/108107127/
6. http://www.iitk.ac.in/npsc/Papers/NPSC2016/1570293957.pdf
7. https://www.power-technology.com/features/featurethe-10-worst-blackouts-in-the-last-50-years-4486990/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
3	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
4	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2
5	3	3	3	2	2	-	-	-	-	-	-	1	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE720	SPECIAL ELECTRICAL MACHINES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the construction, operating modes and characteristics of stepper motors.
- To learn about the construction, principle of operation and characteristics of synchronous reluctance motors.
- To get familiar with construction, characteristics and various controllers for switched reluctance motors.
- To equip the students on the construction, principle of operation and characteristics of brushless D.C. motor.
- To learn the construction, characteristics and different controllers for permanent magnet synchronous motors.

Course Outcomes

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

CO1 - Analyze the performance characteristics of stepper motors in various operating modes.**(K4)**
CO2 - Examine performance characteristics of synchronous reluctance motors and select appropriate controllers for any industrial applications. **(K4)**
CO3 - Compare the performance characteristics of different types of controllers used in switched reluctance motors. **(K4)**
CO4 - Interpret the performance of permanent magnet brushless D.C. motor.**(K4)**
CO5 - Analyze the performance characteristics of permanent magnet synchronous motors and to analyze the vector control schemes. **(K4)**

UNIT I STEPPER MOTORS (9 Hrs)

Constructional features and principle of operation: Variable reluctance, Permanent and Hybrid Stepper motor - Torque production in Variable Reluctance (VR) stepper motor– Static and Dynamic Characteristics – Microprocessor based control of stepper motors – Closed loop control – Applications.

UNIT II SYNCHRONOUS RELUCTANCE MOTORS (9 Hrs)

Constructional features of axial and radial air gap Motors - operating principle – Phasor diagram - Derivation of reluctance torque from phasor diagram- motor characteristics – Controller for Synchronous Reluctance motor - Vernier motor – Applications.

UNIT III SWITCHED RELUCTANCE MOTORS (9 Hrs)

Constructional features - principle of operation - Torque equation - Torque Speed Characteristics – Converters for SRM – Current control schemes: Hysteresis and PWM – Microprocessor based controller and Sensorless Controller - Closed loop control of SRM – Applications.

UNIT IV BRUSHLESS DC MOTORS (9 Hrs)

Construction and Principle of operation - Torque and EMF equation - Torque-Speed characteristics - Permanent Magnet materials - electronic commutator - Difference between mechanical and electronic Commutator – Rotor Position sensors: Hall effect sensors – Optical sensor - Microprocessor based controller - Sensorless control – Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (9 Hrs)

Construction – Principle of operation – EMF and Torque equations - Phasor diagram – Torque-speed characteristics – Self-control– Vector control schemes - Microprocessor based control – Comparison of BLDC and PMSM – Applications.

Text Books

1. E.G.Janardanan, "Special electrical machines", PHI learning Pvt. Ltd ,2nd Edition, 2014
2. T. J. E. Miller, "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford, 2nd Edition, 1993.
3. K. Venkataratnam, "Special Electrical Machines", Universities Press Private Limited, 1st Edition, 2009.

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Reference Books

1. P. P. Acarnely, “Stepping Motors – A Guide to Motor Theory and Practice”, Peter Perengrinus, London, IFT Publishers, 4th Edition, 2007.
2. R. Srinivasan, “Special Electrical Machines”, Lakshmi Publications, 2013.
3. T. Kenjo and S. Nagamori, “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.
4. J. Gnanavadivel, J. Karthikeyan and S. Albert Alexander, “Special Electrical Machines”, Anuradha publications, 3rd Edition, 2009.

Web References

1. https://ndl.iitkgp.ac.in.
2. http://ess.inflibnet.ac.in.
3. https://nptel.ac.in/courses/108/102/108102156.
4. http://www.electrical4u.com.
5. https://vidwan.inflibnet.ac.in.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	-	-	-	-	-	-	-	1	1	2	1
2	3	3	2	3	-	-	-	-	-	-	-	1	2	1	1
3	3	2	2	3	-	-	-	-	-	-	-	1	3	3	3
4	2	3	3	2	-	-	-	-	-	-	-	1	3	2	3
5	3	2	3	2	-	-	-	-	-	-	-	1	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ICCM01	FUZZY LOGIC AND NEURAL NETWORKS (Common to EEE, ECE,CCE, CSE, IT, CIVIL, BME, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquaint the students with the basics of fuzzy logic.
- To impart knowledge about fuzzy logic control system.
- To familiarize the basics of neural networks
- To inculcate knowledge on neural network based computation.
- To make the students understand the concept of hybrid Neuro-fuzzy logic controller schemes.

Course Outcomes

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

CO1 - Illustrate the fuzzy sets and the properties of fuzzy logic **(K2)**
CO2 - Comprehend fuzzy logic controllers and its applications. **(K2)**
CO3 - Familiarize in the neural network architecture. **(K2)**
CO4 - Impart knowledge on various training algorithm of neural network and its application. **(K3)**
CO5 - Recognize the hybrid Neuro-fuzzy logic controllers. **(K2)**

UNIT I INTRODUCTION TO FUZZY LOGIC (9 Hrs)

Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.

UNIT II FUZZY LOGIC CONTROL SYSTEM (9 Hrs)

Introduction to Fuzzy logic controller: Architecture – Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification - Applications of Fuzzy logic controller.

UNIT III INTRODUCTION TO NEURAL NETWORK (9 Hrs)

Introduction to neural networks – Biological neural networks, Artificial Neural network: Single and Multi layer feed forward network- Activation function, types (step and sigmoid function), threshold function- Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.

UNIT IV NEURAL NETWORKS CONTROL (9 Hrs)

Back propagation neural net: standard architecture, algorithm -Hopfield net: architecture and algorithm- Kohonnen's Self Organizing map- Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control - Applications of neuro controller.

UNIT V HYBRID CONTROL SCHEMES (9 Hrs)

Adaptive Neuro-Fuzzy Inference Systems (ANFIS), Hybrid system: Types of Hybrid Systems: Neuro-Fuzzy Hybrid systems, Neuro Genetic Hybrid systems, Fuzzy Genetic Hybrid systems- Applications of fuzzy logic and neural network.

Text Books

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA .2015

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Reference Books

1. David E. Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Addison Wesley, 2019
2. Rajasekaran. S, Pai. G.A.V. “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice-Hall of India, 2003
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2007
4. W.T.Miller, R.S.Sutton and P.J.Webrose, Neural Networks for Control, MIT Press, 2001.
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Introduction to Neural Networks using MATLAB 6.0”, Tata McGraw Hill Education, 1st Edition, 2017.

Web References

1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.
3. https://nptel.ac.in/courses/106/105/106105173/.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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2	3	3	-	3	3	2	-	-	-	2	-	2	2	2	1
3	3	3	2	3	3	2	-	-	-	2	-	2	2	2	1
4	3	3	3	3	3	2	-	-	-	2	-	2	2	2	1
5	3	3	3	2	2	2	-	-	-	2	-	2	2	2	1

Correlation Level: 1-Low, 2-Medium, 3- High

(DR.S. ANBUMALAR)

U20EEE821	POWER SYSTEM ECONOMICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Gain knowledge on operation of power plants and electrical tariff of the power system.
- To solve cost and loss calculation for optimum economy.
- To determine and explain the economic scheduling of operation of thermal and hydro thermal stations.
- To acquire knowledge on analyzing, synthesizing various constraints methods.
- To estimate and analysis generation system reliability.

Course Outcomes

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

CO1 - Compute the structure of electrical tariff and the impact of depreciation. **(K2)**
CO2 - Analyze the technical problems associated with operation of power systems. **(K4)**
CO3 - Analyze Thermal and Hydro generator characteristics and their economic operation. **(K4)**
CO4 - Solve the Unit Commitment problem with various constraints using conventional optimization techniques. **(K3)**
CO5 - Comprehend the importance of maintaining reliability of power systems. **(K3)**

UNIT I ECONOMIC CONSIDERATIONS (9 Hrs)

Cost of electrical energy - Expressions for cost of electrical energy – Capital-interest – Depreciation - Different methods - Factors affecting cost of operation - Number and size of generating units - Importance of high load factor - Importance of power factor improvement - Most economical power factor - Meeting the KW demand on power stations - Power system tariffs -Regions and structure of Indian Power System - Regulatory and Policy development in Indian power Sector.

UNIT II ECONOMIC DISPATCH (9 Hrs)

Modeling of Cost Rate Curves – Economic Dispatch Calculation - Losses neglected, with generator Real and Reactive power limits; Losses included - Losses of economy in incremental cost data - General loss formula-Participation Factor-Problems - Generator Capability Curve – Effect of Ramping rates – Prohibited Operating Zones - Automatic Load dispatch in Power Systems.

UNIT III INTERCONNECTED SYSTEMS (9 Hrs)

Interconnected operation - Economic operation of hydro thermal power plants - Iteration scheme - Gradient approach – Newton's method - Modeling and solution approach to short term and long term Hydro-Thermal scheduling problem using Dynamic Programming.

UNIT IV OPTIMAL POWER FLOW (9 Hrs)

Problem formulation - Cost minimization - Loss minimization - Solution using NLP and successive LP methods – Constraints - DC and AC OPF (Real and Reactive Power Dispatch) – Effect of Contingencies - Voltage and Phase angle - Transient Voltage Dip/Sag Criteria.

UNIT V FUNDAMENTALS OF MARKETS (9 Hrs)

Fundamentals of Markets – Introduction to Efficiency and Equilibrium - Modeling of consumers and producers – Single and Double Auction mechanism - Global welfare – Dead Loss – Spot and Forward Markets- carbon credit.

Text Books

1. Allen J Wood and BF Wollen berg, "Power Generation, Operation and Control", John Wiley and Sons, New York, 1st Edition, 2013.
2. Steven Stoft, "Power System Economics", John Wiley and Sons, 1st Edition, 2002.
3. V.K.Metha and Rohit Metha, "Principles of Power System", S. Chand, 4th Edition, 2008.

Reference Books

1. Daniel S .Kirschen and Goran Strbac, "Power System Economics", John Wiley and Sons Ltd, 2nd Edition, 2018.
2. Hadi Saadat, "Power System Analysis", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st Reprint Edition, 2010.
3. Fereidoon P. Sioshansi and Wolfgang Pfaffenberger, "Electricity Market Reform", Elsevier Science Ltd, 1st Edition, 2006.
4. Xiao-Ping Zhang, "Restructured Electric Power Systems: Analysis of Electricity Markets with Equilibrium Models", John Wiley and Sons, 1st Edition, 2010.
5. M. A. Pai, "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2012.

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Web References

1. https://nptel.ac.in/courses/108/101/108101005/
2. https://nptel.ac.in/courses/108/101/108101040/
3. https://pserc.wisc.edu/webinars/systems_webinars.aspx
4. https://www.classcentral.com/course/swayam-computer-aided-power-system-analysis-12954
5. https://www.powermin.nic.in
6. https://www.posoco.in
7. http://www.ijerd.com/paper/Conference/Version-2/E3645.pdf
8. http://ijoer.com/Paper-January-2016/IJOER-JAN-2016-4.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	-	-	-	-	-	-	-	2	2	2
2	3	3	3	3	1	-	-	-	-	-	-	-	3	3	2
3	3	3	3	3	1	-	-	-	-	-	-	-	3	3	2
4	3	3	3	3	1	-	-	-	-	-	-	-	3	3	2
5	3	3	3	3	1	-	-	-	-	-	-	-	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE822	FACTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To comprehend fundamentals of FACTS Controllers and its various considerations.
- To equip the students to understand the voltage control of SVC and enhancement of stability.
- To impart knowledge on different modes of operation of TCSC and its performance characteristics.
- To equip the students to understand the operation and control of voltage source converter based FACTS controllers
- To study the different emerging FACTS controller for transmission systems

Course Outcomes

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

CO1 - Analyse the problems in AC transmission systems and understand the need for Flexible AC transmission systems. **(K2)**

CO2 - Analyse the voltage control of SVC and its applications to enhance the stability and damping. **(K3)**

CO3 - Analyse the performance characteristics of TCSC and to model it for power flow and stability studies. **(K3)**

CO4 - Analyse the operation and control of voltage source converter based FACTS controllers. **(K3)**

CO5 - Analyze the different emerging FACTS controller for transmission systems and interaction between the FACTS controllers. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to FACTS- Real and Reactive power control in electrical power transmission lines – loads & system compensation, Uncompensated transmission line – shunt and series compensation-Classifications.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS (9 Hrs)

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator – Modeling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS (9 Hrs)

Operation of the TCSC – Different modes of operation – Modeling of TCSC, Variable reactance model – Modeling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS (9 Hrs)

Static Synchronous Compensator (STATCOM) – Principle of operation– V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow – modeling of SSSC in load flow and transient stability studies.

UNIT V EMERGING FACTS CONTROLLERS (9 Hrs)

Unified Power flow controller (UPFC) - Principles of operation and characteristics - Interline DVR (IDVR) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC); FACTS Controller interactions – SVC interaction – Co-ordination of multiple controllers using linear control techniques

Text Books

1. N.G.Hingorani and L.Guygi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", John Wiley and Sons, Inc., 1st Edition, 2011.
2. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", IEEE press and John Wiley and Sons, Inc., 2nd Edition, 2002.
3. V. K.Sood, "HVDC and FACTS controllers - Applications of Static Converters in Power System", Kluwer Academic Publishers, 2nd Edition, 2004

Reference Books

1. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control", Springer, 1st Edition, 2012.
2. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International,1st Edition, 2013.

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Web References

1. https://link.springer.com/book/10.1007%2F3-540-30607-2
2. http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=00634216
3. https://nptel.ac.in/courses/108107114/
4. https://www.elprocus.com/flexible-ac-transmission-system-need-definition-types/
5. https://link.springer.com/book/10.1007%2F3-540-30607-2

COs/POs/PSOs Mapping

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1	3	3	3	3	1	-	-	-	-	-	-	-	2	2	1
2	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3
3	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3
4	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE823	SMPS AND UPS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide conceptual knowledge of various types of DC – DC converters.
- To impart the knowledge on various types of switched mode power converters and its voltage control techniques
- To understand the importance of Zero voltage and Zero current switching used in resonant converters
- To analyze the PWM techniques and harmonic reduction techniques in DC – AC converters.
- To explain the various types of filters and techniques to improve the power quality.

Course Outcomes

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

CO1 - Design the DC-DC converters for different applications. **(K2)**
CO2 - Analyze, design and select the converters used for switched mode power supplies in Computers, Laptop, and TV. **(K4)**
CO3 - Describe the importance of resonant Converters in reducing power loss and improving the life time of the power semiconductor device. **(K2)**
CO4 - Conclude the different voltage and harmonics reduction techniques used for DC-AC converters. **(K4)**
CO5 - Interpret knowledge on the techniques used to improve the power quality and design of filters for UPS. **(K2)**

UNIT I DC - DC CONVERTERS (9 Hrs)

Principles of DC-DC Converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters, Cascaded Boost Converters – two, three and higher stage – Negative output –Choice of switching frequency – Device Selection - EMI issues

UNIT II SWITCHED MODE POWER CONVERTERS (9 Hrs)

SMPS Types: Self-Oscillating Flyback, Forward, Push pull, Luo, Half bridge and fullbridge converters- control circuits and PWM techniques - SMPS with multiple outputs - Choice of switching frequency – Device Selection - State space modeling.

UNIT III RESONANT CONVERTERS (9 Hrs)

Introduction- classification - Load Resonant converters - ZVS, ZCS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control. Multi energy storage element resonant converters - two, three and four element RPS - Application of Regulated Power Supply.

UNIT IV DC – AC CONVERTERS (9 Hrs)

Single phase and three phase inverters - control techniques, harmonic elimination techniques - Multilevel inverters -Concepts - Types: Diode clamped, Flying capacitor, Cascaded types; Switched Inductor and Capacitor multilevel Inverter - Applications.

UNIT V POWER CONDITIONERS, UPS AND FILTERS (9 Hrs)

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of high frequency inductor and transformer – Selection of capacitor and Batteries

Text Books

1. Simon Ang, Alejandro Oliva, “Power-Switching Converters”, CRC Press, 3rd Edition, 2010.
2. Kjeld Thorborg, “Power Electronics – In theory and Practice”, Overseas Press India Private Ltd, 1st Edition, 2005.
3. M. H. Rashid, “Power Electronics handbook”, Elsevier Publication, 4th Edition, 2017.

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Reference Books

1. Philip T Krein, "Elements of Power Electronics", Oxford University Press, 2nd Edition, 2014.
2. Erickson, W. Robert, "Fundamentals of Power Electronics", Springer, 2nd Edition, 2010.
3. Joseph Vithayathil, "Power Electronics, Principles and Applications", McGraw Hill Series, 6th Reprint, 2013.
4. Ned Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: -Converters, Applications, and Design", John Wiley and sons Publication, 3rd Edition, 2010.
5. Fang Lin Luo, "Advanced DC/AC converters: Applications in renewable Energy", CRC press, 1st Edition, 2013.

Web References

1. https://nptel.ac.in/courses/108/105/108105066/
2. http://www.ni.com/white-paper/14677/en/
3. http://www.smps.us/
4. https://ndl.iitkgp.ac.in/
5. http://www.cpes.vt.edu/areas/
6. https://www.coursera.org/specializations/power-electronics

COs/POs/PSOs Mapping

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4	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE824	OPTIMIZATION TECHNIQUES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the fundamentals optimization Techniques and its evolution process.
- To acquire optimization techniques using both linear and non-linear programming
- To learn various optimization algorithm constrained
- To compute the Genetic Algorithm (GA) search methods.
- To study the concepts particle swam optimization

Course Outcomes

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

CO1 - Familiarize the optimization techniques analysis**.(K1)**
CO2 - Analyse efficient computational procedures to solve optimization problems **(K2)**
CO3 - Apply constrained optimization algorithm for evaluation process **(K2)**
CO4 - Evaluate various genetic algorithm operators for evaluation process.(**K2)**
CO5 - Comprehend the basic structure of PSO and various multi-objective optimization .**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to optimization - historical development - statement of an optimization problem - classification of optimization problem - techniques - single variable optimization- multivariable optimization with equal constraints, Inequality constraints

UNIT II LINEAR AND NON-LINEAR PROGRAMMING (9 Hrs)

Linear programming problems: Definition- Standard form – geometry - simplex algorithm - decomposition principle - karmarkar's method- application.

Non-Linear programming: Elimination method - interpolation methods - classification of unconstrained minimization methods.

UNIT III CONSTRAINED OPTIMIZATION ALGORITHM (9 Hrs)

Characteristics of a constrained problem- Direct methods: complex method- Cutting plane method- Indirect method: Transformation Technique- Basic approach in the penalty function method-Interior penalty function method-convex method.

UNIT IV GENETIC ALGORITHM (9 Hrs)

Genetic algorithm–Representation of design variables- objective function and constraints- genetic operators-GA versus Traditional methods- steady state selection- selection schemes.

UNIT V PARTICLE SWAM OPTIMIZATION (9 Hrs)

Basic principle- algorithm- flowchart- computation implementation- improvement to PSO- solution of constrained optimization problem-Multi swam optimization- Multiobjective Optimization

Text Books

1. S.S. Rao, Engineering optimization: Theory and Practice, New age international (P) Ltd. 4th Edition, 2001
2. David E. Gold Berg, "Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 1st Edition, 2008.
3. Parsopoulos, K.E., Vrahatis, M.N., Particle Swarm Optimization and Intelligence: Advances and Applications, Information Science Reference, IGI Global, 1st Edition, 2010

Reference Books

1. Kalyanmoy Deb, "Optimization for Engineering Design, algorithms and examples", PHI Publishers, 2nd Edition, 2012.
2. T. J. Ross, "Fuzzy Logic with Engineering Applications", Wiley, 3rd Edition, 2010.
3. Sivanandam, S.N., Deepa, S. N, "Introduction to Genetic Algorithms, Springer", 1st Edition , 2011.
4. Ethem Alpydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)", MIT Press, 2nd Edition, 2010.

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Web References

1. https://www.researchgate.net/publication/261831018_Soft_Computing_Techniques_for_Protecting
2. https://shodhganga.inflibnet.ac.in/bitstream/10603/10161/11/11_chapter%203.pdf
3. https://www.semanticscholar.org/paper/Chapter-2-Soft-Computing-Techniques-and-Their Chaturvedi/6bc3d9f13d78b36dabeb06436a2b97bd32dbac50
4. https://ieeexplore.ieee.org/document/7938905
5. https://www.igi-global.com/chapter/soft-computing-its-applications/46389

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	-	-	-	-	-	-	-	-	-	3	2	2
2	3	2	2	-	-	-	-	-	-	--	-	-	3	2	2
3	2	2	2	-	-	-	-	-	-	-	-	-	3	2	2
4	2	2	3	-	-	-	-	-	-	-	-	-	3	2	2
5	3	2	3	-	-	-	-	-	-	-	-	-	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE825	FUNDAMENTALS OF SOLAR PHOTOVOLTAIC SYSTEM AND APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart fundamental knowledge of solar cell formation, its properties and manufacturing
- To understand the various components required in grid connected systems and its importance.
- To discuss the various components in standalone PV systems.
- To gain knowledge on various solar hybrid systems and their comparisons.
- To design the PV systems for various real load applications on cost economics.

Course Outcomes

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

CO1 - Describe the basic concepts of solar cells and its properties. **(K2)**
CO2 - Discuss about the selection of interfacing components in solar grid connected systems. **(K2)**
CO3 - Review about the various DC/AC equipment's used for stand-alone PV applications through requirements and design calculations. **(K2)**
CO4 - Analyze the applications of hybrid systems and define the structure of micro grid system.**(K3)**
CO5 - Compute cost analysis of solar PV systems. **(K3)**

UNIT I PHOTOVOLTAIC BASICS AND DEVELOPING TECHNOLOGIES (9 Hrs)

Solar Cells: Structure and working - Types, Electrical properties - Cell properties and design - PV cell interconnection and Module fabrication - PV Modules and arrays. Commercial technologies: Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells: A–Si, Cd–Te and CIGS, Concentrated PV cells, Developing technologies : Organic cells, Dye sensitized cells – Photovoltaic in global and Indian scenario

UNIT II SOLAR PV FOR ON-GRID APPLICATIONS (9 Hrs)

Solar cells to solar array – On–Grid PV system – With and Without storage – Balance of system – DC–DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring

UNIT III SOLAR PV FOR OFF-GRID APPLICATIONS (9 Hrs)

Off-Grid standalone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One–axis, Two–axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring

UNIT IV HYBRID SYSTEMS (9 Hrs)

Solar, Biomass, Wind and Diesel Hybrid systems - Comparison and selection criteria - simple hybrid systems – storage arrangements - Introduction to Micro grid – Comparison of micro grid with conventional power system – Architecture

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS (9 Hrs)

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system - Simple payback calculation.

Text Books

1. C.S. Solanki, "Solar Photovotaics – Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2nd Edition, 2011.
2. Martin A. Green, "Solar Cells Operating Principles, Technology, and System Applications", Prentice - Hall, 1st Edition, 2008.

Reference Books

1. J. Nelson, "The Physics of Solar Cells", Imperial College Press, 1st Edition, 2003.
2. Thomas Markvart, "Solar Electricity", John Wiley and Sons, 2nd Edition, 2000.
3. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish, "Applied Photovoltaics", Earth scan, 3rd Edition, 2011.
4. Michael Boxwell, "The Solar Electricity Handbook", Green stream Publishing, 10th Edition, 2016.
5. RikDe Gunther, "Solar Power-Your Home for Dummies", Wiley Publishing Inc, 2nd Edition, 2010.

(DR.S. ANBUMALAR)

Web References

1. https://swayam.gov.in/nd1_noc20_ph21/preview
2. https://swayam.gov.in/nd2_nou20_ag13/preview
3. https://www.studentenergy.org/topics/solar-pv
4. https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php
5. https://www.energysage.com/solar/
6. https://www.bca.gov.sg/publications/others/handbook_for_solar_pv_systems.pdf
7. http://www.oas.org/dsd/publications/unit/oea79e/ch05.htm

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
2	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
3	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
4	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
5	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE826	SMART GRID	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To familiarize with the fundamentals of smart grids technologies.
- To get exposure on Communication infrastructure and protocols.
- To study about the Wide Area Measurement Systems, Energy storage technologies for smart grid.
- To know about the various stability assessment tools in smart grid.
- To familiarize with the Power Quality issues of Grid connected Renewable Energy Sources.

Course Outcomes

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

CO1 - Compare the conventional electrical grid concepts with smart grid.**(K1)**

CO2 - Outline about the protocols and networks used in Smart grid.**(K2)**

CO3 - Explain the importance of WAM and energy storage technologies used in smart grid.**(K2)**

CO4 - Acquire knowledge on distributed generation and micro grids in smart grid.**(K3)**

CO5 - Analyze the power quality issues in smart grid. (**K3)**.

UNIT I INTRODUCTION (9 Hrs)

Overview of Electrical Grid – Smart Grid - Characteristics - Inventory Technologies - Operating Principles - Models of Components, Implementation - Early initiatives - Overview of technologies - Key Challenges - Self-Healing Grid - Opportunities and Barriers - Recent Research technology.

UNIT II SMART METERING AND COMMUNICATION (9 Hrs)

Smart meters - Communications infrastructure, protocols and hardware - Automatic Meter Reading (AMR) and Advanced Metering Infrastructure (AMI) drivers - benefits – Power line communication (PLC) - Machine to-machine communication models - Home Area Networks (HAN), Wide Area Networks (WAN) and Neighborhood Area Networks (NAN) - Wired and Wireless communication technologies – Cryptosystem - Internet of things (IOT).

UNIT III WAMS AND ENERGY STORAGE TECHNOLOGIES (9 Hrs)

Synchro-Phasor Measurement Units (PMUs) – Wide Area Measurement Systems (WAMS) - Geographic Information system (GIS) and Google Mapping Tools, Multiagent Systems (MAS) Technology - Sensor Networks, Fault Detection - Phasor Data Concentrator (PDC) – Road Map for synchro-phasor technology – Operational experience and Blackout analysis using PMU. Batteries, Fuel cell, Flywheels, SMES systems and Super capacitors.

UNIT IV INTEGRATION, CONTROL AND OPERATION OF DISTRIBUTED GENERATION (9 Hrs)

Distributed Generation Technologies - benefits - Utilization Barriers –integration to power grid - Introduction to Renewable Energy Technologies – Micro grids – Advantages and disadvantages of DG – Vehicle to Grid technology and Grid to vehicle technology - Performance and stability analysis in smart grid.

UNIT V POWER QUALITY MANAGEMENT IN SMART GRID (9 Hrs)

Power Quality - issues - Conditioners - Web based monitoring – Energy Audit - Cyber Security- Power Quality Improvement methods – Introduction to EMC in smart grid.

Text Books

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid Technology and Applications”, John Wiley and Sons Publication, 1st Edition, 2015.
2. Stuart Borlase, “Smart Grids: Infra structure, Technology and Solutions”, CRC Press, 1st Edition, 2013.
3. James A. Momoh, “Smart Grid: Fundamentals of Design and Analysis”, Wiley-IEEE Press, 1st Edition, 2012.

Reference Books

1. Jean Claude Sabonnadiere, NouredineHadjsaid, “Smart Grids”, Wiley Blackwell,1st Edition, 2012
2. Fereidoon. P. sioshansi, “Smart grid – integrating renewable, distributed and efficient energy”, Academic Press, 1st Edition, 2011.
3. Tony Flick, Justin Morehouse, “Securing the Smart Grid: Next Generation Power Grid Security”, Academic Press, 1st Edition, 2011.
4. Krzysztof Iniewski, “Smart Grid Infrastructure and Networking”, Tata McGraw Hill, 1st Edition, 2012.
5. SawanSen, Samarjit Sengupta, Abhijit Chakrabarti, “Electricity pricing- regulated, deregulated and smart grid systems”, CRC press, 1st Edition, 2018.

(DR.S. ANBUMALAR)

Web References

1. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee42/
2. https://onlinecourses.nptel.ac.in/noc19_ee64/preview
3. https://www.classcentral.com/course/swayam-introduction-to-smart-grid-14165
4. https://npti.gov.in/smart-grid-technologies
5. http://www.infocobuild.com/education/audio-video-courses/electronics/IntroductionToSmartGrid-IIT-Roorkee/lecture-04.html

COs/POs/PSOs Mapping

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3	3	2	2	3	1	1	1	-	-	-	-	2	2	1	2
4	3	2	2	3	1	1	1	-	-	-	-	2	2	1	2
5	3	2	2	3	1	1	1	-	-	-	-	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE827 **EHV AC AND DC TRANSMISSION**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To impart knowledge on structure of power system and standard voltage levels
- To study about the transmission line and ground parameters
- To equip the students to understand the HVDC transmission system and its types.
- To impart knowledge on various FACTS devices on power system
- To understand the electrostatic and magnetic fields of EHV lines

Course Outcomes

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

CO1 - Identify the transmission (HVAC and HVDC) and distribution voltage levels. **(K2)**

CO2 - Compute the transmission line parameters. **(K3)**

CO3 - Analyze and locate required HVDC transmission in power system. **(K3)**

CO4 - Analyze the performance characteristics of FACTS devices and select suitable FACTS devices for various applications. **(K3)**

CO5 - Compute electrostatic and magnetic fields of EHV lines. **(K3)**

UNIT I TRANSMISSION LINE TRENDS (9 Hrs)

Standard transmission voltages, average values of line parameters, Substation equipments – Power handling capacity and line losses - number of lines, Advantages and disadvantages of HVAC and HVDC system.

UNIT II LINE AND GROUND PARAMETERS (9 Hrs)

Resistance, Temperature rise and current carrying capacity of conductors. Properties of Bundle conductors – Calculation of L and C parameters – Modes of propagation – Effect of Earth.

UNIT III HVDC SYSTEM (9 Hrs)

Economics and Terminal equipment of HVDC transmission systems – HVDC Power transmission–Description, principles of operation and Planning for HVDC transmission–DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT IV FACTS (9 Hrs)

Basic concepts – Real and Reactive power control, uncompensated transmission line, series compensation, SVC, thyristor control, series capacitor, static synchronous compensator, unified power flow controller and applications.

UNIT V ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES (9 Hrs)

Electric shock – threshold currents – Calculation of electrostatic fields and magnetic fields of AC and DC lines – Effect of fields on living organism – Electrical field measurement.

Text Books

1. K. R. Padiyar, “HVDC power transmission system”, Wiley Eastern Limited, 3rd Edition, 2014.
2. Rakosh Das Begamudre , “Extra High Voltage AC Transmission Engineering”, New Academic Science, 4th Edition, 2011
3. P. Kundur, “Power System stability and control”, Tata McGraw Hilll Publishers, 1st Edition, 2006.

Reference Books

1. Dragan Jovcic, “High Voltage Direct Current Transmission: Converters, Systems and DC Grids”, Wiley Publishers, 2nd Edition, 2019.
2. N.G.Hingorani and L.Guygi, “Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems”, John Wiley and Sons, Inc., 1st Edition, 2011.
3. S. Rao, “EHV-AC, HVDC Transmission and Distribution”, Khanna Publishers, 3rd Edition, 2009.
4. Jos Arrillaga, “High Voltage Direct Current Transmission”, Institution of Engineering and Technology, 2nd Edition, 2008.

(DR.S. ANBUMALAR)

Web References

1. http://nptel.ac.in/courses/108104013
2. https://nptel.ac.in/courses/108/102/108102047/
3. https://electrical-engineering-portal.com/advantages-of-hvdc-over-hvac-transmission
4. https://electrical-engineering-portal.com/why-hvdc-transmission-system-beats-hvac
5. https://www.youtube.com/watch?v=cEKB4jvW5Mg

COs/POs/PSOs Mapping

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1	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
2	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
4	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20EEE828	RESTRUCTURED POWER SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course objectives

- To provide in-depth understanding of operation of restructured electricity market.
- To explain topical issues in transmission challenges and computation of available transfer capability.
- To explore electricity market operational and control issues under congestion management.
- To comprehend different pricing mechanism of electric energy and trading of power under restructured environment.
- To describe the current scenario and operation issues in restructured Indian power market.

Course outcomes

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

CO1 - Illustrate the need of restructuring power systems and generalize the activities of Independent system operator. **(K2)**
CO2 - Identify the transmission challenges using various methodology and estimate available transfer Capability. **(K3)**
CO3 - Analyze transmission open access pricing issues in congestion management and ancillary service methods in restructured environment. **(K2)**
CO4 - Calculate transmission pricing for reliable operation of the electricity market. **(K3)**
CO5 - Interpret about the available based tariff and open access issues in restructured Indian power market. **(K2)**

UNIT I FUNDAMENTALS OF POWER MARKETS (9 Hrs)

Fundamentals of Restructured Power system – Motivation for restructuring – Components of Restructured Systems: Gencos, Discos and Retailers, Wheeling Methodology - Power exchange and market operations - Framework and methods for the analysis of Bilateral and pool markets - Role of Independent System Operator - Operating Experiences of Restructured Electricity Markets in various Countries - Restructuring process in Indian Electric Power Market.

UNIT II TRANSMISSION CHALLENGES (9 Hrs)

Role of transmission planning– Transmission Capacity – Total Transfer Capability – Computational procedure - Margins– Concept of Available transfer capability – Principles – Constraints - Market splitting- counter - trading - Methodology to compute ATC - Calculation of ATC using AC model - Price based OPF in restructured markets.

UNIT III CONGESTION MANAGEMENT AND ANCILLARY SERVICES (9 Hrs)

Concept of Congestion Management – Methods to relieve the congestion - Inter and Intra zonal Congestion Management – Locational Marginal Pricing – Price area congestion management - Congestion Management in Open - access Transmission Systems - Financial Transmission Right - Ancillary Services - Synchronous Generators as Ancillary Service Providers - Voltage control and reactive power support ancillary services.

UNIT IV TRANSMISSION PRICING (9 Hrs)

Transmission pricing methods - Postage stamp - Contract path - MW-mile methods – Distribution Factor method – Congestion Pricing, Tracing method- Comparison between various methods - Short run marginal cost – Generator Ramping and Opportunity Costs - Marginal cost of generation - least cost operation-incremental cost of generation - Challenges to electricity pricing - ANN based price forecasting.

UNIT V INDIAN POWER MARKET (9 Hrs)

Current Scenario – Regions – Regulatory and Policy development in Indian power Sector – Availability based tariff – Necessity – Working Mechanism – Unscheduled Interchange Rate – Operation of Indian Power Exchange - Attributes of a perfectly competitive market - Opportunities for IPP and capacity power producer - Indian Electricity Grid Code - Open access issues – Power exchange – Reforms in the near future.

Text books

1. LoiLeiLai, "Power system Restructuring and Regulation", John Wiley sons, 1st Edition, 2001.
2. Kankar Bhattacharya, Math H. J. Bollen and Jaap E. Daalder, "Operation of Restructured Power Systems", Kluwer Academic Publishers, 1st Edition, 2001.
3. M. Shahidehpour, H. Yamin and Z. Li, "Market Operations in Electric Power Systems", John Wiley and Sons, Inc., 1st Edition, 2002.

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Reference books

1. M. M. Tripathi. “Restructured Power System and Electricity Market” Createspace Independent Pub., 1st Edition, 2015.
2. M.Shahidehpour and M.Alomoush, “Restructuring Electrical Power Systems”, CRC Press, 1st Edition, 2017.
3. Dr.Rajib Mishra, V. K. Khanija and P. P. Wahi, “Indian Power Market (Electricity Marketing Simplified)” Central Board of Irrigation and Power (CBIP), Govt of India, 2016.

Web References

1. https://greeningthegrid.org/integration-in-depth/ancillary-services
2. https://www.electricalindia.in/ancillary-services-for-power-sector/
3. https://nptel.ac.in/courses/108/101/108101005/
4. https://www.sterlitepower.com/blog/overcoming-transmission-challenges-technology
5. https://ocw.mit.edu/courses/institute-for-data-systems-and-society/ids-505j-engineering-economics-and-regulation-of-the-electric-power-sector-spring-2010/lecture-notes/MITESD_934S10_lec_16.pdf

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1	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
2	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
3	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
4	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
5	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE829	POWER SYSTEM STABILITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of stability of power systems and its classification
- To expose the students to dynamic behavior of the power system for small and large disturbances
- To gain knowledge on various numerical integration methods
- To comprehend the factors affecting voltage stability and voltage collapse
- To provide knowledge about the methods of improving stability

Course Outcomes

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

CO1 - Analyze the stability problems occurring in power grid **(K2)**
CO2 - Perform small signal stability analysis of single machine infinite bus system **(K3)**
CO3 - Interface synchronous machine model to transient stability algorithm **(K3)**
CO4 - Elucidate the factors affecting voltage stability and its characteristics on power system components **(K2)**
CO5 - Analyze the methods used to enhance transient stability and small-signal stability **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Concept and importance of stability to power system: Steady state, transient and dynamic stability - single equivalent machine connected to infinite bus - multi machine stability problem - Swing equation for a synchronous Machine – Modelling of Synchronous machine for stability studies(classical model) - Rotor dynamics and the swing equation.

UNIT II SMALL-SIGNAL STABILITY (9 Hrs)

Fundamental concepts and definitions – State space representation, Physical Interpretation of small–signal stability, Eigen properties of the state matrix: Eigenvalues and eigenvectors, modal matrices, eigenvalue and stability, mode shape, sensitivity and participation factor. Small–signal stability analysis of a Single-Machine Infinite Bus.

UNIT III TRANSIENT STABILITY (9 Hrs)

Review of numerical integration methods: modified Euler and Fourth Order Runge-Kutta methods, Numerical stability. Interfacing of Synchronous machine (classical machine) model to the transient stability algorithm.

UNIT IV VOLTAGE STABILITY (9 Hrs)

Factors affecting voltage stability- Classification of Voltage stability-Transmission system -Generator - Load characteristics- Reactive power compensating Devices- Voltage collapse, Prevention of voltage collapse.

UNIT V METHODS OF IMPROVING STABILITY (9 Hrs)

Transient stability enhancement: High-speed fault clearing regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast-valving, high-speed excitation systems. Small signal stability enhancement: Power system stabilizers, supplementary control of static var compensator and HVDC transmission links.

Text Books

1. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education, 1st Edition, 2006.
2. K R Padiyar, "Power System Dynamics: Stability and Control", BS Publications, 2nd Edition, 2008.
3. Vijay Vittal, James D. McCalley, Paul M. Anderson, "Power System Control and Stability", Wiley-Blackwell, 3rd Edition, 2019.

Reference Books

1. R.Ramnujam," Power System Dynamics Analysis and Simulation, PHI Learning Private Limited, New Delhi, 1st Edition, 2009.
2. Peter W., Saucer, Pai M.A., "Power System Dynamics and Stability, Pearson Education (Singapore), 9th Edition, 2007.
3. EW. Kimbark, "Power System Stability", John Wiley & Sons Limited, New Jersey, 1st Edition, 2013.

(DR.S. ANBUMALAR)

Web References

1. https://www.electrical4u.com/power-system-stability/
2. https://circuitglobe.com/power-system-stability.html
3. https://nptel.ac.in/content/storage2/courses/108106026/chapter1.pdf
4. https://electrical-engineering-portal.com/power-system-stability
5. https://link.springer.com/chapter/10.1007/978-981-15-3212-2_9

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3	3	3	3	2	-	-	-	-	-	-	-	1	3	2	2
4	3	3	3	2	-	-	-	-	-	-	-	1	3	2	2
5	3	3	3	2	-	-	-	-	-	-	-	1	3	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20EEE830	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To discover the importance of renewable energy on power generation.
- To learn the various operating modes of solar and wind energy systems.
- To understand the different power converters for renewable energy systems.
- To gain knowledge on stand-alone and grid connected renewable energy systems.
- To acquire importance of hybrid renewable systems and maximum power point tracking algorithms.

Course Outcomes

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

CO1 - Design and analyze the electrical generators for renewable energy conversion.**(K2)**
CO2 - Interpret the applications of power electronics in wind and solar energy systems. **(K2)**
CO3 - Design different power converters for renewable energy systems. **(K2)**
CO4 - Analyze standalone and grid connected operating modes of wind, solar energy systems**. (K2)**
CO5 - Implement maximum power point tracking algorithm and gain knowledge on hybrid systems. **(K2)**

UNIT I ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION (9 Hrs)

Environmental aspects of electric energy conversion – impacts of renewable energy generation on environment – qualitative study of different renewable energy resources – Modeling and analysis of Doubly Fed Induction Generator – Permanent Magnet Synchronous Generator – Squirrel Cage Induction Generator.

UNIT II SOLAR ENERGY AND WIND ENERGY (9 Hrs)

Solar and Wind potential in India - Solar energy: solar thermal conversion devices and storage – solar cells – characteristics and photovoltaic conversion – estimation of solar radiation – PV systems – analysis of PV systems – applications of PV Systems- Harmonic standards-Harmonic problems- MPPT

Wind Energy: nature of wind – Power in wind-site selection consideration – basic components of wind energy conversion system – types of wind machines – control techniques – applications of wind energy – inter connected systems - Harmonics and power factor improvement.

UNIT III POWER CONVERTERS (9 Hrs)

Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing.

Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS (9 Hrs)

Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS (9 Hrs)

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking

Text Books

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 1st Edition, 2005.
2. B. H. Khan, “Non-conventional Energy Resources”, Tata McGraw-hill Publishing Company, 3rd Edition, 2017.
3. K. Venkataratnam, “Special Electrical Machines”, Universities Press, 1st Edition, 2008.

Reference Books

1. M. H. Rashid, “Power Electronics Hand book”, Academic press, 4th Edition, 2017.
2. Ion Boldea, “Variable speed generators”, Taylor and Francis group, 2nd Edition, 2015.
3. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, “Grid Converters for Photovoltaic and Wind Power Systems”, John Wiley and Sons, Ltd., 1st Edition, 2011.
4. Gray, L. Johnson, “Wind energy system”, Prentice hall linc, Electronic Edition, 2006.
5. Andrzej M. Trzynnadlowski, “Introduction to Modern Power Electronics”, Wiley, India Pvt. Ltd, 2nd Edition, 2012.

(DR.S. ANBUMALAR)

Web References

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/121/106/121106014/
3. https://www.irjet.net/archives/V5/i5/IRJET-V5I5482.pdf
4. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=4778368
5. https://www.youtube.com/watch?v=GnZFi9CzF9Q

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
2	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	1	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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OPEN ELECTIVE

U20ECO401	ENGINEERING COMPUTATION WITH MATLAB (Common to EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB.
- To learn various programming structures in MATLAB.
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB.
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity.

Course Outcomes

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

CO1 - State the basics of MATLAB. **(K1)**

CO2 - Explain how to work with matrices, and their operations. **(K2)**

CO3 - Use the MATLAB functions relevant to communication engineering. **(K3)**

CO4 - Demonstrates various file operations in MATLAB. **(K3)**

CO5 - Applying the plotting capabilities of MATLAB effectively to various systems. **(K3)**

UNIT I INTRODUCTION TO MATLAB (9 Hrs)

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files.

UNIT II LOOPS & CONTROL STATEMENTS (9 Hrs)

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval & lastern commands.

UNIT III PLOTS IN MATLAB & GUI (9 Hrs)

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG - POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions.

UNIT IV MISCELLANEOUS TOPICS (9 Hrs)

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT V SIMULINK & APPLICATIONS (9 Hrs)

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs - Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. Rudra Pratap, “Getting Started with MATLAB 6.0”, 1st Edition, Oxford University Press, 2004.
2. Duane Hanselman ,Bruce LittleField, “Mastering MATLAB 7”, Pearson Education Inc, 2005
3. William J. Palm, “Introduction to MATLAB 6.0 for Engineers”, McGraw Hill & Co, 2001.

Reference Books

1. M. Herniter, “Programming in MATLAB”, Thomson Learning, 2001
2. John OkyereAltla, “Electronics and circuit analysis using MATLAB”, CRC press, 1999
3. K.K.Sharma, “MATLAB Demustifyied”, Vikas Publishing House Pvt Ltd. 2004

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Web References

1. https://www.mathworks.com/products/matlab.html
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	2	3	-	-	-	-	-	-	-	-	2	2
2	2	2	-	2	3	-	-	-	-	-	-	-	-	2	2
3	2	2	-	2	3	-	-	-	-	-	-	-	-	2	2
4	2	2	-	2	3	-	-	-	-	-	-	-	-	1	1
5	2	2	-	2	3	-	-	-	-	-	-	-	-	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ECO402	CONSUMER ELECTRONICS (Common to EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To enable the troubleshoot of different types of microphones and loudspeakers.
- To make the students to analyze the working of digital console, digital FM tuner and troubleshoot audio systems.
- To train and test the working of various colour TV.
- To empower them to troubleshoot colour TV receivers.
- To equip them to maintain various electronic home and office appliances.

Course Outcomes

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

CO1 - Describe the fundamental audio characteristics and measurements, operating principles of microphone and loudspeaker. **(K1)**

CO2 - Explain the working of digital console, digital FM tuner and troubleshoot the audio systems. **(K2)**

CO3 - Distinguish the salient features of colour TV and Monochrome and troubleshoot TV camera. **(K2)**

CO4 - Demonstrate various interfaces in digital TV, the working of DTH receiver, CD/DVD players. **(K3)**

CO5 - Explain the working of FAX, Microwave oven, Washing machine, Air conditioner, Refrigerators and camera. **(K2)**

UNIT I AUDIO FUNDAMENTALS AND DEVICES (9 Hrs)

Basic characteristics of sound signal, Microphone - working principle, sensitivity, nature of response. Types of Microphone, Loud speaker - working principle, Woofers and Tweeters, characteristics. Types of Loudspeaker. Sound recording.

UNIT II AUDIO SYSTEMS (9 Hrs)

Introduction to audio system, Digital Console- Block diagram, working principle, applications, FM tuner- concepts of digital tuning, ICs used in FM tuner TD702IT, PA address system- Planning, speaker impedance matching, characteristics, power amplifier specification.

UNIT III TELEVISION SYSTEMS (9 Hrs)

Monochrome TV standards, Components of TV system, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution. Composite video signal, Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance. Different types of TV camera.

UNIT IV TELEVISION RECEIVERS AND VIDEO STANDARDS (9 Hrs)

Colour TV receiver- block diagram, Digital TVs- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI, Digital Video Interface, CD and DVD player: working principles, interfaces

UNIT V HOME AND OFFICE APPLIANCES (9 Hrs)

Microwave Oven: Types, technical specifications. Washing Machine: hardware and software. Air conditioner and Refrigerators: Components features, applications, and technical specification. Digital camera and cam coder: - pick up devices, picture processing, picture storage

Text Books

1. Bali S.P., “Consumer Electronics”, copyright 2008, Pearson Education India
2. Bali R and Bali S.P. “Audio video systems: principle practices & troubleshooting”, Khanna Book Publishing Co. (P) Ltd.
3. Gulati R.R., “Modern Television practices”, 5^{th} Edition, 2015, New Age International Publication (P) Ltd

Reference Books

1. Gupta R.G., ‘Audio video systems’, 2^{nd} edition,2017, Tata Mcgraw Hill, New Delhi, India
2. Whitaker Jerry & Benson Blair, ‘Mastering Digital Television’, McGraw-Hill Professional, 2006
3. Whitaker Jerry & Benson Blair, ‘Standard handbook of Audio engineering’, 2^{nd} edition,2002, McGraw-Hill Professional

(DR.S. ANBUMALAR)

Web References

1. http://www.scientificamerican.com/article.cfm?id = experts.bluetooth-work
2. http://www.cosc.brocku.ca/Offerings/3P92/seminars/HDTV.ppt
3. http://www.circuitstoday.com/blu-ray-technology-working
4. http://www.freevideolectures.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	2	1	-	1	-	-	-	-	-	-	3	1	3
2	2	-	2	1	-	1	-	-	-	-	-	-	3	1	3
3	2	-	2	1	-	1	-	-	-	-	-	-	3	1	3
4	2	-	2	1	-	1	-	-	-	-	-	-	3	1	3
5	2	-	2	1	-	1	-	-	-	-	-	-	3	1	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20CSO401	**WEB DEVELOPMENT** (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the fundamentals of web application development.
- To understand the design components and tools using CSS.
- To learn the concepts Java Script and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML.

Course Outcomes

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

CO1 - Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 - Validate the web pages using java scripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols – Secure Connections – Application and development tools – Web browser – Server definition – Dynamic IP. Web Design: Web site design principles – Planning the site and navigation. HTML: Development process – Html tags and simple HTML forms – Web site structure.

UNIT II STYLE SHEETS (9 Hrs)

Introduction to CSS: Need for CSS – Basic syntax and structure using CSS – Background images – Colors and properties – Manipulating texts using fonts, borders and boxes – Margins, padding lists, positioning using CSS – CSS2

UNIT III JAVA SCRIPTS (9 Hrs)

Client side scripting: Basic JavaScript – Variables – Functions – Conditions – Loops. Applications: Page Validation – Reporting.

UNIT IV ADVANCE SCRIPT (9 Hrs)

JavaScript and objects – DOM and Web browser environments – Forms and Validations – DHTML. AJAX: Introduction – Web applications – Alternatives of AJAX.

UNIT V XML (9 Hrs)

Introduction to XML – Uses of XML – Simple XML – XML key components – DTD and Schemas – Well-formed XML document – Applications of XML – XSL and XSLT.

Text Books

1. Keith Wald, Jason Lengstorf," Pro PHP and jQuery", Paperback, 2016.
2. Semmy Purewal, "Learning Web App Development", O'Reilly Media, 2014.
3. P.J. Deitel and H.M. Deitel, "Internet and World Wide Web - How to Program", Pearson Education, 2009.

Reference Books

1. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, "Enterprise Web Development ", O'Reilly Media, 2014.
2. Steven Suehring, Janet Valade, "PHP, MySQL, JavaScript & HTML5 All-in-One", John Wiley & Sons, Inc, 2013.
3. Uttam K. Roy, "Web Technologies", Oxford University Press, 2010.
4. Rajkamal, "Web Technology", Tata McGraw-Hill, 2009.
5. Shklar, Leon, Rosen, Rich, "Web Application Architecture: Principles, Protocols and Practices", Wiley Publication, 2009.

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Web References

1. https://www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/
3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

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1	3	3	3	3	3	3	3	3	-	-	3	-	-	-	2
2	2	2	2	2	-	2	-	2	-	2	-	2	-	-	2
3	3	3	3	3	3	3	3	3	-	-	3	-	-	-	2
4	2	2	2	2	-	2	-	2	-	2	-	2	-	-	2
5	2	2	2	2	-	2	-	2	-	2	-	2	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20CSO402	ANALYSIS OF ALGORITHMS (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity.
- To understand the performance of the algorithms such as divide and conquer, greedy method
- To solve problems using Dynamic Programming and derive the time complexity.
- To solve problems using Backtracking technique and derive the time complexity.
- To solve problems using Branch and Bound technique and derive the time complexity.

Course Outcomes

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

CO1 - Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**
CO2 - Understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**
CO3 - Understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**
CO4 - Understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**
CO5 - Understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis – Time complexity, Space complexity, Asymptotic Notation – Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD (9 Hrs)

Divide and Conquer method: Applications – Binary search, Merge sort, Quick sort. Greedy method: General method, applications – Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING (9 Hrs)

Backtracking: General method, Applications – N-queen problem, Sum of subsets problem, Graph Coloring – Hamiltonian Cycles.

UNIT V BRANCH AND BOUND (9 Hrs)

Branch and Bound**:** General method, Applications – Traveling sales person problem, 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution.

Text Books

1. E. Horowitz and S.Sahni, “Fundamentals of Algorithms”, Galgotia Publications, 2nd Edition, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, “Introduction to Algorithms”, PHI/Pearson Education, 3rdEdition, 2009.
3. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, Pearson Education, Third Edition, 2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, “Algorithm Design: Foundations, Analysis and Internet Examples”, Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, “Computer Algorithms Introduction to Design and Analysis”, Pearson Education Asia, 3rd Edition, 2010.
3. Donald E Knuth, “The Art of Computer Programming, Volume I & II”, Addison Wessely, Third Edition, 2011.

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4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 2006.
5. Harsh Bhasin, “Algorithms Design and Analysis”, Oxford university press, 2016.

Web References

1. https://swayam.gov.in/nd1_noc20_cs71/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	2	1	-	-	-	-	-	2	1	2
2	3	2	3	3	2	2	1	-	-	-	-	-	2	1	2
3	3	3	3	3	2	2	2	-	2	-	-	-	2	1	2
4	3	2	3	3	3	2	2	-	-	-	3	-	2	1	2
5	3	3	3	3	2	2	2	-	-	-	3	2	2	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ITO401 **DATABASE SYSTEM: DESIGN & DEVELOPMENT**

(Common to EEE, ECE, ICE, CCE, BME)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes

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

CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application. **(K2)**
CO2 - Manipulate and build database queries using Structured Query Language and relational algebra. **(K2)**
CO3 - Apply data normalization principles to develop a normalized database for a given application. **(K3)**
CO4 - Explain various storage & indexing techniques, transactions and recovery techniques. **(K2)**
CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram-Extended ER Model –ER into Relational Model - **Relational Model**: Structure of Relational Databases, Database Schema, Keys, Tables

UNIT II DATABASE LANGUAGES (9 Hrs)

Relational Algebra – Extended-Relational Algebra Operations – **SQL**: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL - DATA BASE DESIGN (9 Hrs)

Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE (9 Hrs)

RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing.
Transactions: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - **Recovery System**: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY (9 Hrs)

NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

Text Books

1. Silberschatz, Korth, Sudarshan, Database System Concepts, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson, 2016

Reference Books

1. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, —An Introduction to Database Systems‖, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.
5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Kindle Edition

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Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.com/

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ITO402	R PROGRAMMING (Common to EEE, ECE, ICE, CCE, BME, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model

Course Outcomes

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

CO1 - Create artful graphs to visualize complex data sets and functions. **(K3)**
CO2 - Write more efficient code using parallel R and vectorization. **(K3)**
CO3 - Create data frames and working with tables. **(K3)**
CO4 - Interface R with C/C++ and Python for increased speed or functionality. **(K2)**
CO5 - Find new packages for text analysis, image manipulation &perform statistical analysis. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS (9 Hrs)

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES (9 Hrs)

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS (9 Hrs)

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

UNIT V INTERFACING (9 Hrs)

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.
2. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

Reference Books

1. Mark Gardener, “ Beginning R – The Statistical Programming Language”, Wiley, 2013
2. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.

Web References

1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

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COs/POs/PSOs Mapping

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2	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20MEO401

RAPID PROTOTYPING

(Common to EEE, ECE, ICE, CIVIL, BME, FT)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the development of RP systems.
- To learn the classification of liquid based and solid based rapid prototyping systems.
- To understand the powder based rapid prototyping systems.
- To learn about the materials for rapid prototyping systems.
- To discuss about the reverse engineering and new technologies.

Course Outcomes

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

CO1 - Acquire knowledge about the product development. **(K1)**
CO2 - Analyse the classification of liquid based and solid based rapid prototyping systems. **(K4)**
CO3 - Analyse the powder based rapid prototyping systems. **(K4)**
CO4 - Acquire knowledge about the materials for rapid prototyping systems. **(K1)**
CO5 - Acquire knowledge about reverse engineering and new technologies. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format– Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Classification – Liquid based system – Stereo lithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system- Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS (9 Hrs)

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES (9 Hrs)

Introduction, measuring device - contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

Text Books

1. Rafiq I. Noorani, Rapid Prototyping, “Principles and Applications”, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, “Rapid Prototyping: Principles and Applications”, World Scientific, 2nd Edition, 2003.
3. Amitav Ghosh, “Introduction to Rapid Prototyping”, North West Publication, New Delhi, 2008.

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Reference Books

1. Hopkinson N, R.J.M, Hauge, P M, Dickens, “Rapid Manufacturing – An Industrial revolution for the digital age”, Wiley, 2006
2. Ian gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying”, Wiley, 2006
3. Paul F. Jacobs, Rapid Prototyping and Manufacturing, “Fundamentals of Stereo lithography”, McGraw Hill 1993.
4. Pham D.T and Dimov, “Rapid Manufacturing”, Springer Verlog, 2001.
5. Liou W. Liou, Frank W. Liou, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2007.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.digimat.in/nptel/courses/video/112104265/L01.html
3. https://nptel.ac.in/courses/112/107/112107078/
4. https://www.youtube.com/watch?v=oDdOqLblmVQ
5. https://www.youtube.com/watch?v=OhNnKTaciVI

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	-	-	-	-	-	-	2	3	2	3
2	3	3	3	3	1	-	-	-	-	-	-	2	3	2	3
3	3	3	3	3	1	-	-	-	-	-	-	2	3	2	3
4	3	3	3	3	1	-	-	-	-	-	-	2	3	2	3
5	3	3	3	3	1	-	-	-	-	-	-	2	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20MEO402	MATERIAL HANDLING SYSTEM (Common to EEE, ICE, CIVIL, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes

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

CO1 - Describe the principal groups of material handling equipments. **(K2)**
CO2 - Describe about the flexible hosting appliances. **(K2)**
CO3 - Explains about the material handling attachments, hook bearings, crane attachment. **(K1)**
CO4 - Illustrate the basic material handling system, selection. **(K1)**
CO5 - Define theergonomics related to material handling equipment. **(K1)**

UNIT I MATERIAL HANDLING EQUIPMENTS (9 Hrs)

Types of intraplant transporting facility - principal groups of material handling equipments - choice of material handling equipment - hoisting equipment, screw type, hydraulic and pneumatic conveyors - general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications - Introduction to control of hoisting equipments.

UNIT II FLEXIBLE HOSTING APPLIANCES (9 Hrs)

Flexible hoisting appliances like ropes and chains, welded load chains, roller chains - selection of hemp rope chains and steel wire rope - selection of ropes - fastening of chain sand ropes - different types of load suspension appliances - fixed and movable pulleys, different types of pulley systems, multiple pulley systems - Chain and rope sheaves and sprockets.

UNIT III MATERIAL HANDLING ATTACHMENTS (9 Hrs)

Load handling attachments - standard forged hook, hook weights, hook bearings, cross piece and casing of hook - crane grab for unit and piece loads - carrier beams and clamps - load platforms and side dump buckets- electric lifting magnets - grabbing attachments for loose materials - crane attachments for handling liquid materials.

UNIT IV MATERIAL HANDLING SYSTEMS (9 Hrs)

Basic Material Handling systems - Selection, Material Handling method - path, Equipment - function oriented systems.

UNIT V METHODS TO MINIMIZE COST OF MATERIAL HANDLING (9 Hrs)

Methods to minimize cost of material handling- Maintenance of Material Handling Equipments - Safety in handling - Ergonomics of Material Handling equipment - Design, Miscellaneous equipment

Text Books

1. Rudenko N, “Materials Handling Equipment” , Envee Publishers, New Delhi, 2017.
2. Alexandrov M. P, “Materials Handling Equipment”, Mie publications, Moscow, 2013.
3. White, John A., Pence, Ira W, “Materials handling and logistics”, Envee Publishers, New Delhi, 2016.

Reference Books

1. Arora K.C, Vikas V. Shinde, “Aspects of Material handling”, Laxmi Publications; First edition, 2015.
2. Siddhartha Ray, “Introduction to Material Handling”, New Age International, 2nd Edition, 2017.
3. Chowdary RB, G. R. N. Tagore, “Plant Layout and Material Handling”, Khanna publishers; 2nd Edition, 2016.
4. James A Apple, “Plant layout and Material Handling”, Krieger Pub Co, 2016.
5. Mahapatra P.B, “Operations Management”, PHI, 2016

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Web References

1. https://nptel.ac.in/courses/112/102/112102011/
2. https://nptel.ac.in/courses/112/107/112107142/
3. https://nptel.ac.in/courses/112/107/112107143/
4. https://www.youtube.com/watch?v=WXmIdbVDJqE
5. https://www.youtube.com/watch?v=BBWPIByOEfI

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	-	-	-	-	-	-	1	3	1	2
2	3	3	3	3	-	-	-	-	-	-	-	1	2	1	2
3	3	3	3	3	-	-	-	-	-	-	-	1	2	1	2
4	3	3	3	3	-	-	-	-	-	-	-	1	3	1	2
5	3	3	3	3	-	-	-	-	-	-	-	1	3	1	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CEO401

ENERGY AND ENVIRONMENT

(Common to EEE, ECE, MECH, BME, IT, Mechatronics, FT)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of various renewable energy sources
- Discuss the positive and negative aspects of renewable energy along with hybrid technologies
- Explain the importance of biomass energy and its applications

Course Outcomes

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

CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment. **(K3)**

CO2 - Identify, review & analyze the complex problems of Energy crises. **(K4)**

CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations. **(K4)**

CO4 - Understanding the complex problems of impact of energy on environment providing Solutions for sustainable development. **(K5)**

CO5 - Apply biomass energy under relevant technologies. **(K3)**

UNIT I ENERGY (9 Hrs)

Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production, utilization. Global energy scenario, Indian energy scenario, Codes, standards and legislation, Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT (9 Hrs)

Impact of energy on economy & environment, Concerns about change in global temperature, Regional impacts of temperature change, Global warming, Greenhouse effect, Acid rain, Ozone layer depletion, International agreements on environment, Indian environment degradation, Environmental laws , Water Act 1974 (Prevention & control of pollution), The environment protection act 1986 , Air act ,Energy for sustainable development.

UNIT III HYDROPOWER ENERGY (9 Hrs)

Introduction, Advantages of hydropower generation, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control, case study, Numerical Nuclear Energy - Introduction, Site selection, layout of power plant, components & working, reactors, adverse effects, safety measures, disposal of nuclear waste, case study, Numerical.

UNIT IV SOLAR ENERGY (9 Hrs)

Introduction, Advantages, Sun as source of energy, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells, cell technology, PV technology characteristics of PV, case study, Numerical Wind Energy - Introduction, advantages/limitations, history of wind energy, global & Indian wind energy scenario Site selection, layout of power plant, components &working, classifications, case study.

UNIT V BIOMASS ENERGY (9 Hrs)

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass conversion technologies, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant – KVIC & janata model , Biomass programme in India, case study, Numerical Hybrid / Unconventional Energy Technologies: Introduction, need, advantages, Technologies.

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Text Books

1. Trivedi R.R. and Jalka K.R, “Energy Management”, Commonwealth Publication, 2017.
2. Diamant R.M.E., “Total Energy”, Pergamon, Oxford Publishers, 2017.
3. N.G. Ajjanna “ Energy auditing & demand side management” first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar “ Power system Engineering” 2001, Dhanpat Rai & Co, New Delhi.
5. D. P. Kothari, K.C Singal, Rajesh Ranjan, “Renewable Energy sources and Emerging Technologies”, second edition , PHI , India

Reference Books

1. Boyle G, Everett B and Ramett J, “Energy systems and sustainability”, Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar “Energy Technologies” Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd “Renewable Energy systems” Pearson, India
6. Godfrey Boyle, “Renewable Energy power for sustainable future” oxford Publications , New Delhi

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
4. www.cites.org
5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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3	3	3	3	3	2	3	3	3	2	3	2	3	3	3	3
4	3	3	2	3	2	3	3	3	2	3	2	3	3	3	3
5	3	3	2	3	2	3	2	3	2	3	2	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CEO402 **BUILDING SCIENCE AND ENGINEERING**
(Common to EEE, MECH, BME)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the basic materials in civil engineering and Have an insight to different types of doors, windows.
- Analyze the types of foundation.
- Gain the knowledge of bylaws for the planning of a public/private building.
- Understand the different methods and materials of interiors for building.
- Understand the concept of landscaping.

Course Outcomes

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

CO1 - Apply the knowledge of engineering fundamentals to understand, the characteristics of basic civil engineering materials. **(K2)**

CO2 - Apply the knowledge of engineering fundamentals and analyze the types of foundation **(K2)**

CO3 - Develop plan, section and apply bylaws and investigate causes and remedies for cracks, have an insight to cost effective construction. **(K3)**

CO4 - Understand, design and work in a team and develop the interiors. **(K5)**

CO5 - Understand, design and work in a team and develop landscaping for buildings as per design guidelines. **(K5)**

UNIT I MATERIALS FOR CONSTRUCTION (9 Hrs)

Cement concrete: introduction, ingredients of cement, grade of concrete, properties. Steel :definition , types of steel, uses of steel, market forms of steel used in construction Doors and windows : location of doors and windows, types of doors, types of windows, Stairs : requirements of good stairs, types , stairs of different materials

UNIT II FOUNDATION AND STRUCTURAL MEMBERS (9 Hrs)

Selection of site, substructure, objectives of foundation, site inspection, soils, loads on foundations, essential requirements of good foundation, types of foundation, failure of foundation and remedial measures. Structural members: columns, lintels, roofing (flat roof and sloped roof), flooring (types of floors and floor covering), damp proofing, plastering.

UNIT III BUILDING PLANNING AND MAINTAINENCE (9 Hrs)

Plan, section and elevation .Introduction, classification of buildings, components of buildings, building bylaws, orientation of buildings, ventilation, acoustic requirements, Superstructure: introduction, brick masonry, stone masonry and RCC. Building maintenance Deterioration of concrete, deterioration of masonry works, prevention of cracks and leaks, cost effective construction, anti-termite treatment in building.

UNIT IV INTERIOR DESIGN (9 Hrs)

Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area, home offices, sleeping area, bathrooms, public/private buildings

UNIT V LANDSCAPING (9 Hrs)

Elements of Landscape architecture, specialization in landscape, landscape products, landscape materials, and water efficient landscaping, design guidelines for interior landscape

Text Books

1. Basic civil engineering : M.S.palanichamy, fourth edition Tata mcgraw hill limited, 2005
2. Basic civil engineering : sateesh gopi ,pearson, 2010
3. Building Science: Concepts and Applications: Jens Pohl, Wiley-Blackwell, 2011

Reference Books

1. Basic civil engineering : Dr.B.C.Punmia, Ashok kumar jain, Arun kumar jain Laxmi publications year of publication, 2004
2. Basic civil engineering : S.S.Bhavikatti New Age International Limited, 2010
3. Interior Design and Decoration: Seetharaman P.2019

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Web References

1. https://www.youtube.com/watch?v=XsFeVuVQE-E
2. https://www.youtube.com/watch?v=LYvDoy7MtkE
3. https://www.youtube.com/watch?v=zjZVlFt3WQY
4. https://www.youtube.com/watch?v=pYAXsbsFBC8
5. https://www.youtube.com/watch?v=PIY63QacRTc

COs/POs/PSOs Mapping

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3	3	3	2	3	1	3	3	3	2	3	3	3	3	3	3
4	3	3	2	3	2	3	3	3	2	3	3	3	3	3	3
5	3	3	2	3	2	3	2	3	2	3	3	3	3	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20BMO401

MEDICAL ELECTRONICS

(Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To gain knowledge about the various physiological parameters measurements.
- To understand the various biochemical and nonelectrical sensors.
- To study about the assist devices.
- To gain knowledge on surgical equipments and telemetry in healthcare.
- To understand the concepts of recent advancements in healthcare.

Course Outcomes

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

CO1 - Explain the electro- physiological parameters and bio-potentials recording. **(K2)**
CO2 - Measure the biochemical and non-electrical physiological parameters. **(K2)**
CO3 - Interpret the various assist devices used in the hospitals. **(K3)**
CO4 - Identify physical medicine methods and biotelemetry. **(K3)**
CO5 - Analyse recent trends in medical instrumentation. **(K3)**

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (9 Hrs)

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES (9 Hrs)

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters, Heart-Lung Machine.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY (9 Hrs)

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry - Single Channel and Multiple Channel.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION (9 Hrs)

Telemedicine, Insulin Pumps, Radio pill, Endo-microscopy, Brain machine interface, Lab on a chip, Cryogenic Technique.

Text Books

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2011.
2. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, TATA Mc Graw-Hill, New Delhi, 2017.
3. John G. Webster, “Medical Instrumentation Application and Design”, Third Edition, Wiley India, 2012

Reference Books

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2011.
2. R. Anandanatarajan, “Biomedical Instrumentation and Measurements”, Second Edition, PHI Learning, 2016.
3. Mandeep singh, “Introduction to Biomedical Instrumentation”, Second Edition, Prentice Hall of India, New Delhi, 2014.
4. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation Systems”, Cengage Learning, 2012
5. C.Raja Rao, Sujoy K.Guha, “Principles of Medical Electronics and Biomedical Instrumentation”, Universities Press, 2010.

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Web References
1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapetic systems
3. https://nptel.ac.in/courses/127/106/127106136/
4. medicinenet.com/script/main/art.asp?articlekey=6414
5. https://www.verywellhealth.com/cardiopulmonary-bypass-machine-used-for-surgery-3157220

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	2	2	-	1	-	-	-	-	1	-	1
2	3	2	-	2	2	2	-	1	-	-	-	-	1	-	1
3	3	-	-	2	3	3	-	1	-	-	-	-	1	-	1
4	3	-	2	2	3	2	-	1	-	-	-	-	1	-	1
5	3	2	2	3	3	2	-	1	-	-	-	-	1	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20BMO402

TELEMEDICINE

(Common to EEE, ECE, CSE, IT, ICE, CCE, AI&DS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the classification of telemetry.
- To gain knowledge about biotelemetry principles.
- To know about the applications of telemetry in various fields.
- To provide the idea about the value of telemedicine.
- To know the various applications in telemedicine.

Course Outcomes

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

CO1 - Categorize the telemetry systems. **(K2)**
CO2 - Understand the principles of biotelemetry in transmission of biological signals. **(K3)**
CO3 - Apply the various Biotelemetry applications for diagnostics. **(K3)**
CO4 - Acquire clear idea about the fundamentals of telemedicine. **(K2)**
CO5 - Know about various applications of telemedicine. **(K3)**

UNIT I INTRODUCTION TO TELEMETRY (9 Hrs)

Basic system, Classification, Non electrical telemetry systems, Mechanical and Pneumatic type, Voltage and Current telemetry systems, Local transmitters and Converters, Frequency telemetry system, Power Line carrier communication (PLCC).

UNIT II BIOTELEMETRY (9 Hrs)

Radio Telemetry principles, FM, AM, PCM, Transmission of biological data through radio telemetry.

UNIT III APPLICATION OF BIOTELEMETRY (9 Hrs)

Wireless Telemetry - Single Channel and Multi-channel Telemetry systems, Multi Patient Telemetry, Implantable Telemetry Systems, Ambulatory patient monitoring.

UNIT IV FUNDAMENTALS OF TELEMEDICINE (9 Hrs)

History and advancements in telemedicine, Benefits of telemedicine, Functional Block of a telemedicine system, Use of computers in distance mode of healthcare delivery, Familiarizing with technology of telemedicine, scanner, electro stethoscope, data reception equipment, Scope for telemedicine, Limitations of telemedicine.

UNIT V APPLICATIONS OF TELEMEDICINE (9 Hrs)

Telemedicine in Neuroscience, Telecardiology, Telepathology, Telepediatrics, Telepharmacy, Telepsychiatry and mental health, Veterinary.

Text Books

1. Marilyn J. Field, “A Guide to Assessing Telecommunications in Health Care”, Academy Press, 4th Edition, 2011.
2. R. L. Bashshur, J. H. Sanders and G. Shannon, “Telemedicine: Theory and Practice”, Springer, 8th Edition, 2014.
3. Olga (EDT), Ferre Roca, M. Sosa, “Handbook of Telemedicine”, IOS press, 3rd Edition, 2009.

Reference Books

1. Bemmel, J.H. van, Musen, M.A. (Eds.), “Handbook of Medical Informatics”, Springer, 2nd Edition, 2010.
2. W. Simpson, “Video over IP. A practical guide to technology and applications”, Focal Press, Elsevier, 9th Edition, 2009.
3. Ferrer-Roca, O., Sosa-Iudicissa, “Handbook of Telemedicine”, IOS Press, 2012
4. A. C. Norris, “Essentials of Telemedicine and Telecare”, Wiley, 8th Edition, 2017.
5. R. Wotton, J. Craig, V. Patterson (Eds.), “Introduction to Telemedicine”, Royal Society of Medicine Press Ltd., 5th Edition, 2014.

Web References

1. https://en.wikipedia.org/wiki/Biotelemetry
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	2	1	-	1	-	2	-	-	-	-	-
2	3	2	-	-	2	1	-	1	-	2	-	-	-	-	-
3	3	2	3	2	2	1	-	1	-	2	-	-	-	-	-
4	3	2	-	2	2	1	-	1	-	2	-	-	-	-	1
5	3	2	3	2	2	1	-	1	-	2	-	-	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CCO401	BASIC DBMS (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

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

CO1 - Explain the concept of database management system. (**K2**)
CO2 - Create conceptual data model using entity relationship diagram. (**K2**)
CO3 - Analyze the various normalization. (**K4**)
CO4 - Describe the concept of storage indexing and transactions. (**K2**)
CO5 - Explain the database recovery and security. (**K2**)

UNIT I INTRODUCTION TO DATABASE MANAGEMENT (9 Hrs)

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture-Entity - relationship data model

UNIT II THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA (9 Hrs)

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT III STRUCTURED QUERY LANGUAGE AND NORMALIZATION (9 Hrs)

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security. Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT (9 Hrs)

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree. Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT V DATABASE BACKUP, RECOVERY AND SECURITY (9 Hrs)

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

Text Books

1. Gupta.G.K, “Database Management Systems”, Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, “Fundamentals of Database Systems”, Pearson Education, USA, 2018.

Reference Books

1. Silberschatz, Korth.H and Sudarshan.S, “Database System Concepts”, 6th Edition, McGraw-Hill International, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, “Database System The Complete Book, 1st Edition, Pearson 2002.
3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.

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4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.
5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

Web References

1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
2	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
3	3	3	1	-	1	-	-	-	-	-	1	1	-	-	1
4	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1
5	3	1	1	-	1	-	-	-	-	-	1	1	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20CCO402	INTRODUCTION TO COMMUNICATION SYSTEMS (Common to EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge of signals
- To study the various analog and digital modulation techniques
- To study the pulse modulation and multiplexing
- To infer Digital transmission techniques
- To provide knowledge about various multiple access technology and advanced communication techniques

Course Outcomes

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

CO1 - Comprehend the basic Characteristics of the signals. (**K2**)
CO2 - Comprehend needs of modulation and various analog modulation techniques. (**K2**)
CO3 - Illustrate pulse modulation and multiplexing. (**K3**)
CO4 - Explain Digital transmission techniques. (**K2**)
CO5 - Describe multiple access techniques and advanced communication systems. (**K2**)

UNIT I SIGNAL ANALYSIS (9 Hrs)

Introduction to Signals- Representation and classification of Signals, Representation of signal in frequency domain, introduction to Spectrum of signal- Introduction to Fourier series and Fourier Transform

UNIT II ANALOG COMMUNICATION (9 Hrs)

Need for Modulation-– Block diagram of analog communication System- Amplitude Modulation – AM, DSBSC, SSBSC, modulators and demodulators – Angle modulation – PM and FM – modulators and demodulators – Superheterodyne receivers

UNIT III PULSE COMMUNICATION (9 Hrs)

Low pass sampling theorem – Quantization – PAM – PCM, DPCM, DM, and ADPCM And ADM - Time Division Multiplexing, Frequency Division Multiplexing

UNIT IV DIGITAL COMMUNICATION (9 Hrs)

Comparison of digital and analog communication system- Block diagram of digital communication system Phase shift keying – BPSK, DPSK, QPSK

UNIT V MULTIPLE ACCESS TECHNIQUES AND ADVANCED COMMUNICATION (9 Hrs)

Multiple Access techniques- FDMA, TDMA, CDMA- Frequency reuse, Handoff- Block diagram of advanced communication systems – satellite communication – Cellular Mobile Communication – Fibre Optical Communication System.

Text Books

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems”, 3rd edition, TMH 2007
2. S. Haykin, “Digital Communications”, John Wiley, 2005
3. B.P.Lathi,” Modern Digital and Analog Communication Systems”, 3rd edition, Oxford University Press, 2007

Reference Books

1. H P Hsu, Schaum Outline Series, “Analog and Digital Communications”, TMH 2006
2. B.Sklar,” Digital Communications Fundamentals and Applications”, 2nd edition Pearson Education 2007.
3. A.Bource Carson and Paul B.Crilly, “Communication Systems”, 5th Edition, Mc Graw Hill, 2010
4. Torrieri, Don, “Principles of Spread Spectrum Communication Systems”, Springer, 2015
5. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley and Sons, 2001.

Web References

1. www.allaboutcircuits.com
2. https://nptel.ac.in/courses/108/102/108102096/
3. http://www.electronics-tutorials.ws
4. www.tutorialspoint.com
5. https://nptel.ac.in/courses/108/104/108104091/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	1	1
2	3	1	1	-	1	-	-	-	-	-	1	1	-	1	1
3	3	3	1	-	1	-	-	-	-	-	1	1	-	1	1
4	3	1	1	-	1	-	-	-	-	-	1	1	-	1	1
5	3	1	1	-	1	-	-	-	-	-	1	1	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ADO401	KNOWLEDGE REPRESENTATION AND REASONING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

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

CO1 - Analyse and design knowledge based systems intended for computer implementation. **(K3)**
CO2 - Acquire theoretical knowledge about principles for logic-based representation and reasoning. **(K2)**
CO3 - Understand knowledge-engineering process. **(K2)**
CO4 - Implement production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge. **(K3)**
CO5 - Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making. **(K2)**

UNIT I (9 Hrs)

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic. Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II (9 Hrs)

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT III (9 Hrs)

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS (9 Hrs)

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V ETHICS AND RECENT TRENDS (9 Hrs)

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics. Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

Text Books

1. John F. Sowa, Thomson Learning "Knowledge Representation logical, Philosophical, and Computational Foundations", Course Technology Inc. publication, 1999.
2. Ronald J. Brachman, Hector J. Levesque, "Knowledge Representation and Reasoning", Morgan Kaufmann; 1st edition, 2004.
3. Eileen Cornell Way "Knowledge Representation and Metaphor" Springer; 1991st edition, 1991.

Reference Books

1. Trevor Bench-Capon, "Knowledge representation: an approach to artificial intelligence", Academic Press, 2014.
2. Yulia Kahl, Michael Gelfond "Knowledge Representation, Reasoning, and the Design of Intelligent Agents The Answer-Set Programming Approach", Cambridge University Press; 1st edition, 2014.

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3. Arthur B. Markman, "Knowledge representation" Psychology Press; 1st edition, 1998.
4. Sanida Omerović, Grega Jakus, V. Milutinovic, Sašo Tomažič "Concepts, Ontologies, and Knowledge Representation" Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer "Foundations of Knowledge Representation and Reasoning" Springer, 1994.

Web References

1. https://www.javatpoint.com/knowledge-representation-in-ai
2. https://nptel.ac.in/courses/106/106/106106140/
3. https://www.youtube.com/watch?v=kXlr6ydiPAQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	3	-	-	-	-	-	-	-	1	1	-
2	2	3	2	3	2	-	-	-	-	-	-	-	-	1	-
3	1	3	1	2	2	-	-	-	-	-	-	-	-	1	-
4	1	2	1	2	1	-	-	-	-	-	-	-	-	-	1
5	2	1	3	1	3	-	-	2	-	-	-	-	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ADO402	**INTRODUCTION TO DATA SCIENCE** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of data science
- To enable the students to understand the statistics and probability.
- To understand the tools in developing and visualizing data.
- To gain good knowledge in the application areas of data science.
- To inculcate the perceiving, ethics surrounding privacy and acting of data science applications.

Course Outcomes

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

CO1 - Explore the fundamental concepts of data science. **(K2)**

CO2 - Understand the Mathematical Knowledge for Data Science. **(K2)**

CO3 - Visualize and present the inference using various tools. **(K3)**

CO4 - Expose the different opportunities in Industries. **(K3)**

CO5 - Learn to think through the ethics surrounding privacy, data sharing and decision-making. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE (9 Hrs)

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist? - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation.

UNIT II MATHEMATICAL PRELIMINARIES (9 Hrs)

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures - Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities. Logarithms: Logarithms and Multiplying Probabilities – Logarithms and Ratios – Logarithms and Normalizing Skewed Distributions.

UNIT III DATA SCIENCE TOOLS (9 Hrs)

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT IV INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS (9 Hrs)

Data Economy and Industrialization – Introduction: Data Economy, Data Industry, Data Services – Data Science Application: Introduction, General Application Guidance - Different Domain – Advertising – Aerospace and Astronomy – Arts, Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail - Education – Engineering – Finance and Economy – Gaming.

UNIT V ETHICS AND RECENT TRENDS (9 Hrs)

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st edition, 2016.
2. Chirag Shah, "A Hands on Introduction to Data Science", Cambridge University Press, 2020.
3. Sinan Ozdemir, "Principles of Data Science", Packt Publication, 2016.
4. D J Patil, Hilary Mason, Mike Loukides, "Ethics and Data Science", O' Reilly, 1st edition, 2018.

Reference Books

1. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. Mc Owan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.

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4. Rajendra Akerkar, Priti Srinivas Sajja, “Intelligence Techniques for Data Science”, Spring International Publication, 2016.
5. Longbing Cao, “Data Science Thinking: The Next Scientific, Technological and Economic Revolution”, Spring International Publication, 2018.

Web References

1. https://www.youtube.com/watch?v=-ETQ97mXXF0&ab_channel=edureka%21
2. https://www.javatpoint.com/data-science
3. https://www.coursera.org/browse/data-science /

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	3	2	2	-	-	-	-	-	-	-	-	1	-
2	2	2	2	1	1	-	-	-	-	-	-	-	1	1	-
3	2	1	3	2	3	-	-	-	-	-	-	-	-	2	-
4	1	2	2	1	1	-	-	-	-	-	-	-	-	-	1
5	2	1	1	2	1	-	-	1	-	-	-	-	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSO501

PRODUCT DEVELOPMENT AND DESIGN
(Common to all except CSBS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide the basic concepts of product design, product features and its architecture.
- To have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To enhance team working skills.
- To design some products for the given set of applications.
- To compete with a set of tools and methods for product design and development

Course Outcomes

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

CO1 - Apply the concept for new product development. **(K3)**
CO2 - Validate knowledge on the concepts of product specification. **(K3)**
CO3 - Describe the principles of industrial design and prototyping. **(K2)**
CO4 - Apply knowledge on product architecture. **(K3)**
CO5 - Review the concept of product development and customer needs. **(K5)**

UNIT I INTRODUCTION TO PRODUCT DEVELOPMENT (9 Hrs)

Product development versus design, product development process, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method

UNIT II PRODUCT SPECIFICATIONS (9 Hrs)

Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process

UNIT III PRODUCT CONCEPTS (9 Hrs)

A: Concept generation, product configuration, concept evaluation and selection, product embodiments.

B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

UNIT IV PRODUCT ARCHITECTURE (9 Hrs)

Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues

UNIT V PROTOTYPING (9 Hrs)

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging.

Text Books

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood,
3. Otto, K. N. Product design: techniques in reverse engineering and new product development

Reference Books

1. Ashby, M. F., & Johnson. K., "Materials and design: the art and science of material selection in product design", Butterworth-Heinemann.
2. Kevin Otto and Kristin Wood, "Techniques in Reverse Engineering and New Product Development", Pearson Education, Chennai, 3rd Edition.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 6th Edition, PHI.
4. Taurt Pugh, "Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New York.
5. Kumar, A., Jain, P. K., & Pathak, P. M. "Reverse engineering in product manufacturing: an overview", DAAAM international scientific book.

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Web References

1. http://www.worldcat.org/title/product-design-and-development/oclc/904505863
2. https://www.pdfdrive.com/product-design-and-development-e38289913.html
3. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
4. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
5. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/clas1_int_crse_6.pdf
6. https://swayam.gov.in/nd1_noc20_de05/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	-	-	-	-	-	-	2	-	-	3
2	1	-	2	-	3	-	-	-	-	-	-	3	-	-	3
3	1	-	3	-	2	-	-	-	-	-	-	2	-	-	3
4	3	-	1	-	3	-	-	-	-	-	-	1	-	-	3
5	1	-	3	-	3	-	-	-	-	-	-	2	-	-	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSO502	INTELLECTUAL PROPERTY AND RIGHTS (Common to all except CSBS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- Awareness about current trends in IPR and Government steps in fostering IPR

Course Outcomes

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

CO1 - Complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works **(K2)**

CO2 - Presenting useful insight on novelty of their idea from state-of-the art search during their project work period. **(K3)**

CO3 - Posting Intellectual Property as a career option like R&D IP Counsel, Government Jobs – Patent Examiner, Private Jobs, Patent agent and/or Trademark agent and Entrepreneur **(K3)**

CO4 - Disseminate knowledge on Design, Geographical Indication, Plant Variety and Layout Design Protection and their registration aspects **(K1)**

CO5 - Organize their idea or innovations and analyse ethical and professional issues which arise in the intellectual property law context. **(K4)**

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY (9 Hrs)

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT II PATENTS (9 Hrs)

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT III COPYRIGHTS (9 Hrs)

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT IV TRADEMARKS (9 Hrs)

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT V OTHER FORMS OF IP (9 Hrs)

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

Text Books

1. Nithyananda, K V. "Intellectual Property Rights: Protection and Management", Cengage Learning India Private Limited, 2019
2. Neeraj, P., & Khusdeep, D., "Intellectual Property Rights", PHI learning Private Limited, India, 2014.

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Reference Books

1. Ahuja, V K. "Law relating to Intellectual Property Rights", India, IN: Lexis Nexis, 2017.
2. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, 3rd Edition, 2012.
3. Derek Bosworth and Elizabeth Webster, "The Management of Intellectual Property", Edward Elgar Publishing Ltd., 2013.
4. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
5. S.V. Satakar, "Intellectual Property Rights and Copy Rights", Ess Ess Publications, New Delhi, 2002.
6. V. Scople Vinod, "Managing Intellectual Property", Prentice Hall of India Pvt. Ltd, 2012.

Web References

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
6. Journal of Intellectual Property Rights (JIPR): NISCAIR

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	3	-	2	-	1	2	-	-	-	2	-	-	1
2	1	-	3	-	2	-	2	2	-	-	-	2	-	-	1
3	-	-	2	-	1	-	3	3	-	-	-	2	-	-	1
4	2	-	3	-	2	-	2	2	-	-	-	2	-	-	1
5	1	-	1	-	2	-	1	2	-	-	-	2	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSO503	MARKETING MANAGEMENT AND RESEARCH (Common to all except CSBS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To facilitate understanding of the conceptual framework of marketing in engineering.
- To understand the concepts of product and market segmentation for engineering services and technological products.
- Analyzing the various pricing concepts and promotional strategies for engineering and technology markets.
- Learn to focus on a research problem using scientific methods in engineering and technological enterprises.
- To be able to design and execute a basic survey research reports in in engineering and technological enterprises

Course Outcomes

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

CO1 - Analyze the fundamental principles involved in managing engineering and technological markets **(K3)**
CO2 - Understand and develop product, and Market Segmentation for engineering services and technological Products **(K4)**
CO3 - Develop pricing and promotional strategies for engineering and technology markets **(K6)**
CO4 - Analyze market problems and be capable of applying relevant models to generate appropriate solutions to meet challenges in engineering and technological enterprises **(K3)**
CO5 - Identify the interrelationships between market trends, innovation, sustainability and communication in engineering and technological enterprises **(K5)**

UNIT I MARKETING – AN OVERVIEW (9 Hrs)

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II PRODUCT AND MARKET SEGMENTATION (9 Hrs)

Product, Classifications of product, Product Life Cycle, New product development, Branding, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing

UNIT III PRICING AND PROMOTIONAL STRATEGIES (9 Hrs)

Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management. Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics

UNIT IV RESEARCH AND ITS FUNDAMENTALS (9 Hrs)

Research: Meaning, Objectives of Research, Types of Research, Significance of Research - Methods Vs Methodology - Research Process – Components of Research Problem, Literature Survey – Primary Data and Secondary Data, Questionnaire design, Measurement and Scaling Techniques

UNIT V BASIC STATISTICAL ANALYSIS AND REPORT WRITING (9 Hrs)

Fundamentals of Statistical Analysis and Inference- Measures of Central Tendency -Measures of Dispersion - Measures of Asymmetry - Report Writing: Types of research reports, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Report Writing, Layout of Research Report, Mechanics of Writing Research Report, Ethics in Research

Text Books

1. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, 14th Edition, 2012.
2. Lilien, Gary l. and Arvind Rangaswamy, “Marketing managers make ongoing decisions about product features, prices, distribution options”, The Handbook of Marketing Research: Uses, Misuses, and Future Advances (2006).

Reference Books

1. Chandrasekar. K.S., “Marketing Management Text and Cases”, Tata McGraw Hill, 1st Edition 2010.
2. Kothari, C., “Research Methodology Methods and Techniques”, New Age International (P) Ltd., 2017
3. Rajan Sexena, “Marketing Management: Text cases in Indian Context”, Tata McGraw hill, 3rd Edition, 2006.
4. Moisander J, Valtonen A, “Qualitative marketing research: A cultural approach”, Sage Publisher, 2006.
5. Malhotra NK, Satyabhushan Dash, “Marketing Research: An Applied Orientation”, Pearson Education, 7th Edition, 2019.

(DR.S. ANBUMALAR)

Web References

1. https://swayam.gov.in/nd1_noc20_mg26/preview
2. https://swayam.gov.in/nd1_noc20_mg26/preview
3. https://www.entrepreneur.com/encyclopedia/market-research

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	-	1	-	-	1
2	-	1	2	-	1	-	3	-	-	2	-	1	-	-	1
3	-	-	1	-	1	-	-	-	2	1	-	1	-	-	1
4	-	3	2	2	-	1	-	1	1	2	-	1	-	-	1
5	-	2	2	1	2	2	-	2	2	2	-	1	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20HSO504

PROJECT MANAGEMENT FOR ENGINEERS

(Common to all except CSBS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the various concepts and steps in project management.
- To familiarize the students with the project feasibility studies and project life cycle
- To enable the students to prepare a project schedule
- To understand the risk management and project Control process.
- To learn about the closure of a project and strategies to be an effective project manager.

Course Outcomes

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

CO1 - Interpret the different concepts and the various steps in defining a project. **(K2)**
CO2 - Examining the feasibility of a project. **(K3)**
CO3 - Build a schedule for a Project. **(K6)**
CO4 - Predict the risk associated with a project and demonstrate the project audit. **(K2)**
CO5 - Analyse the project team and outline the Project closure. **(K4)**

UNIT I PROJECT MANAGEMENT CONCEPTS (9 Hrs)

Project: Meaning, Attributes of a project, Project Life cycle, Project Stakeholders, Classification, Importance of project management, Project Portfolio Management System, Different Project Management Structure, Steps in Defining the Project, Project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints

UNIT II PROJECT FEASIBILITY ANALYSIS (9 Hrs)

Opportunity Studies, Pre-Feasibility studies, and Feasibility Study: Market Feasibility, Technical Feasibility, Financial Feasibility and Economic Feasibility. Financial and Economic Appraisal of a project, Social Cost Benefit Analysis in India and Project Life Cycle

UNIT III PROJECT SCHEDULING & NETWORK TECHNIQUES (9 Hrs)

Scheduling Resources and reducing Project duration: Types of project constraints, classification of scheduling problem, Resources allocation methods, Splitting, Multitasking, Benefits of scheduling resources, Rationale for reducing project duration, Options for accelerating Project completion

Developing and Constructing the Project Network (Problems), PERT, CPM; Crashing of Project Network

UNIT IV PROJECT RISK MANAGEMENT AND PROJECT CONTROL (9 Hrs)

Project Risk management; Risk concept, Risk identification, Risk assessment, Risk response development, Contingency planning, Contingency funding and time buffers, Risk response control, and Change control management

Budgeting and Project Control Process, Control issues, Tendering and Contract Administration. Steps in Project Appraisal Process and Project Audits

UNIT V PROJECT CLOSURE AND MANAGING PROJECT (9 Hrs)

Project Closure: Team, Team Member and Project Manager Evaluations. Managing versus Leading a Project: Qualities of an Effective Project Manager, Managing Project Stakeholders, Managing Project Teams: Five Stage Team Development Model, Situational factors affecting team development and project team pitfalls

Text Books

1. Erik Larson and Clifford Gray, "Project Management: The Managerial Process", McGraw Hill Education, 6th Edition, 2017.
2. Harold Kerzner, "Project Management: A systems approach to Planning, Scheduling and Controlling", John Wiley & Sons, 12th Edition, 2017.

Reference Books

1. Meredith, J.R. & Mantel, S. J., "Project Management- A Managerial Approach", John Wiley, 2017.
2. Prasanna Chandra, "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review", McGraw Hill Education, 9th Edition, 2019.
3. B C Punmia by K K Khandelwal. "Project Planning and Control with PERT and CPM", Laxmi Publications Private Limited, 4th Edition, 2016.
4. Hira N Ahuja, S. P. Dozzi, S. M. Abourizk. "Project Management", Wiley India Pvt Ltd, 2nd Edition, 2013.
5. PMI, "A guide to Project Management Body of Knowledge", Project Management Institute, 6th Edition, 2017.

(DR.S. ANBUMALAR)

Web References

1. www.pmi.org
2. www.projectmanagement.com
3. https://www.sciencedirect.com/journal/international-journal-of-project-management
4. https://nptel.ac.in/courses/110/107/110107081/
5. https://nptel.ac.in/courses/110/104/110104073/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	-	-	2	-	2	2	-	-	1
2	-	2	1	-	-	1	-	-	1	1	1	1	-	-	1
3	-	1	3	-	-	-	-	-	-	-	1	-	-	-	1
4	3	1	1	-	-	1	1	-	-	1	1	3	-	-	1
5	3	-	3	-	-	-	-	3	3	2	3	2	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20HSO505	FINANCE FOR ENGINEERS (Common to all except CSBS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1 - Understand basic concepts in accounting and finance and their importance for engineers **(K2)**
CO2 - Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**
CO3 - Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**
CO4 - Identify and Appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**
CO5 - Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I UNDERSTANDING THE FUNDAMENTALS (9 Hrs)

Assets – Need and Functions of Assets – Types of Assets – Factors determining Investments in Assets. Liabilities – Meaning and Functions of Liabilities – Types of Liabilities – Capital as a Liability: Why and How - Concept and Meaning of Finance – Distinction between Accounting and Finance – Significance of Accounting and Finance for Engineers

UNIT II MATHEMATICS OF FINANCE (9 Hrs)

Time Value of Money – Computation of Present Value and Future Value – Implications of TVM in Financial Decisions – Concept of Risk and Return – Measuring Risk and Return – Concept of Required Rate of Return and its significance in Investment Decisions

UNIT III FINANCIAL ANALYSIS (9 Hrs)

Meaning and Objectives of Financial Analysis – Annual Report As an Input for Analysis – Basic Understanding of Annual Reports - Tools of Financial Analysis – Horizontal Analysis – Vertical Analysis – Trend Analysis – Accounting Ratios – Significance of Ratio Analysis in Decision-making – Snap-shot of the Past to predict the Future – Computation of Key Ratios – Liquidity Ratios – Profitability Ratios – Performance Ratios – Ratios that are helpful for Potential Investors

UNIT IV FUNDS PROCUREMENT (9 Hrs)

Meaning of Funds – Sources of Funds – Long-Term Sources – Short-Term Sources – Financing Decisions in Business – Capital Structure – Need and Importance of Capital Structure – Determining Optimum Capital Structure – Concept and Computation of Earnings Before Interest and Tax (EBIT), Earnings Before Tax (EBT), and Earnings After Tax (EAT)(Simple Problems) - Leverage in Finance – Types and Computation of Leverages – Operating Leverage, Financial Leverage, and Combined Leverage

UNIT V FUNDS DEPLOYMENT (9 Hrs)

Investment Decisions – Types of Investment Decisions: Long-Term Investment Decisions. Significance – Methods: Pay-Back Period Method, Net Present Value Method and Benefit-Cost Ratio Method. Short-Term Investment Decisions – Concept of Working Capital – Need and Importance of Working Capital in Business – Determinants of Working Capital in a Business. Components of Working Capital. Dividends: Concept and Meaning – Implications of Dividend Decisions on Liquidity Management

Text Books

1. R. Narayanaswamy, "Financial Accounting – A managerial perspective", PHI Learning, New Delhi, 2015.
2. C. Paramasivan and T. Subramanian, "Financial Management", New Age International, New Delhi, 2015.

Reference Books

1. S. N. Maheswari, Sharad K. Maheswari & Suneel K. Maheswari, "Accounting for Management", Vikas Publishing, 2017.
2. Varun Dawar & Narendar L. Ahuja, "Financial Accounting and Analysis", Taxmann Publications, 2018.
3. Athma. P., "Financial Accounting and Analysis", Himalaya Publishing House, 2017.
4. Prasanna Chandra, "Financial Management", Tata-McGraw Hill Publishers, New Delhi, 2019.
5. S.C. Kuchhal, "Financial Management", Chaitanya Publishing House, Allahabad, 2014.

(DR.S. ANBUMALAR)

Web References

1. http://www.annualreports.com/
2. http://www.mmachennai.org/
3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
8. https://www.icsi.edu/home/
9. https://www.investopedia.com/
10. https://www.moneycontrol.com/
11. https://www.rbi.org.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	2	1	-	-	1
2	-	1	2	-	1	-	3	-	-	2	2	1	-	-	1
3	-	-	1	-	1	-	-	-	2	1	2	1	-	-	1
4	-	3	2	2	-	1	-	1	1	2	2	1	-	-	1
5	-	2	2	1	2	2	-	2	2	2	2	1	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20ECO603	ELECTRONIC PRODUCT DESIGN AND PACKAGING (Common to EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge about Electronic Product and Packaging
- To introduce and discuss various issues related to the system packaging
- To get clear idea about design of packages which can withstand higher temperature, vibrations and shock
- To Design of PCBs which minimize the EMI and operate at higher frequency
- To acquire depth knowledge about the concepts of Testing and testing methods

Course Outcomes

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

CO1 - Explain the basics of Electronic Product and Packaging. **(K2)**
CO2 - Infer various issues related to the system packaging. **(K2)**
CO3 - Summarize the clear idea about design of packages which can withstand higher temperature, vibrations and shock **(K2)**
CO4 - Describe the design of PCBs which minimize the EMI and operate at higher frequency **(K2)**
CO5 - Explain the various testing methods **(K2)**

UNIT I OVERVIEW OF ELECT RONIC SYSTEMS PACKAGING (9 Hrs)

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

UNIT II SEMICONDUCTOR PACKAGES (9 Hrs)

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits

UNIT III ELECTRICAL ISSUES IN PACKAGING (9 Hrs)

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps – Hybrid circuits – Resistive, Capacitive and Inductive parasitic

UNIT IV CHIP PACKAGES (9 Hrs)

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded

UNIT V TESTING (9 Hrs)

Testing Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures -thermo mechanically induced -electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

Text Books

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001
2. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
3. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.

Reference Books

1. Blackwell (Ed), “The electronic packaging handbook”, CRC Press, 2000.
2. R.S.Khandpur, “Printed Circuit Board”, Tata McGraw Hill, 2005
3. R. K. Ulrich, “Recent literature in Electronic Packaging”, 2005
4. Michael L. Bushnell and Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed signal VLSI Circuits”, Kluwer Academic Publishers.2000.
5. M. Abramovici, M. A. Breuer, and A.D. Friedman, “Digital System Testing and Testable Design”, Computer Science Press

(DR.S. ANBUMALAR)

Web References

1. http://www.logopeople.in/blog/awesome-packaging-design-of-electronic-products-for-inspiration/
2. https://www.pinterest.com/PackagingTPI/electronic-packaging/
3. https://www.einfochips.com/blog/semiconductor-and-electronic-design-networks-and-profiles-to-follow-in-2018/
4. https://en.wikipedia.org/wiki/Electronic_packaging
5. https://nptel.ac.in/courses/108/108/108108031/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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2	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
3	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
4	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
5	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 – High

(DR.S. ANBUMALAR)

U20ECO604

AUTOMOTIVE ELECTRONICS

(Common to EEE, ICE, MECH)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To provide basic knowledge about Autotronics
- To introduce and discuss the fundamentals of Automotive Electronics
- To get clear idea about various Sensors and Actuators for automobiles.
- To acquire depth knowledge about the Microcontrollers/Microprocessors in Automotive Domain.
- To study the Current Trends in Automotive Electronics.

Course Outcomes

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

CO1 - Explain the basics of Autotronics. **(K2)**
CO2 - Infer the fundamentals of Automotive Electronics**. (K2)**
CO3 - Summarize the clear idea about Sensors and Actuators **(K2)**
CO4 - Demonstrate the role of Microcontrollers/Microprocessors in Automotive Domain **(K3)**
CO5 - Use Current Trends in Automotive Electronic Engine Management System **(K3)**

UNIT I INTRODUCTION TO AUTOTRONICS (9 Hrs)

Autotronics - Definition- need, Field effect transistor-construction and working-applications, Silicon controlled rectifiers-construction and working-applications, logic gates-concept-AND-OR-NOT gates-working with truth tables, Flip flops-concept-applications, registers-concept, Integrated circuits-concept-types, Binary number system- need- conversion process, analog and digital signals-signal conditioning-need-steps, analog to digital conversion-steps

UNIT II FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS (9 Hrs)

Microprocessor architecture, open and closed loop control strategies, PID control, Look up tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Parameters to be controlled in SI and CI engines and in the other parts of the automobile

UNIT III SENSORS AND ACTUATORS (9 Hrs)

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

UNIT IV MICROCONTROLLERS/MICROPROCESSORS IN AUTOMOTIVE DOMAIN (9 Hrs)

Critical review and overview of development within the automotive context of microprocessors, microcontrollers and digital signal processors (architecture of 8/16 bit microcontrollers with emphasis on Ports, Timer/Counters, Interrupts, Watchdog timers and PWM). Criteria to choose the right microcontroller/processor for various automotive applications. Understanding various architectural attributes relevant to automotive applications. Automotive grade processors viz. Renesas, Quorivva, Infineon.

UNIT V ELECTRONICS SYSTEMS (9 Hrs)

Current Trends in Automotive Electronic Engine Management System- Types of EMS Electromagnetic Interference Suppression- Electromagnetic Compatibility- Electronic Dashboard Instruments- Onboard Diagnostic System- Security - Warning System infotainment and Telematics

Text Books

1. William Ribben Butterworth-Heinemann, “Understanding Automotive Electronics” 5th edition, Elsevier, 1998
2. Jack Erjavec, “A Systems Approach to Automotive Technology”, Cengage Learning, 5th edition, 2009
3. Steve.V.Hatch, “Electronic Engine Controls”, Cengage Learning, 2012

Reference Books

1. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications”, Springer, 2009.
2. Mehrdad Ebsani, Ali Emadi & Yimin Gao, “Modern Electronic Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 2nd Edition, CRC Press, 2009.
3. Ronald K Jurgen, “Automotive Electronics Handbook”, 2nd Edition, McGraw-Hill
4. Bennett , “Truck engines Fuel & computerized management systems Sean”, Cengage Learning, 2016

(DR.S. ANBUMALAR)

Web References

1. http://www.diffen.com/difference/Analog vs Digital
2. https://www.youtube.com/watch?v=AiQpYO5E-go
3. https://en.wikipedia.org/wiki/Signal_conditioning
4. https://en.wikibooks.org/wiki/Electronics/Digital to Analog %26
5. http://www.allaboutcircuits.com/textbook/digital/chpt-13/delta-sigma-adc/

COs/POs/PSOs Mapping

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2	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
3	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
4	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
5	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

(DR.S. ANBUMALAR)

U20CSO603	PLATFORM TECHNOLOGY (Common to EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamentals of developing modular application by using object oriented concepts.
- To utilize the C# and .NET framework to build distributed enterprise applications.
- To develop Console Application, Windows Application and Web Applications.
- To connect to multiple data sources and managing them effectively.
- To develop the Enterprise kind of applications

Course Outcomes

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

CO1 - Understand basic concepts in accounting and finance and their importance for engineers **(K2)**
CO2 - Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**
CO3 - Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**
CO4 - Identify and Appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**
CO5 - Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I INTRODUCTION TO .NET FRAMEWORK (9 Hrs)

.NET Framework - Common language Runtime (CLR) – Common Type System (CTS) – Common language Specification (CLS) – Compilation process – Assemblies – Namespaces – Command line compiler.

UNIT II C# FUNDAMENTALS (9 Hrs)

C# class - object - string formatting - Types - scope - Constants - C# iteration - Control flow - Operators - Array - String - Enumerations - Structures - Custom namespaces. Programming constructs – value types and reference types – object oriented concepts – Encapsulation – Inheritance – polymorphism – Interfaces – collections – Multithreading

UNIT III GRAPHICS AND WINDOWS FORMS (9 Hrs)

Tool box controls – Container control – Menu – Tool bar – Tool tip Controls during design time – Run time – Graphics programming GDI+.

UNIT IV DATABASE PROGRAMMING (9 Hrs)

Data Access with ADO.NET – Architecture – Data reader – Data Adapter – Command – Connection – Data set – Data binding – Data Grid Control – XML based Data sets.

UNIT V J2EE (9 Hrs)

Enterprise Edition Overview – Multi-Tier Architecture – Best Practices – Comparison between J2EE and .NET.

Text Books

1. David Chappell, “Understanding .NET – A Tutorial and Analysis”, Addison Wesley, 2002.
2. Herbert Schildt, “C# 3.0 The Complete Reference”, McGraw-Hill Professional, Third Edition, 2008.
3. Keogh, “J2EE The Complete Reference”, Tata McGraw-Hill, 2008.

Reference Books

1. Andrew Troelsen, “Pro C# 5.0 and the .NET 4.5 Framework”, Sixth edition, A Press, 2012.
2. Joh Skeet, “C# in depth, Manning publications”, Third Edition, 2014.
3. Adrew Stellman and Jennifer Greene, “Head First C#”, Third Edition, O’Reilly, 2013.
4. Rod Johnson, “J2EE Design and Development”, Wrox, 2002
5. Michael Schmalz, “C# Database Basics”, O'Reilly Media, January 2012.

Web References

1. https://www. nptel.ac.in/
2. https://www.c-sharpcorner.com/csharp-tutorials
3. https://www.guru99.com/c-sharp-tutorial.html

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	3	2	-	-	-	-	-	-	-	1	1
2	1	2	2	2	-	-	-	-	-	-	-	-	-	1	1
3	2	3	-	3	3	-	2	-	-	-	-	-	-	1	1
4	2	-	-	-	-	-	-	-	2	-	-	-	-	1	1
5	2	2	2	2	-	1	-	-	-	-	-	-	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CSO604 **GRAPHICS DESIGNING**
(Common to EEE, ECE, ICE, MECH, CIVIL, BME, FT)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To develop basic skills using graphics and theory used in design process.
- Create computer-based projects using Adobe Photoshop.
- Understand, develop and employ visual hierarchy using images and text
- Use a computer to create and manipulate images and layers for use in various print and digital mediums.
- To acquire the knowledge of Animation

Course Outcomes

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

CO1 - Develop the basic design elements of graphics. **(K3)**
CO2 - Apply the various Photoshop tools. **(K3)**
CO3 - Modify the image size, selection and grids using tools. **(k3)**
CO4 - Create and Work with colored layers. **(K4)**
CO5 - Apply different methods for Animation & Panoramic Picture creation. **(K5)**

UNIT I BASIC CONCEPTS (9 Hrs)

Basic Concepts of Designing - Design Principles – Basics of design elements – Typography – Color theory - Introduction to Graphics - Introduction to Photoshop - Bitmap and Vector Images - Understanding Image Size and Resolution

UNIT II INTRODUCTION TO PHOTOSHOP (9 Hrs)

Introduction to Tools - Environment - layout of Photoshop - Design layout setup - color - resolution setting - using basic marquee - selection tools Usage of lasso tools - Using brushes - using and filling colors - layers Using text tool - free transform tool - Exercise: Designing Greeting card / Advertisement

UNIT III IMAGE SIZE, SELECTION, GRID AND GUIDES (9 Hrs)

Modifying Image Size - Resolution, Marquee - Lasso - Magic Wand - Selection Tools – Selecting – Saving - Crop tool - Coping Selection And Image - Grid and Guide Options – Masks – Channel - Painting and editing - Working with quick masks - Painting (Brush, and its effects) - Blending Modes, Color palettes – Editing - Background - Color - Touchup - Cleanup - Gradient tools - layer blending modes - all types of text tools - shape tools Exercise : Designing Magazine cover - Poster - Brochure

UNIT IV LAYERS (9 Hrs)

The layer Palette - Changing and controlling layer order - Editing layers - Adjustment layers - Layer Effects Filters - Actions - Automation - Extract - Filter Gallery - Liquefy , Pattern making - Vanishing point - Built in Bitmap Filters - 3rd party Plug-ins - Using predefined Actions - Creating and Recording Actions - Using built in automation - Learning Filter effects - managing the files with layers and layer effects - plugins Manipulation tools - Image control options – HUE - Levels - brightness control Using image – modifying - changing color Exercise : Converting black and white photo to color - designing a photo album

UNIT V ANIMATION & PANORAMIC PICTURE CREATION (9 Hrs)

Creating product Packaging designs - CD cover - Book and magazine front cover - Envelope - Visiting card - Color correction and color channel management - Design automation theory and Practical’s Samples and demos - guidelines for freelance work - website links - resource sharing - Preparing Image For Print and Web - Calculating Image size and Resolution, Changing Image Dimensions - Layout Preview - Color Separation - Optimizing Images for Web - File Formats - Creating Webpages - web photo galleries

Text Books

1. Adobe Creative Team, “Adobe Photoshop – Classroom in a Book”, Adobe system incorporation, Adobe Press, 2010.
2. Katherine A. Hughes, “Graphic Design”, Learn It, Do It, CRC Press 2019.
3. Ken Pender, “Digital color in Graphics Design”, CRC Press 2012.

Reference Books

1. Mike Wooldridge , “Teach Yourself Visually Adobe Photoshop CS 5”, Wiley Publishing , 2010
2. Lesa Snider, “Photoshop the missing Manual”, O’Reilly Media, Inc, 2010.
3. Poppy Evans, Aaris Sherin, Irina Lee, “The Graphic Design”, Rockport, 2013.

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4. Peter Bauer, “Photoshop CC for Dummies”, Wiley, 2013.
5. Scott Onstott, “Enhancing CAD Drawings with Photoshop”, Wiley,2006

Web References

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/lecture-notes/MIT6_831S11_lec18.pdfhttp://www.moshplant.com/direct-or/bezier/
2. https://www.cs.montana.edu/courses/spring2004/352/lectures/CS351-GUIDesign.pdf
3. https://www.university.youth4work.com/study-material/graphic-design-lecture
4. https://kmayeunhia.wordpress.com/lecture-notes/
5. https://nptel.ac.in/courses/106/106/106106090/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	1	-	-	-	-	-	-	-	-	1
2	3	2	2	1	-	1	-	-	-	-	-	-	-	-	1
3	3	2	-	1	-	2	-	-	-	-	-	-	-	-	1
4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	1
5	3	2	1	-	-	2	-	-	-	-	-	-	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ITO603	**ESSENTIALS OF DATA SCIENCE** (Common to EEE, ECE, ICE, MECH, CIVIL, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

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

CO1 - Experiment with data analytics using R language**. (K3)**
CO2 - Demonstrate clustering algorithms and association rules. **(K3)**
CO3 - Use algorithms related to regression and classification. **(K3)**
CO4 - Explore data using time series analysis and text analysis. **(K2)**
CO5 - Summarize Hadoop platform to solve map reduce problems. **(K2)**

UNIT I DATA ANALYTICS USING R (9 Hrs)

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES (9 Hrs)

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms- Clustering in practice: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION (9 Hrs)

Scope of Regression Techniques-Linear Regression - Logistic Regression - Additional Regression models-Scope of Classification Techniques - Decision Trees - Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods - Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS (9 Hrs)

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS (9 Hrs)

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.
2. Vignesh Prajapathi, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, “R Programming for Data Science”, Lean Pub, 2015.
2. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications“, Wiley Publishers, 2014.

Web References

1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	-	-	-	-	-	-	-	-	1	1
2	3	2	1	1	2	-	-	-	-	-	-	-	-	1	1
3	3	2	1	1	2	-	-	-	-	-	-	-	-	1	1
4	2	1	-	-	2	-	-	-	-	-	-	-	-	1	1
5	2	1	-	-	2	-	-	-	-	-	-	-	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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MOBILE APP DEVELOPMENT

U20ITO604

(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

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

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER (9 Hrs)

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III MOBILE TELECOMMUNICATION SYSTEM (9 Hrs)

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT IV MOBILE AD-HOC NETWORKS (9 Hrs)

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS (9 Hrs)

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Jochen H. Schller, “Mobile Communications”, Pearson Education, New Delhi, 2nd Edition, 2007
3. C.K.Toh, “AdHoc Mobile Wireless Networks”, Pearson Education, 1st Edition, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition, Tata McGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

(DR.S. ANBUMALAR)

Web References

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2
2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2
3	2	1	-	-	1	-	-	-	-	-	-	-	-	-	2
4	3	2	1	1	-	1	-	-	-	-	-	-	-	-	2
5	3	2	1	1	2	1	-	-	-	-	-	-	-	-	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20MEO604	**HEATING VENTILATION AND AIR CONDITIONING SYSTEM (HVAC)** (Common to EEE, ECE, ICE, CIVIL)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the principles of heating ventilation and air conditioning, refrigerant properties, selection
- To learn about the heating and cooling load estimation
- To understand about air distribution systems, industrial ventilation
- To impart knowledge of the psychrometric properties, processes and air-conditioning systems
- To provide knowledge on different components and parameters involved in design of air conditioning systems using cooling load calculations

Course Outcomes

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

CO1 - Describe the principles of heating ventilation and refrigerant properties. **(K1)**
CO2 - Analyze the factors affecting the load estimate. **(K4)**
CO3 - Explain the air distribution classification, types of air flow and types of cross section. **(K1)**
CO4 - Appraise the psychrometric processes and air conditioning system performance. **(K5)**
CO5 - Design the Air-conditioning systems with available resources as cost effective. **(K5)**

UNIT I INTRODUCTION TO HVAC (9 Hrs)

Definition – Principles of HVAC –Scope of HVAC Industry with overview of consulting & construction Industry- market size – Growth – Penetration – opportunities- challenges – Energy usage and saving of HVAC - Terminologies – Heat and its types – Psychometric chart – Properties of Air – Codes & Standards used in HVAC- Refrigerants - Desirable properties – classification – refrigerants used – nomenclature – Selection of refrigerants - ozone depletion – global warming–ASHRAE – Recent substitute for refrigerants.

UNIT II VENTILATION, HEATING AND COOLING LOAD (9 Hrs)

Basics of Heat transfer in a building envelop – Understanding of Outdoor & Indoor condition – Factors affecting the loads estimate Sources of Heat gain – External: Sun gain through Glass/Window/Roof/Wall – Partition gain – Internal: People/Lights/Electrical Equipments /motors/Kitchen Appliances – Heat gain through Infiltration air – Ventilation, air quantity and loads –Need, threshold limits of contaminants, estimation of ventilation rate, decay equation, air flow around buildings – Methods of Ventilation – Infiltration load calculation – Heating and cooling load estimation – Calculating ESHF, GTH, ADP, Dehumidified CFM – Cold storage design.

UNIT III DESIGN OF AIR DISTRIBUTION SYSTEM (9 Hrs)

Air Distribution – Classification – Types of Air flow – Types of Cross section – Types of Velocity & pressure duct – Types of material – Types of Insulations – Duct Accessories – SMACNA standard – Duct designing methods: Velocity reduction method, Equal friction method, Static regain method - Duct designing Software – Duct sheet metal calculation: GI sheet, Gauge of duct & thickness of Gauge, Hanger spacing, Hanger Rod Diameter and Angle support Size –Air terminal selection – Industrial ventilation: Steel plants, car parks, plant rooms and mines.

UNIT IV INTRODUCTION TO PSYCHROMETRIC AND HUMAN COMFORT (9 Hrs)

Principle and psychrometric properties of air – Psychrometric Chart – Psychrometric relations; Dalton's law of partial pressures –Wet bulb temperature and measurement – Adiabatic saturation temperature – Psychrometric processes – mixing of air stream - sensible heat factor – HVAC systems: Unitary, Semi-central, Central, Air-cooled systems, Water cooled systems–Human Comfort – Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort – Thermal response – comfort factors– Environmental indices - Indoor air quality(IQA) - Effective temperature and comfort chart – Heat production and regulation of human body.

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UNIT V DESIGN OF AIR CONDITIONING SYSTEMS COMPONENTS (9 Hrs)

Air conditioning loads - Sources of heat load – Sensible load – Latent load - Conduction load – Sun load – Load from occupants – Equipment load – Infiltration air load- Load from moisture gain – Fresh air load- ASHARE standards - concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature - Requirements of industrial air conditioning – Calculation of load on air-conditioning system – Design of space cooling load - Air-conditioning devices and components: Air filters, types, efficiency – Humidifiers and Dehumidifiers – selection of humidifier and design – Fans, types &selection - Coil, Characteristics, types & Coil Accessories - condensate control-blowers – Cooling towers and spray ponds – Air distribution system –precision air conditioning - Automotive air conditioning - Heat pump – heat sources – different heat pump circuits – Commissioning and Maintenance

Text Books

1. Arora, C.P., “Refrigeration and Air conditioning”, Tata McGraw-Hill, New Delhi, Third edition, 2017.
2. McQuiston, F.C., Parker, J.D and Spilter, J.D., “Heating Ventilating and Air Conditioning”, John Wiley & Sons Inc., 2001.
3. Stocker W.F and Jones J.W, “Refrigeration and Air Conditioning”, McGraw-Hill, 1995.

Reference Books

1. Manohar Prasad, “Refrigeration and Air Conditioning”, New Age International Publisher, New Delhi, 2015.
2. Arora.S.C and Domkundwar. S, “A course in refrigeration and Air conditioning”, Dhanpat Rai (P) Ltd, New Delhi, 2016.
3. Legg, R.C., “Air Conditioning System - Design, Commissioning and maintenance”, Batsford Ltd, London 1991.
4. Haines, W.R, and Wilso, C.L,” HVAC systems Design Handbook”, Mcgraw Hill, 2nd Edition, New Delhi, 1994
5. Sapali S.N, “Refrigeration and air Conditioning”, PHI, second edition, 2014

Web References

1. http://nptel.ac.in/courses/112105128/
2. httpp://ocw.mit.edu/courses/mechanical engineering/
3. http://www.nptelvideos.in/2012/12/refrigeration-and-airconditioning.html
4. https://www.youtube.com/watch?v=ScVBPAitibQ
5. https://www.youtube.com/watch?v=z8ZStRCacdM

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	3	1	2	2	-	-	-	-	-	-	-	-	1	-	2
2	3	1	2	2	-	-	-	-	-	-	-	-	1	-	2
3	3	1	2	2	-	-	-	-	-	-	-	-	1	-	2
4	3	1	2	2	-	-	-	-	-	-	-	-	1	-	2
5	3	1	2	2	-	-	-	-	-	-	-	-	1	-	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20MEO605	CREATIVITY INNOVATION AND NEW PRODUCT DEVELOPMENT (Common to EEE, ECE, ICE, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the need for creativity and innovation
- To learn about the project selection and evaluation
- To learn about the Patent and IPR
- To understand the quality standards and new product planning
- To learn model preparation and evaluation

Course Outcomes

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

CO1 - Describe the creativity and problem solving. **(K1)**
CO2 - Analyze the methods for project selection and evaluation. **(K4)**
CO3 - Analyze the patent laws and IPR. **(K4)**
CO4 - Describe the new product planning. **(K1)**
CO5 - Acquire knowledge about the patent applications. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brainstorming - different techniques.

UNIT II PROJECT SELECTION AND EVALUATION (9 Hrs)

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products evaluation techniques.

UNIT III NEW PRODUCT DEVELOPMENT (9 Hrs)

Research and new product development - Patents - Patent search - Patent laws-International code for patents - Intellectual property rights (IPR).

UNIT IV NEW PRODUCT PLANNING (9 Hrs)

Design of proto type - testing - quality standards - marketing research introducing new Products.

UNIT V MODEL PREPARATION & EVALUATION (9 Hrs)

Creative design - Model Preparation - Testing - Cost evaluation – Patent application

Text Books

1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.
3. Lawrence Sanders G, Saylor foundation Publishing Ltd., 2012.

Reference Books

3. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
4. Dr Paul Trott, Innovation Management and New Product Development, 6th Edition, Pearson Publication, 2017
5. Khandwalla, N – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
4. Bulletins I.P.R, TIFAC, New Delhi, 1997.
5. Jacob Goldenberg, Creativity in Product Innovation, Cambridge University Press, 2002.

Web References

1. https://nptel.ac.in/courses/107/103/107103082/
2. https://nptel.ac.in/courses/107/101/107101086/
3. https://nptel.ac.in/courses/110/107/110107094/
4. https://www.youtube.com/watch?v=H6OlyjLJf6k
5. https://www.youtube.com/watch?v=CnKeVs-_9zs

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
3	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
4	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
5	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	DISASTER MANAGEMENT	**L**	**T**	**P**	**C**	**Hrs**
U20CEO603	(Common to EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To provide basic conceptual understanding of disasters
- To understand approaches of Disaster Management
- To build skills to respond to disaster
- To understand the safety precaution
- To know the basic planning and policy act of the disaster

Course Outcomes

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

CO1 - Infer Disasters, man-made Hazards and Vulnerabilities **(K2)**
CO2 - Summarize the disaster management studies **(K2)**
CO3 - Identify disaster mitigation and management mechanism **(K1)**
CO4 - Estimate the disaster safety precaution **(K2)**
CO5 - Determine the disaster plan and act **(K3)**

UNIT I DEFINITION AND TYPES (9 Hrs)

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II STUDY OF IMPORTANT DISASTERS (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters

UNIT III MITIGATION AND MANAGEMENT (9 Hrs)

Concepts of risk management and crisis management - Disaster management cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness- Planning for relief

UNIT IV SAFETY PROCESS (9 Hrs)

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT V PLANNING AND ACT (9 Hrs)

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Text Books

1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt. Ltd
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd.
3. Jagbir Singh, Disaster Management: Future Challenges and Opportunities, K W Publishers Pvt. Ltd.
4. J. P. Singhal, Disaster Management, Laxmi Publications
5. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication

Reference Books

1. Disaster Management by Mrinalini Pandey Wiley 2014.
2. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt. Ltd Wiley 2015
3. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India
5. Manual on Disaster Management, National Disaster Management, Agency Govt. of India.

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Web References

1. http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf
2. http://nidm.gov.in/pdf/guidelines/new/sdmp.pdf
3. http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	3	3	2	-	2	2	2	3	1	1	1
2	3	2	3	2	3	3	2	-	2	2	2	3	1	1	1
3	3	2	3	2	3	3	2	-	2	2	2	3	1	1	1
4	3	2	3	2	3	3	2	-	2	2	2	3	1	1	1
5	3	2	3	2	3	3	2	-	2	2	2	3	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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			L	T	P	C	Hrs
U20CEO604	**AIR POLLUTION AND SOLID WASTE MANAGEMENT** (Common to EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT)		3	0	0	3	45

Course Objectives

- To provide general understanding of air pollution, air pollutants, their sources and their effects
- To provide knowledge about meteorological parameters, air sampling and measurement of pollutants.
- To provide knowledge of air pollution controlling technologies, air pollution due to automobiles and general Idea of noise pollution.
- To study the importance of solid waste management by processing, treatment, disposal and reuse of solid waste.
- To study about the equipment used for waste collection and transportation of solids waste

Course Outcomes

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

CO1 - Understand the type, sources & effect of air pollutants (**K2)**

CO2 - Know the meteorological aspects and various methods of measurement and estimation of pollutants **(K4)**

CO3 - Gain knowledge about air pollution control equipment's and basics of Noise pollution **(K3)**

CO4 - Understand about the concept of solid waste management **(K2)**

CO5 - Gain knowledge about the Equipments used to collection and transportation methods (**K3)**

UNIT I INTRODUCTION TO AIR POLLUTION (8 Hrs)

Introduction to air pollution: Air pollution episodes, Atmosphere and its zones, classification and sources of air pollutants, effects of air pollutants on man, plants animal & materials

UNIT II METEOROLOGICAL ASPECTS (8 Hrs)

Meteorological Aspects: Atmospheric stability, plume behavior, Ambient air sampling and stack sampling, collection of particulates and gaseous pollutants, methods of estimation

UNIT III AIR POLLUTION CONTROL METHODS (9 Hrs)

Air pollution control methods and equipment: Principle of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters cyclones, wet scrubbers, automobile exhaust: Pollution due to diesel and petrol engines, exhaust treatment and abatement, noise Pollution: Sources, ill effects, control measures

UNIT IV SOLID WASTE MANAGEMENT (8 Hrs)

Introduction to solid waste management, sources, quantification and characterization, classification and components, sampling and analysis, Method of collection

UNIT V EQUIPMENT (12 Hrs)

Equipment used for collection and transportation, transfer stations, solid waste processing and management. Treatment and disposal methods: composting, sanitary landfills, Incineration – concept, components and applications, leachate management

Text Books

1. M.N. Rao & H.V.N. Rao, 1988, Air Pollution, Tata McGraw Hill Publishing Co. Ltd.
2. C.S. RAO, 2007, Environmental Pollution Control Engineering, New Age International, Wiley Eastern Ltd. New Delhi.
3. Stern A. C., 1973, Air pollution, Academic Press.
4. A.D. Bhide & Sunderesan B.B., 1983, Solid Waste Management in Developing countries, INSDOC, New Delhi.
5. Tohobanoglous, 1993, Integrated Solid Waste Management Engineering Principle and Management Issues, McGraw-Hill publication Ltd

Reference Books

1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.
2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.
3. Waste Management: A Reference Handbook. Contributors: Jacqueline Vaughn - Author. Publisher: ABC-Clio
4. K. V. S. G. Murlikrishna, 1995, Air Pollution, Kaushal & Company

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Web References

1. https://nptel.ac.in/courses/120108005/
2. http://cpheeo.gov.in/upload/uploadfiles/files/Part1
3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	3	2	3	2	3	3	3	3	3	2	3	1	1	1
2	3	3	2	3	3	3	3	2	3	2	2	3	1	1	1
3	3	3	3	2	2	2	3	3	3	3	2	3	1	1	1
4	2	3	2	3	2	3	2	3	3	2	2	3	1	1	1
5	3	3	3	2	3	3	3	3	3	2	3	3	1	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20BMO603	BIOMETRIC SYSTEMS (Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of Biometric systems
- To gain knowledge in different fingerprint technologies
- To understand the classification of face recognition methods.
- To understand multimodal Biometrics and its performance evaluation.
- To know personal privacy and security implications of biometrics systems

Course Outcomes

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

CO1 - Explain the fundamentals of biometric systems **(K2)**
CO2 - Describe the various fingerprint technologies **(K3)**
CO3 - Distinguish different face recognition and hand geometry pattern **(K3)**
CO4 - Analyze the multimodal biometrics and performance evaluation of biometrics **(K4)**
CO5 - Recognize various Biometric authentication methods **(K3)**

UNIT I INTRODUCTION TO BIOMETRICS (9 Hrs)

Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification – Authentication technologies – Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics

UNIT II FINGERPRINT TECHNOLOGY (9 Hrs)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modelling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching.

UNIT III FACE RECOGNITION AND HAND GEOMETRY (9 Hrs)

Introduction to face recognition - face recognition from correspondence maps - Hand geometry- scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION (9 Hrs)

Voice scan - Physiological biometrics – Behavioral biometrics - Introduction to multimodal biometric system- Integration strategies - Architecture - level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics - FAR - FRR - FTE - EER - Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Introduction - Biometric Authentication Methods - Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines - Biometric authentication by hand geometry - Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multi-biometrics and Two-Factor Authentication

Text Books

1. Anil K. Jain, Arun Ross, and Karthik Nandakumar “ Introduction to Biometrics”, Springer ,2011
2. Richard O. Duda, David G.Stork, Peter E. Hart, “Pattern Classification,”, Wiley 2007
3. S.Y.Kung, S.H. Lin, M.W.Mak, “Biometric Authentication: A Machine Learning Approach”, Prentice Hall, 2005

Reference Books

1. Anil K. Jain, Patrick Flynn, and Arun A. Ross, “Handbook of Biometrics”, Springer, 2008
2. John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley, 2003.
3. John R. Vacca, “Biometric Technologies and Verification Systems”, Elsevier Inc, 2007
4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, 2005
5. Nikolaos V. Boulgouris, Konstantinos N. Plataniotis ,Evangelia Micheli-Tzanakou, “Biometrics: Theory, Methods, and Applications” , Wiley 2009

(DR.S. ANBUMALAR)

Web References

1. http://www.findbiometrics.com/Pages/glossary.html
2. http://www.biometrics.gov/Documents/privacy.pdf
3. http://zing.ncsl.nist.gov/biousa/docs/Usability_and_Biometrics_final2.pdf
4. User Interface, System Design
5. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	-	1
2	3	2	2	1	1	2	-	-	-	-	-	1	-	-	1
3	3	2	2	1	2	2	-	-	-	-	-	1	-	-	1
4	3	1	1	1	1	1	-	-	-	-	-	1	-	-	1
5	3	1	2	1	2	2	-	-	-	-	-	1	-	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20BMO604

MEDICAL ROBOTICS

(Common to EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the basics of Robotics
- To gain knowledge in Kinematics
- To know about the robot vision
- To describe various motion planning solutions
- To explain various applications of Robots in Medicine

Course Outcomes

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

CO1 - Understand the basics of robotic systems. **(K2)**
CO2 - Explore workspace and related motion of the Robots **(K3)**
CO3 - Analyze and extract information from the image using Robots **(K3)**
CO4 - Design of task planning and simulating the task. **(K4)**
CO5 - Construct Robots for Medical applications **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot - Five-axis robot - Six-axis robot.

UNIT II KINEMATICS (9 Hrs)

Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion – Straight-line motion.

UNIT III ROBOT VISION (9 Hrs)

Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.

UNIT IV PLANNING (9 Hrs)

Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.

UNIT V MEDICAL APPLICATIONS (9 Hrs)

Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.

Text Books

1. Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, 2003.
2. Paula Gomes, “Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications”, Wood head Publishing, 2012
3. Klafter, Chmielewski and Negin, “Robotic Engineering - An Integrated approach”, PHI, first edition, 2009

Reference Books

1. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2005.
2. Fu, Lee and Gonzalez., “Robotics, control vision and intelligence”, McGraw Hill International, 2nd Edition, 2007
3. John J. Craig, “Introduction to Robotics”, Addison Wesley Publishing, 3rd Edition, 2010.
4. Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, “Robotics”, McGraw Hill, 2008.

(DR.S. ANBUMALAR)

Web References

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_robotic surgery
3. https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
4. https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
5. https://www.worldscientific.com/worldscinet/jmrr

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	1	-	-	-	-	-	1	-	2	1
2	3	2	-	1	1	1	-	-	-	-	-	1	-	2	1
3	3	2	-	1	1	1	-	-	-	-	-	1	-	2	1
4	3	1	1	1	1	1	-	-	-	-	-	1	-	2	1
5	3	1	1	-	1	1	-	-	-	-	-	1	-	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CCO603

NETWORK ESSENTIALS

(Common to EEE, ICE, MECH, CIVIL, Mechatronics, BME)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of computer communication and data networks
- To gain the necessary knowledge and skills to work effectively with network engineering and administrators
- To learn how to research ,communicated network and IT issuing by reading relevant industry information
- To understanding the basic technologies and step required for setting up managing small LAN
- To understand the various technologies of security to protect the information in network

Course Outcomes

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

CO1 - Understand the basic knowledge and skills to implement defined network architecture
CO2 - Explain the performances of data link control and their access medium
CO3 - Describe about internet Protocol and their working processes in IPV.
CO4 - Explain the basic concepts of Transport Protocols and working of TCP layer
CO5 - Design and study the operations of Security and their different algorithm

UNIT I NETWORK MODELS (9 Hrs)

Data communications – Networks - PAN, LAN, MAN and WAN - Internet, Intranet and Extranets - Protocols and standards - OSI/ISO reference model - TCP/IP protocol suite - Broadband ISDN - ATM protocol reference model - SONET/SDH architecture - Bluetooth and UWB – WiFi - WiMax Cognitive Radios - Adhoc and Sensor Networks - Green communications.

UNIT II DATA LINK CONTROL AND MEDIUM ACCESS (9 Hrs)

Types of errors - Error detection and correction – Checksum – Framing - Flow control - Stop and wait protocol - Go-back N - Selective repeat protocols HDLC - Random access protocols - Controlled access - Wired LANs - IEEE standards, IEEE 802.3, 802.4, 802.5 and 802.6 - Fast Ethernet - Gigabit Ethernet – Wireless LANs - IEEE 802.11.

UNIT III NETWORK ROUTING (9 Hrs)

Logical addressing - IPv4 addresses - IPv6 - Internet protocol - Transition from IPv4 to IPv6 - Mapping logical to physical address - Mapping physical to logical address – ICMP - Direct Vs indirect delivery – Forwarding - Unicast and Multicast routing protocols - Different Routing Algorithms – Internetworking - Routers and gateways.

UNIT IV TRANSPORT AND CONGESTION (9 Hrs)

Elements of Transport Protocols: addressing, Connection Establishment, Connection Release, Error Control and Flow Control - Congestion control: Desirable Bandwidth Allocation, Regulating the Sending Rate, Wireless Issues - UDP, RPC - TCP Protocol, TCP connection management, TCP sliding window and congestion control.

UNIT V SECURITY (9 Hrs)

Introduction to Cryptography, Cipher text, symmetric key cryptography – AES and DES, RSA public key and private keys – Digital signature. Security in the Internet: IP Sec, PGP, VPN and Firewalls. Authentication Protocols: Shared Secret Key, The Diffie-Hellman Key Exchange, Authentication using Kerberos. Wireless Security - issues and challenge.

Text Books

1. William Stallings, “Data and computer communications”, Ninth Edition, Pearson Education, New Delhi, 2014.
2. Behrouz. A. Forouzan, “Data Communication and Networking”, Fifth Edition, McGraw Hill, New Delhi, 2013.
3. Pallapa Venkatram and Sathish Babu. B, “Wireless & Mobile Network security”, Tata McGraw Hill, New Delhi, 2010.

(DR.S. ANBUMALAR)

Reference Books

1. Douglas E. Comer, “Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture”, 6th Edition, Pearson Education, 2013.
2. Nader F. Mir, “Computer and Communication Networks”, 2nd Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan and Firouz Mosharraf, “Computer Networks a Top Down Approach”, Tata McGraw-Hill, 2017.
5. Rich Seifert, James Edwards, “The All New Switch Book: The Complete Guide to LAN Switching Technology”, 2nd Edition , Wiley Publishing Inc, 2011

Web References

1. https://tinyurl.com/ycy6x454
2. https://tinyurl.com/yapn9ac7
3. https://tinyurl.com/ydf33ye6
4. https://nptel.ac.in/courses/106/105/106105081/
5. https://nptel.ac.in/courses/106/105/106105183/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	-	-	-	-	-	1	-	2	2
2	2	1	2	1	-	1	-	-	-	-	-	1	-	2	2
3	2	1	2	1	-	1	-	-	-	-	-	1	-	2	2
4	2	1	1	1	-	1	-	-	-	-	-	1	-	2	2
5	2	1	1	1	1	1	-	-	-	-	-	1	-	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CCO604	WEB PROGRAMMING (Common to EEE, ECE, MECH, CIVIL,ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the fundamentals of web application development.
- To understand the design components and tools using CSS.
- To learn the concepts of JavaScript and programming fundamentals.
- To understand the working procedure of XML
- To study about advance scripting and Ajax applications.

Course Outcomes

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

CO1 - Comprehend basic web applications using HTML**(K2)**
CO2 - Use CSS to design web applications **(K3)**
CO3 - Use java scripts functions for the web page creation **(K3)**
CO4 - Explain XML structure **(K2)**
CO5 - Demonstrate the web 2.0 application to advance scripts **(K2)**

UNIT I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. HTML: The development process, Html tags and simple HTML forms

UNIT II STYLE SHEETS (9 Hrs)

CSS: Need for CSS, Introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT III JAVA SCRIPTS (9 Hrs)

Client side scripting, JavaScript, develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

UNIT IV XML (9 Hrs)

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

UNIT V ADVANCE SCRIPT (9 Hrs)

JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations **DHTML:** Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, **AJAX**: Introduction, advantages & disadvantages, AJAX based web application, alternatives of AJAX.

Text Books

1. Ralph Moseley, M.T. Savaliya, “Developing Web Applications”, BPB Publications, 2017.
2. Hirdesh Bhardwaj,, “Web Designing”, Pothi.com, 2016
3. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.

Reference Books

1. Ralph Moseley, “Developing Web Applications”, Wiley India Pvt. Ltd, 2013
2. Joel Sklar, “ Principles of Web Design”, 6th Edition, Cengage Learning, Inc, 2014
3. B. M. Harwani,” Developing Web Applications in PHP and AJAX”, Tata McGraw-Hill Education, 2010
4. Uttam K. Roy, “Web Technologies”, Oxford University Press, 2010.
5. Rajkamal, “Web Technology”, Tata McGraw-Hill, 2009.

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Web References

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://www.coursera.org/learn/html-css-javascript-for-web-developers
3. https://code.tutsplus.com/courses/how-to-become-a-web-developer
4. https://webdesignerwall.com/
5. https://www.smashingmagazine.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2	1	-	-	-	-	-	1	-	1	1
2	2	1	2	1	2	1	-	-	-	-	-	1	-	1	1
3	2	1	2	1	2	1	-	-	-	-	-	1	-	1	1
4	2	1	1	1	2	1	-	-	-	-	-	1	-	1	1
5	2	1	1	1	2	1	-	-	-	-	-	1	-	1	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ADO603	PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand basic principles of Artificial Intelligence
- To learn and design Knowledge representation
- To understand the concept of reasoning
- To master the fundamentals of machine learning, mathematical framework and learning algorithms
- To understand the reinforcement and statistical learning.

Course Outcomes

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

CO1 - Understand foundational principles of artificial intelligence. **(K2)**
CO2 - Understand formal methods of knowledge representation. **(K2)**
CO3 - Understand the fundamental issues and challenges of Reasoning. **(K2)**
CO4 - Analyze the underlying mathematical relationships with Machine Learning algorithms. **(K3)**
CO5 - Apply various models for Artificial Intelligence programming techniques. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Artificial Intelligence - Artificial Intelligence Problems -Timelines of Artificial Intelligence - Production Systems - State Space Representation - Branches of Artificial Intelligence - Application of Artificial Intelligence

UNIT II KNOWLEDGE REPRESENTATION (9 Hrs)

Knowledge Management - Types of Knowledge - Knowledge representation - Approaches to Knowledge representation - Issues in Knowledge representation - Knowledge base. First order Logic – Frames — Conceptual Dependency

UNIT III REASONING (9 Hrs)

Types of reasoning - reasoning with Fuzzy Logic - Rule based Reasoning - Diagnosis Reasoning

UNIT IV LEARNING (9 Hrs)

Types of Learning - Machine Learning - Intelligent agents - Association Learning: Apriori Algorithm - Case Study: Customer Sequence and SCADA Application – k-Means Clustering - Fuzzy Clustering - Cluster Similarity

UNIT V REINFORCEMENT AND STATISTICAL LEARNING (9 Hrs)

Markov Decision Problem - Hidden Markov Model - Linear Classifier - decision Trees: Random forest - Bayesian Network – ANN - ANN Learning process - Types of Network – Perceptron - RBF Network - Case studies: Character recognition

Text Books

1. Anand Hareendran S., Anand Hareendran, Vinod Chandra S.S. “Artificial Intelligence and Machine Learning” PHI Publication, 2014.
2. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Science, 1997.
3. Peter Harrington, “Machine Learning in action”, Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal “Data Classification Algorithms and Applications”, Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, “Introduction to Machine Learning with Python”, O’Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos “Machine Learning Refined Foundations, Algorithms, and Applications”, Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014

Web References

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	1	-	-	-	-	-	-	-	1	2	1
2	1	2	2	-	-	-	-	-	-	-	-	-	1	2	1
3	2	2	1	2	-	-	-	-	-	-	-	-	1	2	1
4	3	2	2	2	1	-	-	-	-	-	-	-	1	2	1
5	2	2	2	2	1	-	-	-	-	-	-	-	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U20ADO604	**DATA SCIENCE APPLICATION OF VISION** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the capability of a machine to get and analyze visual information and make decisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes

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

CO1 - Understand the methods and algorithms for image processing. **(K2)**
CO2 - Apply object detection and segmentation concepts for image processing. **(K4)**
CO3 - Apply scalable algorithms for large datasets in vision. **(K4)**
CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K3)**
CO5 - Apply vision-based solutions for specific real-world applications. **(K4)**

UNIT I IMAGE FUNDAMENTALS (9 Hrs)

Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION (9 Hrs)

Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION (9 Hrs)

Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS (9 Hrs)

Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE (9 Hrs)

Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Cengage Learning, 2007.
3. Gary Bradski, “Learning OpenCV”, First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, “Recognition of Humans and Their Activities for Video Surveillance”, IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, “Event Detection, Query, and Retrieval for Video Surveillance”, IGI Global, 2009.
3. Matthew Turk, Gang Hua, “Vision-based Interaction”, First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, “Deep Learning (Adaptive Computation and Machine Learning series)”, MIT Press, 2017.
5. Fan Jiang, “Anomalous Event Detection from Surveillance Video”, ProQuest, 2012.

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Web References

1. https://www.kaggle.com/learn/computer-vision
2. https://machinelearningmastery.com/what-is-computer-vision/
3. https://www.udemy.com/course/pythoncv/
4. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
5. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	-	2	2
2	2	1	1	2	-	-	-	-	-	-	-	-	-	2	2
3	2	2	2	1	-	-	-	-	-	-	-	-	-	2	2
4	1	2	2	2	1	-	-	-	-	-	-	-	-	2	2
5	2	1	2	2	1	-	-	-	-	-	-	-	-	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U20ECCM04	**INTERNET OF THINGS** (Open Elective to EEE, CSE, MECH, IT, CIVIL, FT)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of Reference modules and architecture of IoT.
- To understand the concepts of Hardware and Software Elements.
- To acquire the knowledge about various Functions with IoT elements.
- To develop skills required to build real-time IoT based Applications.

Course Outcomes

After completion of the course, students will be able to

CO1 - Infer internet of Things and its components**. (K2)**

CO2 - Describe about Reference modules and Architecture**. (K2)**

CO3 - Explain the concepts of Hardware and Software Elements**. (K2)**

CO4 - Build and deploy various Functions with IoT elements**. (K3)**

CO5 - Develop real-time IoT based Applications**. (K3)**

UNIT – I INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust.

UNIT - II ARCHITECTURE OF IoT (9 Hrs)

State of the Art – Introduction, Architecture Reference Model- IoT reference Model, IoT Reference Architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - III ELEMENTS OF IoT (9 Hrs)

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.
Software Components- Programming APIs (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT - IV IoT DEVELOPMENT (9 Hrs)

Solution framework for IoT applications- Implementation of Device Integration, Data acquisition, and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices

UNIT -V IoT APPLICATIONS (9 Hrs)

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, IoT for Retailing Industry, IoT for Oil and Gas Industry.

(DR.S. ANBUMALAR)

Text Books

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands-on Approach", University Press,3rd/e, Aug 2018.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017
3. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A Practical Approach", ETI Labs 2014

Reference Books

1. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2007
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2002
4. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Web Resources

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	2	-	-	-	-	-	-	-	-	3	3	-
2	3	-	3	2	-	-	-	-	-	-	-	-	3	2	-
3	2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
4	2	2	2	-	-	-	-	-	-	-	3	-	3	3	-
5	2	3	2	-	3	-	-	-	-	-	3	-	3	3	-

Correlation Level: 1-Low, 2-Medium, 3-High

(DR.S. ANBUMALAR)

U20ECO706	SENSORS FOR INDUSTRIAL APPLICATIONS (Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study principles of sensor and calibration
- To understand different types of motion sensors
- To demonstrate force, magnetic and heading sensors with its application to the learners
- To enhance students to understand the concept of optical, pressure and temperature sensor
- To select suitable sensor for industrial application

Course Outcomes

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

CO1 - Explain principles of sensor and illustrate the calibration. **(K2)**
CO2 - Demonstrate different types of range and sensors. **(K3)**
CO3 - Determine the principles of Force, magnetic and heading sensors. **(K3)**
CO4 - Describe different optical and thermal sensors. **(K2)**
CO5 - Select suitable sensor for real time applications. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Principles of Physical and Chemical Sensors: Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors.
Sensor Characterization and Calibration: Study of Static and Dynamic Characteristics, Sensor reliability, aging test, failure mechanisms and their evaluation and stability study.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS (9 Hrs)

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS (9 Hrs)

Strain Gage, Load Cell and Magnetic Sensors – types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS (9 Hrs)

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement. Radiation Sensors - Smart Sensors - Film sensor, MEMS and Nano Sensors, LASER sensors.

UNIT V APPLICATIONS OF SENSORS (9 Hrs)

Applications of Sensors for Industry Automation - Design of smart Industry using Temperature, Humidity and Pressure sensors - Applications of Flow sensors in Industries-Applications of Gyro sensor. Applications of Position sensors.

Text Books

1. D. Patranabis, “Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., 2nd Edition, 2005.
2. S. Renganathan, “Transducer Engineering”, Allied Publishers (P) Ltd., 2005.
3. Ernest O. Doebelin, “Measurement systems Application and Design”, Tata McGraw-Hill, 6th Edition, 2012.

Reference Books

1. Kr. Iniewski, “Smart Sensors for Industrial Applications”, CRC Press, 2017.
2. W. Bolton, “Mechatronics”, Thomson Press, 3rd Edition, 2004.
3. Ian R Sinclair, “Sensors and Transducers”, Newnes publishers, 3rd Edition, 2001.
4. Robert B. Northrop, “Introduction to Instrumentation and Measurement”, CRC Press Taylor and Francis Group, 3rd Edition, 2005.
5. Curtis D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall International Edition, 2015.

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Web References

1. https://www.first-sensor.com/en/applications/industrial/
2. https://www.finoit.com/blog/top-15-sensor-types-used-iot/
3. https://www.iaasiaonline.com/smart-sensors-for-industrial-applications-2/
4. https://www.plantautomation-technology.com/articles/types-of-sensors-used-in-industrial-automation
5. https://www.thomasnet.com/articles/instruments-controls/sensors/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	-	-	-	-	-	1	3	2	3
2	3	-	3	-	-	-	-	-	-	-	-	1	3	2	3
3	2	2	3	-	-	-	1	-	-	-	-	-	3	2	3
4	2	2	3	-	-	-	1	-	-	-	-	1	3	2	3
5	2	2	3	-	-	-	1	-	-	-	-	1	3	2	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CSO705	ARTIFICIAL INTELLIGENCE (Common to EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To cover fundamentals of Artificial Intelligence,
- To understand various knowledge representation techniques.
- To provide knowledge of AI systems and its variants
- To understand the planning and different learning.
- To understand the communication process of language translator.

Course Outcomes

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

CO1 - Understand the basics of Artificial Intelligence. **(K1)**
CO2 - Apply AI problem solving techniques, knowledge representation, and reasoning methods in Knowledge based systems **(K3)**
CO3 - Develop simple intelligent / expert system using available tools and techniques of AI to analyze and interpret domain knowledge. **(K3)**
CO4 - Become familiar with planning and different learning methods. **(K3)**
CO5 - Understanding the human language to Machine language and Robotics. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

Introduction - Foundations of AI – History of AI –Structure of AI agents, Problem solving - Informed and uninformed search techniques.

UNIT II KNOWLEDGE REPRESENTATION AND REASONING (9 Hrs)

Logical Agents –Propositional logic - First-Order Logic - Forward and backward chaining - Knowledge Representation.

UNIT III UNCERTAIN KNOWLEDGE AND REASONING (9 Hrs)

Basic probability notations - Bayes rule – Wumpus world revisited - Bayesian network.

UNIT IV PLANNING AND LEARNING (9 Hrs)

Introduction to planning, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Knowledge in Learning - Statistical Learning Methods - Reinforcement Learning.

UNIT V COMMUNICATING, PERCEIVING AND ACTING (9 Hrs)

Natural Language Processing – Natural Language for communication – Perception - Robotics.

Text Books

1. Kevin Night, Elaine Rich, B. Nair, “Artificial Intelligence (SIE)”, McGraw Hill, 2008.
2. Stuart Russel, Peter Norvig, “AI – A Modern Approach”, Pearson Education, 2nd Edition, 2007.
3. Patrick Henry Winston, “Artificial Intelligence”, Addison Wesley Books, 3rd Edition, 2000.

Reference Books

1. George F Luger, “Artificial Intelligence”, Pearson Education, 6th Edition, 2009.
2. Peter Jackson, “Introduction to Expert Systems”, Pearson Education, 3rd Edition, 2007.
3. Engene Charniak and Drew Mc Dermott, “Introduction to Artificial intelligence”, Addison Wesley, 2000.
4. Nils J. Nilsson, “Principles of Artificial Intelligence”, Narosa Publishing House, 2000.

Web References

1. https://www.tutorialspoint.com/artificial_intelligence/index.htm
2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://www.w3schools.com/ai/
4. https://www.mygreatlearning.com/blog/artificial-intelligence-tutorial/
5. https://nptel.ac.in/courses/112/103/112103280/

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COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	1	3	3	3	3	3	3	-	-	3	-	1	3	3
2	2	2	2	2	-	2	-	2	-	2	-	2	1	3	3
3	3	3	3	3	3	3	3	3	-	-	3	-	1	3	3
4	2	2	2	2	-	2	-	2	-	2	-	2	1	3	3
5	2	2	2	2	-	2	-	2	-	2	-	2	1	3	3

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U20CSO706	**CLOUD TECHNOLOGY AND ITS APPLICATIONS** (Common to EEE, ICE, MECH, CIVIL, BME, CCE, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To define the fundamental ideas behind Cloud Computing.
- To classify the basic ideas and principles in cloud information system.
- To relate cloud storage technologies and relevant distributed file systems.
- To explain the Cloud Applications.
- To define the Future of Cloud.

Course Outcomes

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

CO1 - Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing. **(K1)**

CO2 - Apply fundamental concepts in cloud infrastructures to understand the tradeoffs in power, efficiency and cost, and then study how to leverage and manage single and multiple datacentres to build and deploy cloud applications that are resilient, elastic and cost-efficient. **(K3)**

CO3 - Illustrate the fundamental concepts of Cloud Applications. **(K4)**

CO4 - Explain the Applications of cloud. **(K3)**

CO5 - Advancing towards a Cloud. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Cloud Computing- The Evolution of Cloud Computing – Hardware Evolution – Internet Software Evolution – Server Virtualization - Web Services Deliver from the Cloud – Communication-as-a-Service – Infrastructure-as-a-Service – Monitoring-as-a-Service – Platform-as-a-Service – Software-as-a-Service – Building Cloud Network.

UNIT II CLOUD INFORMATION SYSTEMS (9 Hrs)

Federation in the Cloud - Presence in the Cloud - Privacy and its Relation to Cloud-Based Information Systems – Security in the Cloud - Common Standards in the Cloud – End-User Access to the Cloud Computing.

UNIT III CLOUD INFRASTRUCTURE (9 Hrs)

Introduction– Evolving IT infrastructure – Evolving Software Applications –Service Oriented Architecture – Interoperability Standards for Data Center Management - Virtualization – Hyper Threading – Blade Servers - Automated Provisioning - Policy Based Automation – Application Management – Evaluating Utility Management Technology - Virtual Test and development Environment.

UNIT IV CLOUD APPLICATIONS (9 Hrs)

Software Utility Application Architecture - Characteristics of a SaaS - Software Utility Applications - Cost Versus Value - Software Application Services Framework - Common Enablers – Conceptual view to Reality – Business Profits - Implementing Database Systems for Multitenant Architecture - Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

UNIT V FUTURE OF CLOUD (9 Hrs)

Other Design Considerations - Design of a Web Services Metering Interface - Application Monitoring Implementation - A Design for an Update and Notification Policy - Transforming to Software as a Service - Application Transformation Program - Business Model Scenarios - Virtual Services for Organizations - The Future.

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Text Books

1. Sandeep Bhowmik, "Cloud Computing", Cambridge University Press, 1st Edition, 2017.
2. Erl, "Cloud Computing: Concepts, Technology & Architecture", Pearson Education India, 1st Edition, 2014.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

Reference Books

1. Sanjiva Shankar Dubey, "Cloud Computing and Beyond", Dreamtech Press, 2nd Edition, 2019.
2. John W. Rittinghouse and James F. Ransome, "Cloud Computing Implementation, Management and Security", CRC Press, Taylor & Francis Group, 2010.
3. George Reese, "Cloud Application Architectures", O'reilly Publications, 2009.
4. Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007.
5. Bunker and Darren Thomson, "Delivering Utility Computing", John Wiley & Sons Ltd., 2006.

Web References

1. www.coltdatacentres.net/Cloud Technology.
2. www.zdnet.com.
3. https://www.cloudbakers.com/blog/what-is-a-cloud-application
4. https://www.cloudbakers.com/blog/what-is-a-cloud-application
5. https://blog.servermania.com/what-is-a-cloud-application

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	1	-	2	1	3	1	1	2	2
2	1	1	2	1	1	3	1	-	2	1	3	1	1	2	2
3	2	2	1	1	-	3	1	1	2	1	3	1	1	2	3
4	1	1	1	1	2	2	1	-	2	1	3	1	1	2	2
5	2	1	1	1	1	3	1	-	2	1	3	1	1	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ITCM08	**AUTOMATION TECHNIQUES & TOOLS - DEVOPS** (Common to EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- The Background and mindset of Devops
- To enable students appreciate the agile led development environment.
- To give the students a perspective to grasp the need for Minimum viable product led development using Sprints.
- To enable students acquire fundamental knowledge of CI/CD and CAMS.
- To enable learners realize various aspects of DevOps Ecosystem

Course Outcomes

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

CO1 - Explain traditional software development methodologies like waterfall. **(K2)**
CO2 - Apply the Agile Methodology and comparing various other software development models with agile. **(K3)**
CO3 - Explain implementing Continuous Integration and Continuous Delivery. **(K2)**
CO4 - Explain CAMS for DevOps (Culture, Automation, Measurement and Sharing). **(K2)**
CO5 - Create quick MVP prototypes for modules and functionalities. **(K3)**

UNIT I TRADITIONAL SOFTWARE DEVELOPMENT (9 Hrs)

The Advent of Software Engineering - Software Process, Perspective and Specialized Process Models – Software Project Management: Estimation - Developers vs IT Operations conflict.

UNIT II RISE OF AGILE METHODOLOGIES (9 Hrs)

Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

UNIT III INTRODUCTION DEVOPS (9 Hrs)

Introduction to DevOps - Version control - Automated testing - Continuous integration - Continuous delivery - Deployment pipeline - Infrastructure management – Databases

UNIT IV PURPOSE OF DEVOPS (9 Hrs)

Minimum Viable Product - Application Deployment - Continuous Integration - Continuous Delivery

UNIT V CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) (9 Hrs)

CAMS – Culture, CAMS – Automation, CAMS – Measurement, CAMS – Sharing, Test-Driven Development, Configuration Management-Infrastructure Automation- Root Cause Analysis- Blamelessness- Organizational Learning

Text Books

1. Dev Ops – Volume 1 , Pearson and Xebia Press
2. Grig Gheorghiu, Alfredo Deza, Kennedy Behrman, Noah Gift, “Python for DevOps”, 2019.

Reference Books

1. The DevOps Handbook - Book by Gene Kim, Jez Humble, Patrick Debois, and Willis Willis
2. What is DevOps? - by Mike Loukides
3. Joakim Verona, Practical DevOps, 2016.

Web References

1. https://www.pinkelephant.com/en-CA/Course/DevOps-Essentials
2. https://www.edureka.co/devops-certification-training
3. https://devopsinstitute.com/certifications/devops-foundation/
4. https://www.softed.com/course/foundation-of-devops

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	1	2	1
2	3	2	1	1	2	-	-	-	-	-	-	-	1	2	1
3	2	1	-	-	2	-	-	-	-	-	-	-	1	2	1
4	2	1	-	-	2	-	-	-	-	-	-	-	1	2	1
5	3	2	1	1	2	-	-	-	-	-	-	-	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ITO706 **AUGMENTED AND VIRTUAL REALITY**
(Common to EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To learn basics of VR and AR systems
- To know about basic Augment reality functions
- To know about basic Virtual reality functions
- To know about Virtual reality environment and steps to work on it
- To learn various application on AR and VR

Course Outcomes

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

CO1 - Understand the concepts of VR **(K2)**
CO2 - Summarize different VR modelling Process **(K2)**
CO3 - Identify applications of virtual reality environment **(K2)**
CO4 - Explore and work on Augmented Reality environment **(K2)**
CO5 - Illustrate applications related to VR and AR **(K3)**

UNIT I VIRTUAL REALITY AND 3D COMPUTER GRAPHICS (9 Hrs)

Introduction - Benefits of virtual reality - The Virtual world space – Positioning the virtual observer – Stereo perspective projection – 3D clipping – Color Theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms

UNIT II VR MODELLING PROCESS (9 Hrs)

Geometric modeling – kinematics modeling - physical modeling – behaviour modeling – model Management.

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR (9 Hrs)

Methodology and terminology - user performance studies - VR health and safety issues – Usability of virtual reality system - cyber sickness - side effects of exposures to virtual reality environment

UNIT IV AUGMENTED REALITY (AR) (9 Hrs)

Introduction – Benefits of AR – Key players of AR technology - Understanding Augmented reality - Working with AR and System structure

UNIT V APPLICATIONS ON VR ` (9 Hrs)

Medical applications - robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations

Text Books

1. Kelly S. Hale, Kay M. Stanney, “Handbook of Virtual Environments: Design, Implementation, and Applications”, Human Factors and Ergonomics, 2nd Edition, 2014.
2. C. Burdea and Philippe Coiffet, “Virtual Reality Technology”, Gregory, John Wiley and Sons, Inc., 2nd Edition, 2008.
3. Jason Jerald, “The VR Book: Human-Centred Design for Virtual Reality”, Association for Computing Machinery and Morgan and Claypool, 2015.

Reference Books

1. Dieter Schmalstieg and Tobias Hollerer, “Augmented Reality: Principles and Practice (Usability)”, Pearson Education, 2016.
2. Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)”, Addison-Wesley Professional, 1st Edition, 2016.
3. Tony Parisi, “Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile”, OReilly Media, 1st Edition, 2015.
4. Tony Parisi, “Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages”, OReilly Media, 1st Edition, 2014.

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Web References

1. https://www.coursera.org/courses?query=augmented%20reality
2. https://nptel.ac.in/courses/106/106/106106138/
3. http://www.vrmedia.it/en/xvr.html
4. http://www.hitl.washington.edu/artoolkit/

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	2	-	2	-	2	1
2	2	1	-	-	2	-	-	-	-	2	-	2	-	2	1
3	2	1	-	-	2	-	-	-	-	2	-	2	-	2	1
4	2	1	-	-	2	-	-	-	-	2	-	2	-	2	1
5	2	1	-	-	2	-	-	-	-	2	-	2	-	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ICO705

INDUSTRIAL AUTOMATION
(Common to EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives
- To know about the design of a system using PLC.
- To study about PLC Programming
- To study knowledge on application of PLC
- To have an exposure SCADA architecture
- To know about the fundamentals of DCS

Course Outcomes
After completion of the course, the students will be able to

CO1 - Know the fundamentals of data networks and Understand working of PLC, I/O modules of PLC, automation and applications in industry. **(K1)**

CO2 - Know about the design of systems using PLC and PLC programming. **(K3)**

CO3 - Acquire knowledge on application of PLC. **(K3)**

CO4 - Know about the SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software. **(K3)**

CO5 - Know the fundamentals of DCS. **(K1)**

UNIT I PLC ARCHITECTURE (9 Hrs)
Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

UNIT II PLC PROGRAMMING (9 Hrs)
Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

UNIT III APPLICATION OF PLC (9 Hrs)
Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

UNIT IV INTRODUCTION OF SCADA (9 Hrs)
Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements.

UNIT V DISTRIBUTED CONTROL SYSTEM (9 Hrs)
Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Field bus and PROFIBUS – Application and case studies of large scale process control using DCS.

Text Books
1. John W. Webb and Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, Prentice Hall Inc., 5th Edition, 2002.
2. M. P. Lukcas, “Distributed Control Systems”, Van Nostrand Reinhold Co., 1986.
3. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, 4th Edition, 2010.

Reference Books
1. P. B. Deshpande and R. H. Ash, “Elements of Process Control Applications”, ISA Press, 1995.
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, Prentice Hall, 8th Edition, 2005.
3. Krishna Kant, “Computer-based Industrial Control”, Prentice Hall, 2nd Edition, 2011.

Web References
1. https://nptel.ac.in/courses/108105063/
2. https://www.google.com/amp/s/controlstation.com/what-is-a-distributed-control-system/amp/
3. https://nptel.ac.in/courses/108/105/108105088/
4. https://onlinecourses.nptel.ac.in/noc20_me39/preview
5. https://nptel.ac.in/content/syllabus_pdf/108105088.pdf.

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COs/POs/PSOs Mapping

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3	3	2	1	-	-	1	-	-	-	1	1	2	2	3	2
4	2	3	1	-	-	1	-	-	-	1	1	2	2	3	2
5	3	2	1	-	-	1	-	-	-	1	1	3	2	3	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ICO706

ULTRASONIC INSTRUMENTATION

(Common to EEE, ECE, MECH, Mechatronics)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To know about the ultrasonic waves characteristics
- To study about ultrasonic wave generation
- To study knowledge on ultrasonic test methods
- To have an exposure on ultrasonic measurements
- To explore the ultrasonic applications

Course Outcomes

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

CO1 - Know the fundamentals of ultrasonic characteristics **(K1).**
CO2 - Know about the generation of ultrasonic generation **(K1).**
CO3 - Acquire knowledge on ultrasonic test methods **(K2)**
CO4 - Know about the ultrasonic density **(K1)**
CO5 - Explore knowledge on ultrasonic applications **(K3)**

UNIT I ULTRASONIC WAVES CHARACTERISTICS (9 Hrs)

Ultrasonic waves: principle and propagation of various waves, characterization of ultrasonic transmission, reflection and transmission coefficients, intensity and attenuation of sounds beam .power level, medium parameters.

UNIT II ULTRASONIC WAVE GENERATION (9 Hrs)

Generation of ultrasonic waves: magnetostrictive and piezoelectric effects, search unit types, construction and characteristics

UNIT III ULTRASONIC TEST METHODS (9 Hrs)

Ultrasonic test methods: pulse echo, transit time, resonance, direct contact and immersion type and ultrasonic methods of flaw detection.

UNIT IV ULTRASONIC MEASUREMENTS (9 Hrs)

Ultrasonic measurements: ultrasonic methods of measuring thickness, depth and flow, variables affecting ultrasonic testing in various applications.

UNIT V ULTRASONIC APPLICATIONS (9 Hrs)

Ultrasonic applications: ultrasonic applications in medical diagnosis and therapy, acoustical holography.

Text Books

1. J. David, N. Cheeke, “Fundamentals and Applications of Ultrasonic Waves”, CRC Press, 2002.
2. Dale Ensminger, “Ultrasonic: Fundamentals, Technology, Applications”, CRC press, 2nd Edition, 1988.

Reference Books

1. Baldev Raj, P. Palanichamy, V. Rajendran, “Science and Technology of Ultrasonic”, Alpha Science, 2004.
2. Emmanuel P. Papadakis, “Ultrasonic Instruments and Devices”, ASA, 1998.

Web References

1. https://www.intechopen.com/chapters/47872
2. https://nptel.ac.in/courses/108/105/108105064/
3. https://www.ti.com/lit/an/slaa907c/slaa907c.pdf?ts=1630072911996&ref_url=https%253A%252F%252F
4. www.google.com%252F
5. https://pocketdentistry.com/6-ultrasonic-instrumentation-technique/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	1	1	-	-	-	-	1	-	2	1	2	1
2	3	1	-	1	1	-	-	-	-	1	-	2	1	2	1
3	3	1	-	1	1	-	-	-	-	1	-	2	1	2	1
4	2	1	-	1	1	-	-	-	-	1	-	2	1	2	1
5	3	1	-	2	1	-	2	-	-	1	-	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20MEO706	PRINCIPLES OF HYDRAULIC AND PNEUMATIC SYSTEM (Common to EEE, ECE, ICE, CIVIL)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of Hydraulic system design and industrial applications.
- To provide fundamental knowledge of components forming pneumatic systems.
- To design pneumatic circuits.
- To understand the PLC programming and its applications in Hydro mechanical servo systems.

Course Outcomes

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

CO1 - Identify the components of a typical hydraulic systems. **(K2)**

CO2 - Design and predict simple pressure and direction flow circuits. **(K3)**

CO3 - Understand the pneumatic components (Cylinders, valves, etc.), their use, symbols, and their constructional details. **(K2)**

CO4 - Design Industrial Pneumatics automatic control circuits. **(K3)**

CO5 - Develop circuits for controlling hydraulic and pneumatic system using PLC. **(K3)**

UNIT I ELEMENTS OF HYDRAULIC SYSTEMS (9 Hrs)

Introduction to fluid power, Power unit and accessories, Types of power units –elements. Design properties - Hydraulic fluids, Selection of hydraulic fluid, comparison of hydraulics and pneumatics. Types of cylinders, cylinder cushioning, Pipes- material, pipe fittings. Seals and packing. Filter arrangement, maintenance of hydraulic systems. Selection criteria for cylinders, pipes, Heat generation in hydraulic system.

UNIT II HYDRAULIC SYSTEM DESIGN AND INDUSTRIAL APPLICATIONS (9 Hrs)

Pressure, flow and direction control valves – types & constructional details, circuit symbols. Flow, Pressure and direction control circuits. Regenerative circuits, differential circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits. Design of hydraulic circuits.

UNIT III ELEMENTS OF PNEUMATIC SYSTEMS (9 Hrs)

Compressors- types, selection. Symbols of pneumatic elements. Cylinders - types, typical construction details. Valves – Types, typical construction details.

UNIT IV PNEUMATIC SYSTEMS DESIGN AND INDUSTRIAL APPLICATIONS (9 Hrs)

General approach, travel step diagram. Types - sequence control, cascade, step counter method. K.Mapping for minimization of logic equation. Metal working, handling, clamping, application with counters. Design of pneumatic circuits.

UNIT V ADVANCES IN HYDRAULICS AND PNEUMATICS (9 Hrs)

Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC-construction, types, operation, programming.

Text Books

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2005.
2. R. Srinivasan, “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints Private Ltd, 2005.
3. F. D. Yeaple, “Hydraulic and Pneumatic Power and Control: Design”, McGraw-Hill, USA, 2007.
4. S.Sameer, “Hydraulic and Pneumatic”, R. K. Publications, 2010.
5. I. C.Turner, “Engineering Applications of Pneumatics and Hydraulics”, Taylor & Francis, 2020.

Reference Books

1. Majumdar, S.R, ‘‘Oil Hydraulic Systems: Principles and Maintenance”, Tata McGraw- Hill, New Delhi, 2003.
2. Sundaram K.Shanmuga, ‘‘Hydraulic and Pneumatic Controls”, S. Chand, 2006.
3. Pippenger J.J Tyler G Hicks, “Industrial Hydraulics”, McGraw-Hill, USA, 2007.
4. Jarosław Stryczek, “Advances in Hydraulic and Pneumatic Drives and Controls”, Springer, 2020.
5. Joji Parambath, “Hydraulics Accumulators and Circuits”, 2020.

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Web References

1. https://nptel.ac.in/courses/112/106/112106300/
2. https://nptel.ac.in/courses/112/105/112105046/
3. https://nptel.ac.in/courses/112/102/112102011/
4. https://nptel.ac.in/courses/112/106/112106175/
5. https://www.hydraulicspneumatics.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	2	1	-	1	-	1	-	2	1	2	-
2	3	2	2	1	2	1	-	1	-	1	-	2	1	1	-
3	3	1	2	-	1	-	-	1	-	1	-	1	1	2	-
4	3	2	2	2	1	1	-	1	-	1	-	3	1	1	-
5	3	1	2	1	2	1	-	1	1	1	-	3	1	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20MEO707

SUPPLY CHAIN MANAGEMENT
(Common to EEE, ECE, ICE, CIVIL)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1 - Examine the process and strategy of supply chain management **(K2)**

CO2 - Enumerate the inventory in supply chain management **(K2)**

CO3 - Identify the importance of logistics and information technology in supply chain management **(K3)**

CO4 - Discuss the importance of integrated systems in supply chain management **(K2)**

CO5 - Demonstrate how agile and lean method will help to optimise resources in supply chain management **(K2)**

UNIT I INTRODUCTION TO SUPPLY CHAIN MANAGEMENT (9 Hrs)

Generic Types of supply chain, Various Definitions and Implications, Major Drivers of Supply chain. Strategic Decisions- in Supply Chain Management-Introduction, Business Strategy, Core Competencies in Supply Chain, Strategic SC Decisions

UNIT II SOURCE OF MANAGEMENT AND INVENTORY IN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Elements of Strategic Sourcing, - Collaborative Perspective, Development of Partnership, Types of Inventory, Supply/ Demand Uncertainties, Inventory costs, Selective Inventory Control, Vendor Manage Inventory system, Inventory Performance Measure

UNIT III LOGISTICS AND INFORMATION TECHNOLOGY IN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Strategy, Transportation Selection, Trade-off, Third Party Logistics,, Overview of Indian Infrastructure for Transportation- Types of IT Solutions like Electronic Data Interchange (EDI), Data Mining/ Data Warehousing, E-Commerce, E- Procurement, Bar Coding Technology- Computer Based Information Systems- ERP, ERP & SCM.

UNIT IV REVERSE AND COLLABORATIVE SUPPLY CHAIN MANAGEMENT (9 Hrs)

Reverse Supply Chain v/s Forward Supply Chain, Types and, Issues, Reverse Supply Chain for Food items, Reverse Logistic and Environment Impact. Evolution of collaborative SCM, Efficient Customer response, Collaboration at various levels, Imperatives for Successful Integrative Supply Chains.

UNIT V AGILE AND LEAN SUPPLY CHAIN MANAGEMENT (9 Hrs)

Source of Variability, Characteristics of Agile Supply Chain, Achieving Agility in Supply Chain. Lean supply chain management-Concept and Application, Cases of Supply Chain like, News Paper Supply Chain, Book Publishing, Mumbai Dabbawala, Disaster management, Organic Food, Fast Food.

Text books

1. Chopra, Sunil, Peter Meindl, and Dharam Vir Kalra "Supply chain management: strategy, planning, and operation", Pearson, 6th Edition, 2016.
2. Martin Christopher, "Logistics and Supply Chain Management", FT Publishing International, 5th Edition, 2016
3. D K Agrawal, "A text book of Logistics and supply chain management", MACMILAN, 2015.
4. Badenhorst Weiss H "Supply Chain Management: A Logistic Approach", Oxford E-Books, 2018.
5. Sunil Chopra, "Supply Chain Management: Strategy, Planning and Operation", Pearson, 2017.

Reference books

1. Michael H. Hugos, "Essentials of Supply Chain Management", John Wiley & Sons, 3rd Edition, 2018.
2. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, "Operations & Supply Chain Management", Mc Graw Hill, 15th Edition, 2018.
3. William C Copacino, "Supply chain Management, Basics and Beyond", CRC press, 2010.
4. William C Copacino, "Retail supply chain Management", CRC press, 2018.
5. James R Good, "The essentials of Supply Chain Management", Bowling Green state University, 2019.

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Web References

1. https://www.edx.org/learn/supply-chain-management
2. http://library.jgu.edu.in/content/logistics-and-supply-chain-management
3. https://onlinelibrary.wiley.com/ Journal of Supply Chain Management
4. https://www.emerald.com/insight/ An International Journal of Operations and Logistics Management
5. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mg22/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	-	-	-	-	2	1	-	-	3	1	-	1	-
2	2	2	-	-	-	-	3	-	-	-	1	-	-	1	-
3	1	2	-	-	-	-	3	-	-	-	2	1	-	1	-
4	2	-	-	-	-	-	2	-	-	-	-	-	-	1	-
5	2	1	-	-	-	-	1	1	-	-	-	1	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CEO705 **ENERGY EFFICIENT BUILDINGS** (Common to EEE, ECE, MECH)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the concept of energy consumption of building
- Aware about the various energy efficiency implementation
- Understand the measurements available to indicate energy efficiency
- Understand the investment in energy efficiency
- Understand the audit and management of energy

Course Outcomes

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

CO1 - Assess the energy consumption of buildings. **(K2)**
CO2 - Choose suitable energy efficiency implementation. **(K2)**
CO3 - Identify the measurements available to indicate energy efficiency. **(K2)**
CO4 - Apply the investment in energy efficiency. **(K3)**
CO5 - Select the audit and apply it for management of energy. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Energy consumption of building, Energy efficiency potential in buildings, Energy efficient building design (procedure), Energy efficient building technologies, energy efficient materials, certification of energy efficient building, cooling comfort in hot climates

UNIT II ENERGY EFFICIENCY IMPLEMENTION (9 Hrs)

Energy efficiency policies, Target setting and stakeholder engagement, Various building codes and standards, Energy efficient building operation, Passive solar, Natural ventilation, Day lighting of building

UNIT III ENERGY EFFICIENCY MEASUREMENT (9 Hrs)

Data and energy efficiency indicators, Evaluation of energy efficiency, The multiple benefits of energy efficiency. Electrical Energy Measurements, Thermal Energy Measurements, Mechanical & Utility System Measurements, Measurement & Verification. Case studies.

UNIT IV ENERGY EFFICIENCY INVESTMENT (9 Hrs)

Energy efficiency investment – through policy, through project standardization, through procurement, through funding, finance and fiscal instruments, through energy markets. Case studies with cutting edge of sustainable construction.

UNIT V ENERGY AUDIT AND MANAGEMENT (9 Hrs)

Definition, energy audit, need, types of energy audit. energy management (audit) approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering, precautions, smart metering.

Text Books

1. Ana-Maria Dabija, “Energy Efficient Building Design”, Springer Nature, 2020.
2. Dean Hawkes and Wayne Forster, “Energy Efficient Buildings”, W.W. Norton & Company, 2002.
3. Amritanshu Shukla, Atul Sharma, “Sustainability through Energy-Efficient Buildings”, CRC Press, 2018.
4. Ursula Eicker, “Energy Efficient Buildings with Solar and Geothermal Resources”, John Wiley & Sons, 2014.
5. Jacob J. Lamb and Bruno Georges Pollet, “Energy-Smart Buildings: Design, Construction and Monitoring of Buildings for Improved Energy Efficiency”, Institute of Physics Publishing, 2020.

Reference Books

1. Umberto Desideri, Francesco Asdrubali, “Handbook of Energy Efficiency in Buildings: A Life Cycle Approach”, Butterworth-Heinemann, 2019.
2. Susan Roaf and Mary Hancock, “Energy Efficient Building: A Design Guide”, Wiley, 1992
3. Xiaoqiang Zhai and Ruzhu Wang, “Handbook of Energy Systems in Green Buildings”, Springer Berlin Heidelberg, 2018.
4. Roberto Gonzalo, “Energy-efficient architecture”, Walter de Gruyter, 2012
5. José Manuel Andújar and Sergio Gómez Melgar, “Energy Efficiency in Buildings: Both New and Rehabilitated”, MDPI, 2020.

(DR.S. ANBUMALAR)

Web References

1. https://nptel.ac.in/courses/105/102/105102175/
2. https://nptel.ac.in/courses/105/102/105102195/
3. https://alison.com/course/sustainable-architecture-energy-efficiency-and-quality

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	1	3	3	3	3	3	3	3	-	1	-
2	2	1	1	1	1	3	3	3	3	3	3	3	-	1	-
3	2	1	1	1	1	3	3	3	3	3	3	3	-	1	-
4	2	1	1	1	1	3	3	3	3	3	3	3	-	1	-
5	2	1	1	1	1	3	3	3	3	3	3	3	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U20CEO706	**GLOBAL WARMING AND CLIMATE CHANGE** (Common to EEE, ECE, CSE, IT, ICE, MECH, BME,CCE, AI&DS, FT)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- Understand the basics and importance of global warming.
- Gain adequate knowledge about the characteristic of atmosphere components.
- Gain knowledge about impart of climate change.
- Gain knowledge about the Changes in Climate and Environment
- Impart knowledge about the mitigation measures

Course Outcomes

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

CO1 - Understand the concept and effects of global warming **(K2)**
CO2 - Understand Climate system, earth's atmosphere and its components.**(K2)**
CO3 - Analyze the Impacts of Climate Change on various sectors **(K4)**
CO4 - Assess the concept about carbon credit and clean development mechanism.**(K3)**
CO5 - Understand climate changes, its impact and mitigation activities.**(K2)**

UNIT I EARTH'S CLIMATE SYSTEM (9 Hrs)

Ozone layer-Role of ozone in environment-ozone depleting - Green House gases - Effects of Greenhouse Gases - Global Warming - Hydrological Cycle – Radiative Effects and Carbon Cycle.

UNIT II ATMOSPHERE AND ITS COMPONENTS (9 Hrs)

Importance of Atmosphere-Physical Chemical Characteristics of Atmosphere - Vertical structure of the atmosphere - Composition of the atmosphere - Atmospheric stability - Temperature profile of the atmosphere-Lapse rates - Temperature inversion-effects of inversion on pollution dispersion.

UNIT III IMPACTS OF CLIMATE CHANGE (9 Hrs)

Causes of Climate change: Change of Temperature in the environment-Melting of ice Pole-sea level rise-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 OBSERVED CHANGES AND ITS CAUSES (9 Hrs)

Climate change and Carbon credits- Initiatives in India-Kyoto Protocol-Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks –The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

UNIT V CLIMATE CHANGE AND MITIGATION MEASURES (9 Hrs)

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels - Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices–Carbon sequestration – Carbon capture and storage (CCS) – International and Regional cooperation- Remedial measures.

Text Books

1. Joan Fitzgerald, "Greenovation: Urban Leadership on Climate Change", Oxford University Press, 2020.
2. J. David Neelin, "Climate change and climate modelling", Cambridge University press, 2011.
3. Robin Moilveen, "Fundamentals of weather and climate", Oxford University Press, 2^{nd} Edition, 2010.
4. Andrew Dessler and Edward A. Parson, "The Science and Politics of Global Climate Change", 2009.
5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

Reference Books

1. Bill McKibben, "The Global Warming Reader: A Century of Writing about Climate Change", Penguin, 2012.
2. Jason Smerdon, "Climate Change: The Science of Global Warming and Our Energy Future", Columbia University, 2009
3. "Adaptation and mitigation of climate change-Scientific Technical Analysis", Cambridge University Press, Cambridge, 2006.
4. J.M. Wallace and P.V. Hobs, "Atmospheric Science", Elsevier / Academic Press, 2006.
5. Jan C. van Dam, "Impacts of Climate Change and Climate Variability on Hydrological Regimes", Cambridge University Press, 2003.

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Web References

1. https://nptel.ac.in/courses/105102089/
2. https://www.warmheartworldwide
3. https://nptel.ac.in/content/storage

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	3	3	3	3	3	3	3	3	3	3	-	2	-
2	3	3	2	3	3	3	3	3	3	2	3	3	-	1	1
3	3	3	3	3	3	3	3	3	3	3	3	3	-	-	-
4	2	3	3	2	3	3	3	3	3	3	3	3	-	-	1
5	3	3	3	3	3	3	3	3	3	3	3	3	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20BMO705

INTERNET OF THINGS FOR HEALTHCARE

(Common to EEE, ECE, ICE, CCE)

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand the architecture of IoT and its associated protocols
- To gain knowledge on interfacing IoT and cloud
- To analyse the design and development of IoT.
- To get trained with m-IoT components and equipments
- To understand wearable technologies and applications of m-IoT

Course Outcomes

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

CO1 - Understand the architecture of IoT and its associated protocols **(K2)**
CO2 - Gain knowledge on interfacing IoT and cloud. **(K2)**
CO3 - Analyse the design and development of IoT. **(K3)**
CO4 - Understand m-IOT components and equipments **(K2)**
CO5 - Gain knowledge in wearable technologies and applications of m-IoT **(K2)**

UNIT I INTRODUCTION TO IoT (9 Hrs)

Brief History of IoT, Architectural Layers of IoT, Bluetooth, ZigBee, Wi-Fi, IP-Based Protocols, UPnP, CoAP, MQTT, XMPP. SCADA, Authentication protocols, IEEE 802.15.4.

UNIT II IOT IN THE CLOUD (9 Hrs)

Network layer, Cloud, Network Technologies, Types of Networks, BAN, Cloud and Virtualization, Cloud terminologies, Types of Cloud, Service Models, Fog and edge customization.

UNIT III DESIGN & DEVELOPMENT (9 Hrs)

Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino board details – IDE programming – Raspberry Pi – Introduction and Interfacing.

UNIT IV M-IoT (9 Hrs)

Perception Layer, RFIDs, cameras, Sensors, Introduction to ASICs, pulse oximeters, instrumentation amplifiers, surgical equipment and dependencies, Surgery and its types, role of IoT in surgery.

UNIT V APPLICATION OF IoT IN HEALTH CARE (9 Hrs)

Ventilators, Wearable Technologies, smart watches, Computer Assisted Anthropology, Smart Health Organizations

Text Books

1. Aboul Ella Hassanien, Nilanjan, Dey, Surekha Borra, “Medical Big Data and Internet of Medical Things”, CRC Press, 1st Edition, 2018.
2. Pankajavalli, P. B., Karthick, G. S. “Incorporating the Internet of Things in Healthcare Applications and Wearable Devices”, IGI Global, 1st Edition, 2019.
3. Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.

Reference Books

1. Valentia E. Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar “Internet of Things in Biomedical Engineering”, Academic Press, 2019.
2. Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, “Technologies Sensors for the Internet of Things Businesses & Market Trends”, Yole Development, 2014.
3. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad “A Handbook of Internet of Things in Biomedical and Cyber Physical System”, Springer International Publishing, 2019.
4. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues, “Internet of Medical Things for Smart Healthcare”, Springer Singapore, 2019.
5. Subhas Chandra Mukhopadhyay, “Intelligent IoT Systems in Personalized Health Care”, Elsevier Science Publishing, 2020.

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Web References

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.digimat.in/nptel/courses/video/108105091/L01.html
3. https://youtu.be/ZIBBZnGjFCg
4. https://youtu.be/UrwbeOIlc68
5. https://youtu.be/gGNz-SduPnM

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	2	2	3	-	-	-	-	-	3	1	2	1
2	3	1	1	2	2	3	-	-	-	-	-	3	1	2	1
3	3	3	2	2	2	3	-	-	-	-	-	2	1	2	1
4	3	2	1	2	2	3	-	-	-	-	-	3	1	2	1
5	3	2	2	2	2	3	-	-	-	-	-	3	1	2	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20BMO706	TELEHEALTH TECHNOLOGY (Common to EEE, ECE, ICE, CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To Learn the key principles for telehealth technologies
- To understand communication networks and services.
- To know telemedicine system deployment
- To know the technology for alternative medicine
- To get an adequate knowledge of telemedicine applications.

Course Outcomes

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

CO1 - Understand fundamentals of telemedicine **(K2)**
CO2 - Gain knowledge in Communication networks and services (**K2)**
CO3 - Explain telemedicine system deployment and apply safeguard technologies in telemedicine **(K3)**
CO4 - Gain knowledge in technology for alternative medicine (**K2)**
CO5 - Explain telemedicine applications. **(K2)**

UNIT I FUNDAMENTALS OF TELEMEDICINE (9 Hrs)

Information Technology and Healthcare Professionals- Providing Healthcare to Patients- Technical Perspective - Healthcare Providers - Healthcare Informatics Developments - Different Definitions of Telemedicine - The Growth of the Internet: Information Flooding in E-Health.

UNIT II COMMUNICATION NETWORKS AND SERVICES (9 Hrs)

Wireless Communications Basics - Types of Wireless Networks - Wireless Technology in Patient Monitoring - Body Area Networks - Remote Recovery, General Health Assessments. Technologies in Medical Information Processing - Collecting Data from Patients - Bio-signal Transmission and Processing - Patient Records and Data Mining - Knowledge Management for Clinical Applications - Electronic Drug Store.

UNIT III TELEMEDICINE SYSTEM DEPLOYMENT AND SECURITY (9 Hrs)

Planning and Deployment Considerations - OSI Model - Scalability to Support Future Growth - Integration with Existing IT Infrastructure – Database - Evaluating IT Service and Solution Provider - Technologies for Safeguarding Medical Data and Privacy - Information Security Overview – Safeguarding Patient Medical History.

UNIT IV TECHNOLOGY FOR ALTERNATIVE MEDICINE (9 Hrs)

Technology for Natural Healing and Preventive Care - Consumer Electronics in Healthcare- Telehealth in General Healthcare and Fitness - Telemedicine in Physiotherapy - Healthcare Technology and the Environment.

UNIT V APPLICATIONS OF TELEMEDICINE (9 Hrs)

Teleradiology- Telepathology -Telecardiology-Tele oncology-Tele dermatology-Telesurgery- e-Health and Cyber Medicine - Future Trends in Healthcare Technology.

Text Books

1. Norris A C, “Essentials of Telemedicine and Telecare”, John Wiley, New York, 2002.
2. Bernard Fong, A. C. M. Fong, C. K. Li, “Telemedicine Technologies: Information Technologies in Medicine and Telehealth”, John Wiley & Sons, Ltd, 2010.
3. Khandpur R S, “Telemedicine Technology and Applications”, PHI Learning Pvt Ltd., 2017.

Reference Books

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, “Handbook of Telemedicine”, IOS Press, Netherland, 2002.
2. Wootton, R., Craig, J., Patterson, V. (Eds.), “Introduction to Telemedicine”, Taylor & Francis, 2017.
3. Carroll, P.W. Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), “Public Health Informatics and Information Systems”, Springer, 2003.
4. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), “Handbook of Telemedicine, Studies in Health Technology and Informatics”, IOS Press, 2002.
5. R. Latifi, “Current Principles and Practices of Telemedicine and e-Health”, IOS Press, 2008.

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Web References

1. https://youtu.be/B9oC8vUjqk8
2. https://youtu.be/AMyTpsG86Pk
3. https://youtu.be/ZfDheAo4nCo
4. https://youtu.be/d87Iyj4rCNg
5. https://youtu.be/QfAoYUsTvtk

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	2	2	-	-	-	-	3	-	1	-
2	3	1	2	-	2	2	2	-	-	-	-	2	-	1	-
3	3	1	1	-	2	2	2	-	-	-	-	3	-	1	-
4	3	2	1	-	2	3	2	-	-	-	-	3	-	1	-
5	3	2	2	-	2	3	2	-	-	-	-	3	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CCO705	DATA SCIENCE USING PYTHON (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the concepts of Real world data science and Python.
- To learn the OOPs concepts with data science.
- To understand the NumPy operations with data science.
- To learn the data manipulation with Pandas.
- To clean, prepare and visualize with real data science.

Course Outcomes

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

CO1 - Infer the Real world data science and and solve basic problems using Python. **(K2)**
CO2 - Design an application with user-defined modules and packages using OOP concept **(K2)**
CO3 - Employ efficient storage and data operations using NumPy arrays. **(K2)**
CO4 - Apply powerful data manipulations using Pandas. **(K3)**
CO5 - Do data preprocessing using Pandas. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE AND PYTHON (9 Hrs)

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators.

Decision Making - Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

UNIT II FILE, EXCEPTION HANDLING AND OOP (9 Hrs)

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods- Python Exception Handling.

OOPs Concepts - Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

UNIT III INTRODUCTION TO NUMPY (9 Hrs)

NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes.

Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic.

UNIT IV DATA MANIPULATION WITH PANDAS (9 Hrs)

Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection and Filtering- Function Application and Mapping - Sorting and Ranking.

UNIT V DATA CLEANING AND PREPARATION (9 Hrs)

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String. Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Text Books

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson, 2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition, 2018.
3. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

Reference Books

1. Wesley J. Chun, “Core Python Programming”, Prentice Hall, 2006.
2. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.
3. Steven S. Skiena, “Data Science Design Manual”, Spring International Publication, 2017.
4. Rajendra Akerkar, Priti Srinivas Sajja, “Intelligence Techniques for Data Science”, Spring International Publication, 2016.
5. Longbing Cao, “Data Science Thinking: The Next Scientific, Technological and Economic Revolution”, Spring International Publication, 2018.

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Web References

1. https://www.programmer-books.com/introducing-data-science-pdf/
2. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf
3. http://math.ecnu.edu.cn/~lfzhou/seminar/[Joel_Grus]_Data_Science_from_Scratch_First_Princ.pdf
4. https://www.edx.org/course/python-basics-for-data-science
5. https://www.edx.org/course/analyzing-data-with-python

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	1	1	-	-	-	-	-	-	-	3	1	-
2	2	2	2	2	2	-	-	-	-	-	-	-	2	1	-
3	2	2	2	2	2	-	-	-	-	-	-	-	3	1	-
4	3	3	3	3	3	-	-	-	-	-	-	-	3	1	-
5	3	2	2	2	2	-	-	-	-	-	-	-	3	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20CCO706	MOBILE APPLICATIONS DEVELOPMENT USING ANDROID (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

Course Outcomes

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

CO1 - Describe the requirements for mobile applications. (**K2**)
CO2 - Explain the challenges in mobile application design and development. (**K3**)
CO3 - Develop design for mobile applications for specific requirements. (**K3**)
CO4 - Implement the design using Android SDK. (**K2**)
CO5 - Implement the design using Objective C and iOS. (**K2**)

UNIT I INTRODCTION (9 Hrs)

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN (9 Hrs)

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – user interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN (9 Hrs)

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID (9 Hrs)

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IOS (9 Hrs)

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wi-fi - iPhone marketplace

Text Books

1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd Edition, 2011.
2. Charlie Collins, Michael D. Galpin, Matthias Käppler, "Android in Practise", Manning Publications Co., 1st Edition, 2012.
3. Jeff McWherter, Scott Gowell, "Professional Mobile Application Development", John Wiley & Sons, Inc., 2012.

Reference Books

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", Dream Tech, 2012
3. James Dovey and Ash Furrow, "Beginning Objective C", Apress, 2012.
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.
5. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.

(DR.S. ANBUMALAR)

Web References

1. http://developer.android.com/develop/index.html
2. http://developer.android.com/reference/
3. https://www.udacity.com/course/developing-android-appsfundamentals--ud853-nd

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	2	3	-	-	-	3	2	2	2	1	-
2	3	2	3	2	2	3	-	-	-	3	2	2	2	1	-
3	3	2	3	2	2	3	-	-	-	3	2	2	2	1	-
4	3	2	3	2	2	3	-	-	-	3	2	2	2	1	-
5	3	2	3	2	2	3	-	-	-	3	2	2	2	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ADO705	DATA SCIENCE APPLICATION OF NLP (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the fundamental concepts and techniques of Natural language Processing(NLP)
- To analyzing words based on Text processing.
- To analyzing words based on Morphology.
- To examine the syntax and language modeling
- To get acquainted with syntax and semantics

Course Outcomes

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

CO1 - Understand the principles and process the Human Languages such as English using computers. **(K2)**
CO2 - Creating CORPUS linguistics based on digestive approach (Text Corpus method). **(K2)**
CO3 - Demonstrate the techniques for text-based Processing of NLP with respect to morphology. **(K4)**
CO4 - Perform POS tagging for a given natural language. **(K3)**
CO5 - Check the syntactic and semantic correctness of sentences using grammars and labelling. **(K3)**

UNIT I INTRODUCTION TO NLP (9 Hrs)

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, and machine translation.

UNIT II TEXT PROCESSING (9 Hrs)

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

UNIT III MORPHOLOGY (9 Hrs)

Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.

UNIT IV LEXICAL SYNTAX AND LANGUAGE MODELING (9 Hrs)

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions - The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

UNIT V SYNTAX AND SEMANTICS (9 Hrs)

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense. Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Applications of NLP.

Text Books

1. Dan Jurafsky, James H. Martin, “Speech and Language Processing”, Third Edition, Prentice Hall, 2018.
2. Emily Bender, “Linguistics Fundamentals for NLP”, Morgan Claypool Publishers, 2013.
3. Jacob Eisenstein, “Introduction to Natural Language Processing”, MIT Press, 2019.

Reference Books

1. Chris Manning, Hinrich Schuetze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.
2. Cole Howard, Hobson Lane, Hannes Hapke, “Natural Language Processing in Action” Manning Publication 2019
3. Li Deng, Yang Liu “Deep Learning in Natural Language Processing” Springer, 2018.
4. Tom Hoobyar, Tom Dotz, Susan Sanders, “NLP The Essential Guide to Neuro-Linguistic Programming”, William Morrow Paperbacks, 2013.
5. Kate Burton, “Coaching With NLP For Dummies”, Wiley, 2011.

Web References

1. https://machinelearningmastery.com/natural-language-processing/
2. https://towardsdatascience.com/your-guide-to-natural-language-processing-nlp-48ea2511f6e1
3. https://www.nlp.com/what-is-nlp/

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	1	-	-	-	-	-	-	-	-	1	-
2	2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
3	2	2	1	2	-	-	-	-	-	-	-	-	-	1	-
4	1	2	2	2	1	-	-	-	-	-	-	-	-	1	-
5	2	1	2	2	1	-	-	-	-	-	-	-	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)

U20ADO706	ARTIFICIAL INTELLIGENCE APPLICATIONS (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To study the basic design concept of AI.
- To understand the Machine learning concepts.
- To learn the concept of Deep learning and its applications
- To learn the concept of RPA.
- To acquire the skill to design a chatbot using NLP.

Course Outcomes

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

CO1 - Apply the concept of data science. **(K3)**
CO2 - Understand the concept of Machine learning. **(K2)**
CO3 - Understand the concept of Deep Learning. **(K2)**
CO4 - Apply the design ideas in RPA. **(K3)**
CO5 - Make use of NLP concepts to create chatbot. **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Introduction – Alan Turing and Turing test - The rise and fall of expert system - technological drivers of modern AI -Structure of AI - Data: types of Data - Big Data - Database and other tools - Data Process - Ethics and Governance - Data terms.

UNIT II MACHINE LEARNING (9 Hrs)

Machine learning - Standard deviation - the normal distribution - Naive Bayes Classifier - K-Nearest Neighbor - Linear regression - K-Means Clustering.

UNIT III DEEP LEARNING (9 Hrs)

Deep Learning - Difference between Deep Learning and Machine learning – ANN – Backpropagation – RNN – CNN – GAN - Deep Learning Applications - Use Case: detecting Alzheimer's Disease - Deep Learning Hardware - When to use Deep Leaning? - Drawbacks of deep learning.

UNIT IV ROBOTIC PROCESS AUTOMATION (9 Hrs)

RPA - pros and cons of RPA - Determine the right function to automate - assess the processes - RAP and AI - RPA in the real world.

UNIT V NATURAL LANGUAGE PROCESSING (9 Hrs)

Challenges of NLP - Understanding How AI translated Language - NLP in real World - Voice Commerce - Virtual assistants – Chatbot - Future of NLP - The Future of AI.

Text Books

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing" 3rd Edition, 2000.
2. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, "Artificial Intelligence (AI) Recent Trends and Applications" CRC Press, 2021.
3. Navin Sabharwal, Amit Agrawal, "Cognitive Virtual Assistants Using Google Dialog flow" Apress, 2020.

Reference Books

1. Durkin, J., "Expert systems Design and Development", Macmillan, 1994.
2. Peter Jackson, "Introduction to Expert Systems", Addison Wesley Longman, 1999.
3. Amir Shevat," Designing Bots: Creating Conversational Experiences" O'Reilly, 2017.
4. Anik Das and Rashid Khan, "Build Better Chatbots: A Complete Guide to Getting Started with Chatbots" Apress, 2017.
5. Akhil Mittal "Getting Started with Chatbots: Learn and create your own chatbot with deep understanding of Artificial Intelligence and Machine Learning" BPB Publications,2019

Web References

1. https://www.javatpoint.com/application-of-ai
2. https://pytorch.org/tutorials/beginner/chatbot_tutorial.html
3. https://www.mygreatlearning.com/blog/basics-of-building-an-artificial-intelligence-chatbot/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/lecture-videos/lecture-3-reasoning-goal-trees-and-rule-based-expert-systems/
5. http://www.umsl.edu/~joshik/msis480/chapt11.htm

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COs/POs/PSOs Mapping

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1	2	2	2	-	1	-	-	-	-	-	-	-	2	3	1
2	2	2	1	-	-	-	-	-	-	-	-	-	2	3	1
3	2	2	1	2	-	-	-	-	-	-	-	-	2	3	1
4	1	2	2	2	1	-	-	-	-	-	-	-	2	2	1
5	2	1	2	2	1	-	-	-	-	-	-	-	2	3	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

(DR.S. ANBUMALAR)