SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

ACADEMIC REGULATIONS 2019
(R-2019)

CURRICULUM AND SYLLABI

Volume - IV

(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 exploit 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)	09
2	Basic Sciences(BS)	35
3	Engineering Sciences (ES)	32
4	Professional Core (PC)	68
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Project Work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**183**

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)	4	-	-	-	3	-	1	1	09
2	Basic Sciences(BS)	16	12	3	3	1	-	-	-	35
3	Engineering Sciences (ES)	10	18	-	4	-	-	-	-	32
4	Professional Core (PC)	-	-	18	8	15	15	8	4	68
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		**30**	**30**	**21**	**21**	**22**	**21**	**19**	**19**	**183**

**** 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	T101	Mathematics – I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Lab	BS	0	0	3	2	50	50	100
8	P105	Chemistry Lab	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
							30	300	600	900

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	T107	Mathematics –II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Laboratory	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	0	0	3	2	50	50	100
9	P103	Basic Electrical and Electronics Laboratory	ES	0	0	3	2	50	50	100
Mandatory Course										
10	P107	NSS / NCC *	MC	0	0	0	-	-	-	-
							30	300	600	900

To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation

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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	U19EET31	Complex Analysis and Applications of Partial Differential Equations	BS	2	2	0	3	25	75	100
2	U19EET32	Electric Circuit Analysis	PC	2	2	0	3	25	75	100
3	U19EET33	Electromagnetic Theory	PC	3	0	0	3	25	75	100
4	U19EET34	Electrical Machines – I	PC	3	0	0	3	25	75	100
5	U19EET35	Electronic Devices and Circuits	PC	3	0	0	3	25	75	100
6	U19EET36	Digital Electronics	PC	3	0	0	3	25	75	100
Practical										
7	U19EEP31	Electric Circuit Analysis Lab	PC	0	0	2	1	50	50	100
8	U19EEP32	Electrical Machines Lab- I	PC	0	0	2	1	50	50	100
9	U19EEP33	Electronics Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19EEC3X	Certification Course – I **	EEC	0	0	4	-	100	-	100
11	U19EES31	Skill Development Course 1: General Proficiency - I	EEC	0	0	2	-	100	-	100
12	U19EES32	Skill Development Course 2 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19EEM31	Physical Education	MC	0	0	2	-	100	-	100
							21	700	600	1300

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19EET41	Probability and Statistics	BS	2	2	0	3	25	75	100
2	U19EET42	Data Structure and Object Oriented Programming	ES	3	0	0	3	25	75	100
3	U19EET43	Electrical Machines – II	PC	3	0	0	3	25	75	100
4	U19EET44	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U19EEE4X	Professional Elective - I #	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective-I $	OE	3	0	0	3	25	75	100
Practical										
7	U19EEP41	Data Structure and Object Oriented Programming Lab	ES	0	0	2	1	50	50	100
8	U19EEP42	Electrical Machines Lab- II	PC	0	0	2	1	50	50	100
9	U19EEP43	Linear Integrated Circuits Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19EEC4X	Certification Course – II **	EEC	0	0	4	-	100	-	100
11	U19EES41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19EES42	Skill Development Course 4 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19EEM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

#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***

**** Skill Development Courses (2 and 4) 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	U19EET51	Measurements and Instrumentation for Electrical Engineering	PC	3	0	0	3	25	75	100
2	U19EET52	Control Systems	PC	2	2	0	3	25	75	100
3	U19EET53	Transmission and Distribution	PC	3	0	0	3	25	75	100
4	U19EET54	Microprocessor and Microcontroller	PC	3	0	0	3	25	75	100
5	U19EEE5X	Professional Elective - II #	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective – II $	HS	3	0	0	3	25	75	100
Practical										
7	U19EEP51	Numerical Methods and Optimization Lab	BS	0	0	2	1	50	50	100
8	U19EEP52	Measurements and Instrumentation Lab	PC	0	0	2	1	50	50	100
9	U19EEP53	Control Systems Lab	PC	0	0	2	1	50	50	100
10	U19EEP54	Microcontroller and its applications Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19EEC5X	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U19EES51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19EES52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19EEM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19EET61	Embedded System	PC	3	0	0	3	25	75	100
2	U19EET62	Power Electronics	PC	3	0	0	3	25	75	100
3	U19EET63	Power System Analysis	PC	2	2	0	3	25	75	100
4	U19EET64	Electrical Machine Design	PC	2	2	0	3	25	75	100
5	U19EEE6X	Professional Elective - III #	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III $	OE	3	0	0	3	25	75	100
Practical										
7	U19EEP61	Embedded System Lab	PC	0	0	2	1	50	50	100
8	U19EEP62	Power Electronics and Drives Lab	PC	0	0	2	1	50	50	100
9	U19EEP63	Power System Analysis Lab	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19EEC6X	Certification Course – IV **	EEC	0	0	4	-	100	-	100
11	U19EES61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U19EES62	Skill Development Course 8: Technical Seminar	EEC	2	0	0	-	100	-	100
13	U19EES63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19EEM61	Professional Ethics	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	U19EET71	Industrial Automation and Control	PC	3	0	0	3	25	75	100
2	U19EET72	Electric and Hybrid Vehicle	PC	3	0	0	3	25	75	100
3	U19EEE7X	Professional Elective – IV #	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV $	OE	3	0	0	3	25	75	100
Practical										
5	U19EEP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19EEP72	Industrial Automation and Control Lab	PC	0	0	2	1	50	50	100
7	U19EEP73	Electric and Hybrid Vehicle Lab	PC	0	0	2	1	50	50	100
Project Work										
8	U19EEW71	Project Phase – I	PW	0	0	4	2	50	50	100
9	U19EEW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							19	450	450	900

SEMESTER – VIII										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19EET81	Protection and Switchgear	PC	3	0	0	3	25	75	100
2	U19EEE8X	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U19EEE8X	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U19EEP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
5	U19EEP82	Comprehensive Viva	PC	0	0	2	1	50	50	100
Project Work										
6	U19EEW81	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
7	U19EES81	Skill Development Course 10: 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	U19EEE41	Electrical Safety Engineering
2	U19EEE42	Computer Aided Design for Electrical Apparatus
3	U19EEE43	Sensors and Transducers for Electrical Engineering
4	U19EEE44	Finite Element Analysis
5	U19EEE45	Energy Storage Technology
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19EEE51	Utilization of Electrical Energy
2	U19EEE52	Renewable Energy Sources
3	U19EEE53	Electrical Energy Audit and Conservation
4	U19EEE54	Automotive Electronics for Electrical Engineering
5	U19EEE55	Industrial Electrical System
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19EEE61	Smart Grid
2	U19EEE62	High Voltage Engineering
3	U19EEE63	Special Electrical Machines
4	U19EEE64	Digital Signal Processing
5	U19EEE65	Electric Drives
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19EEE71	Communication Engineering
2	U19EEE72	Distributed Generation and Microgrids
3	U19EEE73	Power Electronics for Renewable Energy Systems
4	U19EEE74	Power System Operation and Control
5	U19EEE75	SMPS and UPS

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Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19EEE80	Power System Economics
2	U19EEE81	Modern Power Electronic Converters
3	U19EEE82	Electric Traction
4	U19EEE83	Soft Computing Techniques
5	U19EEE84	Fundamentals of Solar photovoltaic system and applications
Professional Elective – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19EEE85	Principles of Virtual Instrumentation
2	U19EEE86	EHV AC and DC transmission
3	U19EEE87	Restructured Power System
4	U19EEE88	Power System Stability
5	U19EEE89	Robotics and Control

Annexure – II

OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics

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10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	
Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME

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8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
Open Elective – IV (Offered in Semester VII)				
1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Sensors for Industrial Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH
6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics
8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Ultrasonic Instrumentation	ICE	EEE, ECE, MECH, Mechatronics

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11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

Annexure – III

EMPLOYABILITY ENHANCEMENT COURSES – (A) CERTIFICATION COURSES

Sl. No	Course Code	Course Title
1	U19EECX1	AutoCAD for Electrical
2	U19EECX2	Solar and Smart Energy System with IOT
3	U19EECX3	ANSYS- Multi-Physics
4	U19EECX4	Design and documentation using Eplan Electric P8
5	U19EECX5	Python Programming
6	U19EECX6	Artificial intelligence and Edge computing
7	U19EECX7	JAVA Programming
8	U19EECX8	Machine Learning and Deep Learning
9	U19EECX9	Revit MEP

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Annexure – IV

EMPLOYABILITY ENHANCEMENT COURSES – (B) SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19EES31	Skill Development Course 1 : General Proficiency - I
2	U19EES32	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	U19EES41	Skill Development Course 3 : General Proficiency - II
4	U19EES42	Skill Development Course 4 *
		1) Mobile Phone Servicing
		2) Autonomous Robotics
		3) Repair and Maintenance of Power Supply, Inverter and UPS
5	U19EES51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19EES52	Skill Development Course 6 : Presentation Skills using ICT
7	U19EES61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19EES62	Skill Development Course 8 : Technical Seminar
9	U19EES63	Skill Development Course 9 : NPTEL/MOOC - I
10	U19EES81	Skill Development Course 10 : NPTEL/MOOC-II

Any one course to be selected from the list

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T101	MATHEMATICS – I (Common to all Branches)	L	T	P	C	Hrs
		3	1	0	4	60

Course Objectives

- To introduce the idea of applying calculus concepts to problems in Engineering.
- To understand the concept of partial differentiation
- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.

Course Outcomes

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

CO1 – Understand the concept of curvature. **(K2)**
CO2 – Solve different types of partial differential equation. **(K3)**
CO3 – Understand the concept of double and triple integrals. **(K2)**
CO4 – Solve differential equations**. (K3)**
CO5 – Solve higher order differential equations. **(K3)**

UNIT I CALCULUS (12 Hrs)

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

UNIT II FUNCTIONS OF SEVERAL VARIABLES (12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of Variables, Jacobians and their properties, Taylor's series for functions of two variables, Maxima and minima, Lagrange's method of undetermined multipliers.

UNIT III MULTIPLE INTEGRALS AND APPLICATIONS (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 IV DIFFERENTIAL EQUATIONS (12 Hrs)

Exact equations, First order linear equations, Bernoulli's equation, orthogonal Trajectories, growth, decay and geometrical applications. Equations not of first degree: Equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT V 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, simultaneous linear Differential equations, solution by Variation of parameters method simple application to Electric circuits.

Text Books

1. Venkataraman M.K, Engineering Mathematics-First year, National Publishing Company, Chennai, 2010
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.

Reference Books

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2, S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi, 8th Edition.
5. Bali N.P and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

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1. https://www.youtube.com/watch?v=rAof9Ld5sOg
2. https://nptel.ac.in/courses/111/104/111104092/
3. https://nptel.ac.in/courses/111/107/111107108/
4. https://www.youtube.com/watch?v=BJ_0FURo9RE
5. https://www.youtube.com/watch?v=p_di4Zn4wz4

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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	-	-	-	1	1	-	-	-	-	1	2	1	1
2	3	2	1	1	-	1	1	-	-	-	-	1	2	1	1
3	2	1	-	-	-	-	-	-	-	-	-	1	2	1	1
4	3	2	1	1	-	1	1	-	-	-	-	1	2	1	1
5	3	2	1	1	-	1	1	-	-	-	-	1	2	1	1

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

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T102	PHYSICS (Common to all Branches)	L	T	P	C	Hrs
		4	0	0	4	60

Course Objectives

- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines
- To understand the concepts and applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics

Course Outcomes

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

CO1 - Understand the basic concepts of sound Engineering and ideas to get good audibility inside a hall. Also gain knowledge about the production, propagation, properties and application of ultrasonic waves. **(K2)**

CO2 - Interpret the different characteristic behavior of light waves with air, glass, lens, grating, prism etc., Gain adequate knowledge about the interference, diffraction and polarization phenomenon of light waves and their applications**. (K2)**

CO3 - Understand the principle mechanism of laser light; distinguish between ordinary light and laser light. Basic idea about the various laser sources. Also gain knowledge about the optical fibers and their importance in communication. **(K3)**

CO4 - Understand the basic concept of quantum mechanics, dual nature of matter, and importance of energy of electrons associated with the properties of the materials. Also able to calculate energy of electron in an energy level by solving Schrodinger's equation. **(K1)**

CO5 - Gain knowledge about the structure of nucleus its constituents, nature. Understanding the nuclear energy fission and fusion concepts. Basic ideas of nuclear reactors to produce energy. **(K3)**

UNIT I ACOUSTICS & NDT (12 Hrs)

Ultrasonics - Ultrasonic Waves Productions (Piezoelectric & Magnetostriction method) – Detections (Acoustic Grating) NDT applications – Ultrasonic Pulse Echo Method - Liquid Penetrant Method

Acoustics - Factors affecting Acoustic of Buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies - Sabine's formula for Reverberation Time – Doppler effect and its application to Radars. (elementary ideas)

UNIT II OPTICS (12 Hrs)

Interference - Air Wedge – Michelson's Interferometer - Wavelength Determination – Interference Filter – Antireflection Coatings

Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism

Polarisation - Basic concepts of Double Refraction - Huygens Theory of Double Refraction- Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polarimeter

UNIT III LASERS & FIBER OPTICS (12 Hrs)

Lasers - Principles of Laser – Spontaneous and Stimulated Emissions - Einstein's Coefficients – Population Inversion and Laser Action – types of Optical resonators (qualitative ideas) – Types of Lasers - NdYAG, CO_2 laser, GaAs Laser - applications of lasers

Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode) - applications to sensors and Fibre Optic Communication

UNIT IV WAVE MECHANICS (12 Hrs)

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrödinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box – Quantum Mechanical Tunneling – Tunnel Diode.

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UNIT V NUCLEAR ENERGY SOURCE **(12 Hrs)**

General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – Nuclear Reactor: Materials Used in Nuclear Reactors. – PWR – BWR – FBTR. Nuclear fusion reactions for fusion reactors - D-D and D-T reactions, Basic principles of Nuclear Fusion reactors.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi, 2011. (For units I to IV only)
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008. (For unit V only)

Reference Books

1. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Lasers, New Age International, New Delhi, 2008.
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997.
6. Avadhanulu M N, Engineering Physics, S. Chand & Co, 2009.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/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	-	-	-	-	-	-	-	**1**	**3**	**1**
2	3	3	2	2	3	-	-	-	-	-	-	-	**1**	**2**	**3**
3	3	3	2	3	3	-	-	-	-	-	-	-	**2**	**2**	**3**
4	3	3	3	3	2	-	-	-	-	-	-	-	**2**	**-**	**-**
5	3	3	3	1	3	-	-	-	-	-	-	-	**2**	**3**	**2**

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

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T103 **CHEMISTRY** (Common to all Branches)

L	T	P	C	Hrs
4	0	0	4	60

Course Objectives

- Know the fundamental principles of Engineering Chemistry required solving engineering problems.
- Practical implementation of fundamental theory concepts.
- Introducing new techniques and latest information that motivates the students to bring out his or her views and work effectively.
- To enable the students understand the role of engineering materials such as polymers, energy production, electrical field basic concepts of material behaviour and study the environmental applications in the field of engineering and technology
- To acquire knowledge of engineering materials and about fuels and batteries

Course Outcomes

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

CO1 - Understand the basic concept of hardness of water, the chemicals responsible for it, measurement of hardness, its disadvantages and its removal. **(K2)**

CO2 - Understand the synthesis of various organic and inorganic polymer **(K3)**

CO3 - Understand the application of the concept of oxidation and reduction reaction to various cells **(K2)**

CO4 - Understand the application of electrochemistry in corrosion of metals and also about different types of corrosion control methods **(K3)**

CO5 - Understand the concept of phase equilibrium and its application to different types of heterogeneous equilibrium system like eutectic alloys. **(K3)**

UNIT I WATER (12 Hrs)

Hardness of water - units and calcium carbonate equivalent. Determination of hardness of water – EDTA method. Disadvantages of hardwater – boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening methods – internal & external conditioning – Lime-Soda process, Zeolite process and Ion-exchange process. Desalination – reverse osmosis & electrodialysis.

UNIT II POLYMER (12 Hrs)

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties –chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, Rubbers– vulcanization, synthetic rubber, BuNa-S, BuNa-N, silicone and butyl rubber. Conducting polymers–classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastic, moulding techniques – compression, injection, transfer and extrusion moulding.

UNIT III ELECTROCHEMICAL CELLS (12 Hrs)

Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes–hydrogen, calomel, Ag/AgCl & glass electrodes. Batteries – primary and secondary cells, Leclanche cell, Lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells – H_2-O_2 fuel cell

UNIT IV CORROSION AND ITS CONTROL (12 Hrs)

Chemical & electrochemical corrosion – Galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion – corrosion control methods – cathodic protection and corrosion inhibitors. Protective coating – types of protective coatings – metallic coating–tinning and galvanizing, cladding, electroplating and anodizing

UNIT V PHASE RULE (12 Hrs)

Definition and derivation of phase rule. Application to one component system – water and sulfur systems. Thermal analysis, condensed phase rule. Two component systems– Pb-Ag, Cu-Ni, and Mg-Zn systems.

Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai and Sons, New Delhi 15th Ed,2010.
2. B.Sivasankar (2008) , "Engineering Chemistry ", Tata McGraw Hill , India
3. Shaley Oberoi & Monica Malik (2009), "Engineering Chemistry made easy", Cengage Learning, Delhi.

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4. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, New Delhi. (2016)
5. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)

Reference Books

1. S. S. Dara, A Textbook of Engineering Chemistry, 11^{th} Ed, S.Chand& Co., Ltd. New Delhi, 2008.
2. B. K. Sharma, Engineering Chemistry, 3^{rd}edition Krishna Prakashan Media (P) Ltd., Meerut, 2001.
3. P. Kannan and A. Ravi Krishnan “Engineering Chemistry” Hi-Tech Sri Krishna Publications, Chennai, 9^{th} Ed, 2009
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2^{nd}Ed. PHI Learning PVT., LTD, New Delhi, 2008
5. C.V.Agarwal, C.P.Naidu, “A text book of Engineering Chemistry”, BS Publication, Hyderabad.

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1. https://water.usgs.gov/edu/hardness.html
2. https://www.polymer-project.org/
3. www.materials.unsw.edu.au/tutorials/online-tutorials/corrosion
4. www.electrochem.org/redcat-blog/4-useful-electrochemistry-websites-2/
5. https://serc.carleton.edu/research_education/equilibria/phaserule.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	2	1	-	-	-	1	1	-	-	-	-	1	-	1	-
2	2	1	-	-	-	1	1	-	-	-	-	1	3	1	-
3	2	1	-	-	-	1	1	-	-	-	-	1	3	1	-
4	2	1	-	-	-	1	1	-	-	-	-	1	1	1	-
5	2	1	-	-	-	1	1	-	-	-	-	1	2	1	-

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

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T110	BASIC CIVIL AND MECHANICAL ENGINEERING (Common to all Branches)	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- To be able to differentiate the type of buildings according to national building code.
- To understand building components and their functions.
- Discuss the different types of roads, bridges and dams.
- To describe different types of combustion systems such as Internal and External Combustion systems
- To discuss various Energy Resources available for power generation.
- To explain the working of various different manufacturing process.

Course Outcomes

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

CO1 - Understand the basic concepts of different types of buildings and building materials. **(K3)**
CO2 - Learn various types of building components and their functions. **(K3)**
CO3 - Describe the importance of the basic infrastructure. **(K3)**
CO4 - Understand the classification of engines, low pressure Steam generators, its mounting and accessories. **(K2)**
CO5 - Apply the knowledge of thermal systems and equipment's in power plants and analyze the way of harnessing the renewable energies and its utilization. **(K3)**
CO6 - Understand the basic principles of machining, manufacturing and metal joining processes such as Lathe machine, Drilling, Grinding, Welding, green sand moulding foundry process. **(K2)**

PART – A CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS (10 Hrs)

Buildings – Definition - Classification according to NBC - plinth area, Floor area, carpet area, floor space index - construction materials - stone, brick , cement, cement-mortar, concrete, steel-their properties and uses.

UNIT II BUILDINGS AND THEIR COMPONENTS (10 Hrs)

Buildings: Various Components and their functions. Soils and their classification. Foundation: function and types. Masonry - function and types. Floors: definition and types of floors. Roofs: definition and types.

UNIT III BASIC INFRASTRUCTURE (10 Hrs)

Surveying: classification, general principles, types, Uses, instruments used. Roads- types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply- sources and quality requirements, need and principles of rainwater harvesting

PART – B MECHANICAL ENGINEERING

UNIT IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS (10 Hrs)

IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits. Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT V POWER GENERATION SYSTEMS (10 Hrs)

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only) Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT VI MANUFACTURING PROCESS (10 Hrs)

Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding. Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011.
2. Venugopal, K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012.

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3. K.Pravin Kumar, Basic Mechanical Engineering, Pearson Publications, 2009.
4. Shanmugam G, Palanichamy MS, Basic Civil and Mechanical Engineering, 1st Edition, McGraw Hill Education, 2018.
5. R.Vaishnavi, M.Prabhakaran, V.Vijayan, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013.

Reference Books

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai, 2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New delhi, 2012.
3. Punmia, B.C., et. al., surveying, Vol-1, Laxmi publishers, New Delhi, 2012.
4. Punmia, B.C., et. al., Building Construction, Laxmi publishers, New Delhi, 2012
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co., 1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media promoters publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R.A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C. Gupta and Arun Mittal, Manufacturing Process, New Age Publications, 2001.
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

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1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/ lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

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	1	1	2	1	-	1	2	1	3	-	-	-
2	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
3	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
4	3	2	1	-	-	1	2	-	-	-	-	3	1	1	1
5	3	2	2	2	2	2	2	-	-	-	-	3	3	3	1
6	3	2	2	2	2	2	2	-	-	-	-	3	1	1	1

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

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T111

ENGINEERING MECHANICS
(Common to all Branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives
- To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions.
- To comprehend the effect of friction on equilibrium
- To analysis of trusses and friction
- To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
- To emphasis the concepts through solved examples

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

CO1 - Understand the concepts of Equilibrium of a body, Moment of a force and to convert multiple forces into a single resultant force **(K2)**

CO2 - Apply the principles of internal forces, support reactions on Trusses/beams and friction between two surfaces. **(K3**)

CO3 - Interpret the knowledge of Centroid and center of gravity for different sections to calculate the moment of inertia for sections. **(K3**)

CO4 - Analyze and compare the principle of conservative forces, conservation of energy and D'Alembert's principle **(K4**)

CO5 - Analyze and compare the kinematics and kinetics of rigid bodies.**(K4)**

UNIT I FUNDAMENTAL OF MECHANICS (12 Hrs)
Basic Concepts Force System and Equilibrium, Definition of force, Moment and Couple, Principle of Transmissibility, Varignon's theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

UNIT II PRACTICAL APPLICATION OF FORCE SYSTEM (12 Hrs)
Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT III PROPERTIES OF SURFACES (12 Hrs)
Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

UNIT IV KINEMATICS AND KINETICS OF PARTICLES (12 Hrs)
Equations of motion – Rectilinear motion, curve linear motion, relative motion, D'Alembert's principle, work-Energy equation – conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact

UNIT V KINEMATICS AND KINETICS OF RIGID BODIES (12 Hrs)
Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

Text Books

1. Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2002.
2. Dr.I.S.Gujral, "Engineering Mechanicas" second edition, Lakshmi Publication (P), Ltd., 2011.
3. Dr. Sadhu Singh, A Textbook of Engineering Mechanics, S Chand & company Pvt Ltd., 2013.

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1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill, 2011.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw - Hill International Edition, 1997.
3. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 2010.
4. Arthur P. Boresi and Richard J. Schmidt, "Engineering Mechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
5. D.P.Sharma "Engineering Mechanics", Dorling Kindersley India Pvt. Ltd, New Delhi, 2010.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

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	2	1	1
2	3	2	2	3	-	-	-	-	-	-	-	1	2	1	1
3	3	2	2	3	-	-	-	-	-	-	-	1	2	1	1
4	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1
5	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1

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

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T112	COMMUNICATIVE ENGLISH (Common to all Branches)	L	T	P	C	Hrs
		4	0	0	4	60

Course Objectives

- To improve the LSRW skills of I B.Tech students
- To instil confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess
- To sequence the thought of writing with cohesion and coherence
- To extend knowledge on varied aspects of business correspondence

Course Outcomes

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

CO1 - Procure holistic development of LSRW skills **(K2)**
CO2 - Gain efficacies to compete confidently in the interviews **(K3)**
CO3 - Effectively enhances the oral communication skills **(K3)**
CO4 - Select compile and synthesize information for written mode of communication **(K2)**
CO5 - Familiarize and Excels in different business correspondence in work place **(K3)**

UNIT I BASIC COMMUNICATION THEORY (12 Hrs)

Importance of Communication – stages of Communication - modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective - listening skills.

UNIT II COMPREHENSION AND ANALYSIS (12 Hrs)

Comprehension of technical and non-technical material – Skimming, scanning, inferring-Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing

UNIT III WRITING (12 Hrs)

Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary - Writing – Four modes of writing – Use of dictionaries, indices, library references – making - bibliographical entries with regard to sources from books, journals, internet etc.

UNIT IV BUSINESS WRITING / CORRESPONDENCE (12 Hrs)

Report writing – Memoranda – Notice – Instruction– Letters – Resumes – Job applications

UNIT V ORAL COMMUNICATION (12 Hrs)

Basics of phonetics – Presentation skills – Group Discussions – Dialogue writing –Short Extempore – Debates-Role Plays-Conversation Practice

Text Books

1. Ashraf M.Rizvi., "Effective Technical Communication", Tata-McGraw, 2005.

Reference Books

1. Robert J. Dixson., Complete Course in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2006.
2. Boove, Courtland R et al., Business Communication Today, Pearson Education, New Delhi, 2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles and Practice, OUP, 2007.
4. Robert J. Dixson., Everyday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi, J and Kamalesh Sadanand., A Practical Course in English Pronunciation, Prentice - Hall of India Pvt. Ltd, New Delhi, 2007

Web References

1. https://books.google.co.in/books/about/Effective_Tech_Communication.html
2. http://www.prenhall.com/bov
3. https://global.oup.com/academic/product/technical-communication
4. https://www.amazon.in/Everyday-Dialogues-English-Dixson-R-J/dp
5. https://www.sapnaonline.com/books/practical-course-english-pronunciation-w-sethi-j-812032594x-9788120325944

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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	-	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
3	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-
4	1	-	-	-	-	-	-	-	-	3	-	1	-	-	1
5	1	-	-	-	-	-	-	-	-	3	-	1	-	-	-

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

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P104	PHYSICS LAB (Common to all Branches)	L	T	P	C	Hrs
		0	0	3	2	30

Course Objectives

- To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

Course Outcomes

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

CO1 - Operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power. **(K2)**

CO2 - Capable of handling screw gauge, venire caliper and travelling microscope to calculate the required parameters. **(K4)**

CO3 - Acquired basic knowledge about Thermal conduction and magnetic field due to a current carrying coil. **(K3)**

CO4 - Prepare formal laboratory reports describing the results of experiments and to interpret the data from the experiments. **(K5)**

List of Experiments (Any 10 Experiments)

1. Thermal conductivity – Lee's DISC
2. Thermal conductivity - Radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer - Ordinary & Extraordinary rays
6. Newton's rings
7. Air – wedge
8. Half shade polarimeter – Determination of specific rotatory power
9. Jolly's experiment – determination of α
10. Magnetism: i – h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor

Reference Books

1. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Lasers, New Age International, New Delhi, 2008.
5. Avadhanulu M N, Engineering Physics, S. Chand & Co, 2009.
6. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi, 2011.
7. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview

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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	1	1	3	3	2	2	3	3	2	3	2	2	1
2	3	3	1	1	3	3	1	2	3	3	2	3	1	1	-
3	3	3	2	1	3	3	2	2	3	3	2	3	2	1	1
4	3	3	2	1	-	3	2	3	3	3	2	3	1	-	1

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

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P105 **CHEMISTRY LAB** (Common to all Branches)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

- To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications
- To enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.
- To understand and explain scientifically the various chemistry related problems in the industry
- To develop experimental skills for building technical competence.
- To learn the laboratory skills needed to design, safely conduct and interpret chemical research

Course Outcomes

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

CO1 - To understand about titrimetric analysis which can be used to estimate the amount of metal in a mineral. **(K2)**

CO2 - To understand about titrimetric analysis which can be used to estimate the amount of chemical present in a sample **(K3)**

CO3 - To understand about titrimetric analysis which can be used to estimate the quality of any sample. **(K2)**

CO4 - To perform conductometric titration and its uses to analyze any sample**. (K3)**

CO5 - To perform experiments by using colorimeter From which concentration of a sample can be determined from absorbance value.**(K3)**

List of Experiments (Any 10 Experiments)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
9. Estimation of available chlorine in bleaching powder.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permagnanometry
12. Estimation of iron by colorimetry

Demonstration Experiments (Any two of the following)

1. Determination of COD of water sample.
2. Determination of lead by conductometry
3. Percentage composition of sugar solution by viscometry

Reference Books

1. Vogel's Text book of Macro and Semimicro Qualitative Analysis G. Svehla, Longman Inc., Newyork. 1997
2. Basic Principles of Practical Chemistry, Venkateswaran. V, Veeraswmay. R, Kulandaivelu. A.R., Pearson Education. 1989.
3. Vogel's Text book of Quantitative Analysis, Mendham. J, Denney. R.C, Bames. J.D, and Thomas, M. Pearson Education. 1989.
4. Practical Chemistry, D. N Bajpai, S. Giri and O P Pandey, Chand Publishing 2013
5. Allied Practical Chemsitry, A R Kulandaivelu , V Venkateswaran & R Veeraswamy, Chand Publications, 2001

Web References

1. https://edu.rsc.org/resources/titration-screen-experiment/2077.article
2. https://edu.rsc.org/resources/aspirin-screen-experiment/1644.article

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3. https://www.stem.org.uk/resources/collection/3959/practical-chemistry
4. https://www.scienceinschool.org/2010/issue14/practical
5. http://www.chemlabs.bris.ac.uk/outreach/resources/Teachers_Websites.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	-	-	-	2	2	-	-	1	3	1	-	-	-	-	-
2	-	-	-	2	2	-	-	1	3	1	-	-	-	-	-
3	-	-	-	2	2	-	-	1	3	1	-	-	1	2	-
4	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-
5	-	-	-	2	2	-	-	1	3	1	-	-	-	-	-

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

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P106

WORKSHOP PRACTICE

(Common to all Branches)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering and underlying physical mechanism used in mechanical machines.

Course Outcomes

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

CO1 - Understand the functioning and usage of basic hand tools of fitting, welding and carpentry. **(K2)**

CO2 - Apply the knowledge of fitting tools and machineries to perform the exercise on fitting joints like symmetric asymmetric and angular fitting. **(K3)**

CO3 - Apply the knowledge of gas and Arc welding principles to perform to join the metal with joints like Lap and V- Butt joints. **(K3)**

CO4 - Apply the knowledge of metal joining process using sheet metals and to perform to make tray and frustum. **(K3)**

CO5 - Apply the knowledge of carpentry tools and equipment's to perform the joints like mortise and half lap joint. **(K3)**

Sl. No.	Trade	List of Exercises
1	Fitting	Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.
2	Welding	Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding
3	Sheet metal work	Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.
4	Carpentry	Study of tools and Machineries – Exercises on Lap joints and Mortise joints

LIST OF EXERCISES

I - FITTING

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. M Single V butt welding (Arc)

III - SHEET METAL WORK

1. Study of tools and machineries
2. Frustum
3. Waste collection tray

IV - CARPENTRY

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.

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Reference Books

1. HS Bawa, Workshop Practices, Tata Mc Graw Hill Publishing Co Ltd, 2015
2. S.K. Hajra Choudhury, A. K. Hajra Choudhury, "Elements of Workshop Technology", Vol I:Manufacturing Processes, 15th Edition Reprinted, Media Promoters & Publishers Pvt Ltd.,2013
3. D.Sathish, Engineering Workshop Practices Laboratory Manual, Notion press publisher, 2019
4. R.K. Rajput, Workshop Practice, Published by Laxmi Publications Pvt. Ltd. 2011
5. RS Khurmi and JK Gupta, Basics of Workshop Practice, S Chand Publisher, 2011

Web References

1. http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804
3. https://www.tpctraining.com/collections/machine-shop-practices-training
4. https://www.vlab.co.in/broad-area-mechanical-engineering
5. https://nptel.ac.in/courses/112/107/112107219/

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	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
3	2	1	-	1	-	-	-	-	-	-	-	-	1	-	1
4	2	1	-	-	1	-	-	-	-	-	-	-	1	-	-
5	2	1	1	1	-	-	-	-	-	-	-	-	1	-	-

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

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T107 **MATHEMATICS – II** (Common to all Branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus
- To equip themselves familiar with Laplace transform
- To solve the differential equations using Inverse Laplace transform techniques.
- To gain good knowledge in application of Fourier transform.

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 - Understand the use of vector calculus. **(K2)**
CO3 - Apply Laplace transform of simple function. **(K3)**
CO4 - Apply inverse Laplace transform of simple functions**. (K3)**
CO5 - Compute Fourier transforms of various functions. **(K3)**

UNIT I MATRICES (12 Hrs)

Eigen values and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigen values and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.

UNIT II VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof). Simple application problems

UNIT III 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

UNIT IV APPLICATIONS OF LAPLACE TRANSFORM (12 Hrs)

Methods for determining inverse Laplace Transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT V FOURIER TRANSFORMS (12 Hrs)

Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms their properties, convolution and Parseval's identity.

Text Books

1. Venkataraman M.K., Engineering Mathematics, National Publishing Company, Chennai, 2012
2. Kandasamy P. et al, Engineering Mathematics, Vol.2 & 3, S. Chand & Co., New Delhi.

Reference Books

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 1st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

Web References

1. https://www.youtube.com/watch?v=1wjXVdwzgX8
2. http://www.snggdcg.ac.in/pdf/study-material/mathematics/SMch18.pdf
3. https://www.youtube.com/watch?v=MLSfh33ZCwE
4. https://www.khanacademy.org/math/differential-equations/laplace-transform/convolution-integral/v/the-convolution-and-the-laplace-transform
5. http://www-users.math.umn.edu/~mille003/fouriertransform.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	2	1	-	-	-	1	1	-	-	-	-	1	3	2	2
2	2	1	-	-	-	1	1	-	-	-	-	1	3	2	2
3	3	2	1	1	-	1	-	-	-	-	-	1	3	2	2
4	3	2	1	1	-	1	-	-	-	-	-	1	3	2	2
5	3	2	1	1	-	1	-	-	-	-	-	1	3	2	2

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

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T108	MATERIAL SCIENCE (Common to all Branches)	L	T	P	C	Hrs
		4	0	0	4	60

Course Objectives

- To understand the importance of Material Science as a subject that revolutionized modern day technologies
- To understand the significance of material science in the development of new materials and devices for all branches of Engineering
- To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

Course Outcomes

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

CO1 - Identify crystal lattices and their structures, crystalline planes and directions in a crystal lattice in terms of Miller Indices. To interpret X-ray diffraction studies and different types of lattice defects and their impact. **(K2)**

CO2 - Identify the nature of polarization in a dielectric material and to explain the various dielectric material and their characterization. **(K2)**

CO3 - Understand the source of a materials magnetic behaviour and be able to distinguish types of magnetism. Having Basic idea about the read/ write mechanism of various magnetic storage devices. **(K3**)

CO4 - Differentiate semiconductors; calculate the intrinsic carrier concentration in semiconductors.Understand the phenomenon of superconductivity: Student is able to define basic properties of superconducting materials and identify potential areas of their applications. **(K1)**

CO5 - Differentiate between nanomaterials and conventional materials. Have a broad understanding of the techniques used to synthesize nanomaterials, evaluate the properties of nanomaterials, identify the role of nanomaterials in current nanotechnology revolution and be prepared for more advanced courses in Materials Science and Engineering. **(K3)**

UNIT I CRYSTAL STRUCTURE AND LATTICE DEFECTS (12 Hrs)

Crystal structure - Bravais Lattices, Crystal Systems — Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method

Lattice defects – Qualitative ideas of point, line, surface and volume defects

UNIT II DIELECTRIC PROPERTIES (12 Hrs)

Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field- Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications

UNIT III MAGNETIC PROPERTIES (12 Hrs)

Origin of atomic magnetic moment – Bohr magneton - Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording

UNIT IV SEMICONDUCTORS AND SUPERCONDUCTORS (12 Hrs)

Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors – Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) - temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors -- Application of Hall Effect, Basic Ideas of Compound Semiconductors (II - VI & III - V)

Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – high temperature superconductors – 123 superconductor – Applications of superconductors.

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UNIT V ADVANCED MATERIALS **(12 Hrs)**

Liquid Crystals – Types – Application as Display Devices
Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications
Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA
Nanomaterials- Nano materials (one, Two & three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes– Properties and applications.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

Reference Books

1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & sons, Singapore, 2007.
4. V Raghavan, Materials Science and Engineering- A First Course, 5th Edition, Prentice Hall of India, 2008.
5. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012
6. M.N. Avadhanulu, Enginerring Physics- Volume-II, S.Chand & Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/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	1	2	3	1	1	1	2	3	3	1	2	-
2	3	3	3	1	2	3	1	1	1	2	1	3	3	1	1
3	3	3	3	1	3	3	2	1	1	2	1	3	3	2	2
4	3	3	3	1	3	3	2	1	1	2	2	3	2	1	-
5	3	1	3	1	3	3	2	1	1	2	3	3	2	2	2

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

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T109	ENVIRONMENTAL SCIENCE (Common to all Branches)	L	T	P	C	Hrs
		4	0	0	4	60

Course Objectives

- To know about the environment
- To understand about environmental pollution
- To apply the knowledge in understanding various environmental issues and problems
- Communicate clearly and competently matters of environmental concern and understanding to a variety of audiences in appropriate forms
- Evaluate and interpret various forms of evidence, including text, data, and other media about the environment

Course Outcomes

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

CO1 - Understand the various environmental segments, its significance to life, also about various natural resources, effects of over utilization and its protection which can lead to sustainable development. **(K2)**

CO2 - Understand the study of ecology of various systems of nature and also about the diverse species present and its protection. **(K3)**

CO3 - Understand various sources of air pollution, the scientific basis behind it and its effect on nature. **(K2)**

CO4 - Understand the various ways of water pollution, its sources and effects, different water pollution monitoring technique, treatment of waste water and also the effects of solid waste and its management. **(K3)**

CO5 - Understand the concept of spectroscopy and its application to monitor pollution. **(K3)**

UNIT I ENVIRONMENT AND ENERGY RESOURCES (12 Hrs)

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification. Pollutants classification. Forest resources – use and over exploitation, deforestation, forest management. Water resources – use and conflicts over water, dams – benefits and problems. Mineral resources – mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources – world food problems, environmental impact of modern Agriculture – fertilizer and pesticides. Energy resources – growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development.

UNIT II ECOSYSTEM AND BIODIVERSITY (12 Hrs)

Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers, and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, esturine and marine) ecosystems. Biodiversity – definition, genetic species and ecosystem diversity. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species. Conservation of biodiversity – in-situ and ex-situ conservation of biodiversity.

UNIT III AIR POLLUTION (12 Hrs)

Definition and classification. Chemical and photochemical reaction in different layers of atmosphere .Causes, sources, effects and control measures of air pollutants - oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro-fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global Warming, Ozone Depletion, Acid Rain, Sulfurous Smog and Photochemical Smog

UNIT IV WATER AND LAND POLLUTION (12 Hrs)

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants. Causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land Pollution – Solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution.

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UNIT V POLLUTION CONTROL AND MONITORING (12 Hrs)

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas Chromatography and Conductometry. Analysis of air pollutants – NO_x, CO_x, SO_x, H_2S, Hydrocarbons and particulates.

Text Books

1. PK. De, “Environmental chemistry” 7th Ed; New age international (P) Ltd, New Delhi, 2010.
2. K. Raghavan Nambiar, “Text Book of Environmental Studies” 2nd Ed, Scitech Publications (India) Pvt Ltd, India, 2010.
3. G. S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000.
4. Essentials of Ecology and Environmental Science, S. V. S. Rana , PHI learning, 2009
5. Basics of Environmental Science and Engineering, Sivashanmugam, P., new publishing book house, 2007
6. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

Reference Books

1. B.K. Sharma, “Environmental chemistry” 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S.Dara, and D.D. Mishra “A text book of environmental chemistry and pollution control, 5th Ed, S.Chand and Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a Sustainable Future, 10thedition, Prentice Hall, 2008
4. Environmental Science, P N Palanisamy , Pearson publications,2012
5. Fundamentals of Environmental Studies, Mahua Basu, Xavier Savarimuthu, SJ, Cambridge University Press· 2017

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1. www.ifpri.org/topic/environment-and-natural-resources
2. https://www.iucn.org/content/biodiversity
3. http://www.world.org/weo/pollution
4. www.water-pollution.org.uk/
5. https://www.tceq.texas.gov/airquality/monops/sites
6. https://guides.library.illinois.edu/c.php?g=347044&p=2349046

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	-	-	-	-	2	2	3	1
2	2	1	1	1	-	1	3	-	-	-	-	2	2	3	1
3	3	1	1	1	-	1	3	-	-	-	-	2	2	3	1
4	3	1	1	1	-	1	3	-	-	-	-	2	2	3	1
5	3	1	1	1	-	1	3	-	-	-	-	2	2	3	1

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

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T104 **BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**
(Common to all Branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To understand and gain basic knowledge about magnetic and electrical circuits
- To gain basic knowledge about single phase and three phase power measurement
- To understand the operating principles of stationary and rotating machines
- To understand the characteristics and applications of semiconductor devices
- To provide the basic knowledge in Digital electronics
- To understand the purpose of communication and acquire knowledge on different communication systems

Course Outcomes

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

CO1 - Analyze the basic concepts, various laws and theorems used in DC circuits. **(K3)**
CO2 - Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver. **(K4)**
CO3 - Gain the knowledge of power production in power system and application of transformers and motors in real time. **(K2)**
CO4 - Understand the operations of semiconductor diode, BJT, FET and its applications. **(K2)**
CO5 - Summarize the digital electronics concepts for sequential and combinational circuits. **(K2)**
CO6 - Explain and Relate different Communication Systems. **(K2)**

PART A – ELECTRICAL

UNIT I DC CIRCUITS (10 Hrs)

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits

UNIT II AC CIRCUITS (10 Hrs)

Concepts of AC circuits – rms value, average value, form and peak factors – Simple RLC series circuits – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method.

UNIT III ELECTRICAL MACHINES AND POWER PLANTS (10 Hrs)

Law of Electromagnetic induction, Fleming's Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor (Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).Fundamentals of fuses and circuit breakers.

PART B – ELECTRONICS

UNIT IV ELECTRONIC CIRCUITS (10 Hrs)

V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

UNIT V DIGITAL ELECTRONICS (10 Hrs)

Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem - Logic gates -Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers.

UNIT VI COMMUNICATION AND COMPUTER SYSTEMS (10 Hrs)

Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system. Network model - PAN, LAN, MAN and WAN - Circuit and packet switching - Overview of ISDN.

Text Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2009.(For Units I to III)
2. Rajendra Prasad, "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, 1st Edition, 2011. (For Unit IV)
3. Morris Mano, "Digital design", PHI Learning, 4th Edition, 2008. (For Unit V)
4. Wayne Tomasi, "Electronic Communication Systems – Fundamentals Theory Advanced", Pearson Education, 6th Edition, 2004. (For Unit VI)

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Reference Books

1. R. Muthusubramaniam, S. Salivahanan and K.A. Mureleedharan, “Basic Electrical Electronics and Computer Engineering”, Tata McGraw Hill, 2004.
2. J.B.Gupta, “A Course in Electrical Power”, Katson Publishing House, New Delhi, 1993.
3. David. A. Bell, “Electronic Devices and Circuits”, PHI Learning Private Ltd, India, 4th Edition, 2008
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications,” Tata McGraw Hill Publishing Company Ltd., New Delhi, 6th Edition, 2008.
5. S.K. Sahdev, “Fundamentals of Electrical Engineering and Electronics”, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, “Electronic Devices and Circuits” Tata McGraw Hill.
7. R.L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Private Limited, 9th Edition, 2008
8. M. S. Sukija and T. K. Nagasarkar, “Basic electrical and Electronics Engineering”, Oxford University Press, 2012.

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1. https://nptel.ac.in/courses/108/108/108108076/
2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. http://electrical-engineering-portal.com/
5. http://www.electronics-tutorials.ws
6. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
7. https://nptel.ac.in/courses/117/102/117102059/

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	-	-	-	-	-	-	-	3	3	3
2	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
3	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
4	3	1	2	2	-	-	-	-	-	-	-	-	3	3	3
5	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2
6	3	-	2	-	-	-	-	-	-	-	-	-	1	2	1

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

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T105 **ENGINEERING THERMODYNAMICS**
(Common to all Branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To understand the basics of the thermodynamic principles
- To establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior
- To establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

Course Outcomes

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

CO1 - Understand the fundamental thermodynamic concepts and its basic laws**. (K2)**
CO2 - Apply first law of thermodynamics concepts to calculate the system work for closed and open systems**. (K3**)
CO3 - Apply Second Law of Thermodynamics and entropy concepts to evaluate the performance of heat engine, heat pump and refrigerator**.(K3)**
CO4 - Apply the principles of gas power cycles to calculate its thermal performance. **(K3)**
CO5 - Understand the basic working principle of refrigeration systems**. (K2)**

UNIT I BASIC CONCEPTS AND DEFINITIONS (12 Hrs)

Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

UNIT II FIRST LAW OF THERMODYNAMICS (12 Hrs)

The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

UNIT III SECOND LAW OF THERMODYNAMICS (12 Hrs)

Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

UNIT IV GAS POWER CYCLES (12 Hrs)

Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

UNIT V REFRIGERATION CYCLES AND SYSTEMS (12 Hrs)

Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books

1. P.K.Nag, “Engineering Thermodynamics”, 4th edition, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2008.
2. R. K. Singal, Mridul Singal “A text book of Engineering Thermodynamics”, I.K. International Publishing House Pvt. Limited, 2010.
3. Er.S.K.Gupta, “Engineering Thermodynamics”, S. Chand publishers, 2013.

Reference Books

1. Arora, C.P., “Thermodynamics”, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Burghardt, M.D., “Engineering Thermodynamics with Applications”, 4th edition, Harper & Row, N.Y., 2009.
3. Huang, F.F., “Engineering Thermodynamics” 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 2011.
4. Cengel, Y.A. and Boles, M.A., “Thermodynamics – An Engineering approach”, 5th edition, Mc Graw Hill, 2008.
5. Wark, K., “Thermodynamics”, 4th edition Mc-Graw Hill, N.Y., 2009.

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2. https://nptel.ac.in/courses/112108148/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.linkedin.com/company/heat-transfer-and-process-design-htpd
5. https://www.udemy.com/course/an-introduction-to-heat-transfer/

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	-	2	-
2	3	2	2	2	2	-	-	-	-	-	-	1	-	1	-
3	3	2	3	3	2	-	-	-	-	-	-	1	-	1	-
4	3	2	3	3	-	-	-	-	-	-	-	1	-	2	-
5	3	2	3	3	-	-	-	-	-	-	-	1	-	2	-

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

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T106 **COMPUTER PROGRAMMING**

(Common to all Branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

- To introduce the basics of computers and information technology.
- To educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.
- To study the basic concepts of File operations.

Course Outcomes

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

CO1 - Identify and understand the working components of a computer system. **(K1)**

CO2 - Understand, analyze and implement like algorithm, pseudo codes and programming structures. **(K2)**

CO3 - Analyze and make use of logical structure of a C program. **(K3)**

CO4 - Make use of pointers, memory allocation and data handling to implement C programs. **(K3)**

CO5 - Understand the working of files and directives. **(K3)**

UNIT I INTRODUCTION TO COMPUTERS (12 Hrs)

History of Computers – Block diagram of a Computer – Components of a Computer system –Classification of computers - Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network structure – Internet and its services – Intranet – Study of word processor – Preparation of worksheets.

UNIT II INTRODUCTION TO C (12 Hrs)

Problem solving techniques – Program – Program development cycle – Algorithm design– Flowchart - Pseudo code.

Introduction to C – History of C – Importance of C - C tokens – data types – Operators and expressions – I/O functions.

UNIT III DECISION MAKING AND ARRAYS (12 Hrs)

Decision making statements – branching and looping – arrays – multidimensional arrays– Functions – Recursion – Passing array to functions. Storage classes – Strings – String library functions.

UNIT IV STRUCTURES AND POINTERS (12 Hrs)

Structures – Arrays and Structures – nested structures – passing structures to functions – user defined data types – Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and Structures.

UNIT V FILE MANAGEMENT AND PREPROCESSORS (12 Hrs)

Files – operations on a file – Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

Text Books

1. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, Sixth edition, 2012.
2. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
3. Kenneth A. Reek, “Pointers on C”, Pearson Education, 2007.

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Reference Books

1. Vikas Verma, “A Workbook on C “, Cengage Learning, Second Edition,2012.
2. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Impression, 2008.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
4. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007.
5. Stephen G. Kochan, “Programming in C”, Third Edition, Pearson Education, 2007

Web References

1. https://www.geeksforgeeks.org/classification-of-computers/
2. http://www.btechsmartclass.com/c_programming/C-Program-Development-Life-Cycle.html
3. https://www.learn-c.org/en/Multidimensional_Arrays
4. https://www.tutorialspoint.com/cprogramming/c_structures.htm
5. https://www.w3schools.in/c-tutorial/command-line-arguments/

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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P101

COMPUTER PROGRAMMING LABORATORY

(Common to all Branches)

L	T	P	C	Hrs
0	0	3	2	45

Course Objectives

- To study and understand the use of OS commands
- To gain a hands on experience of compilation and execution of 'C' programs
- To understand the working of control statements
- To design functional methods.
- To make use pointers in various programs

Course Outcomes

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

CO1 - Apply and practice logical ability to solve the problems. Understand C programming development. environment, compiling, debugging, linking and executing a program using the development environment.**(K2)**

CO2 - Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs.**(K2)**

CO3 - Understand and apply the in-built functions and customized functions for solving the problems. **(K3)**

CO4 - Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems. **(K3)**

CO5 - Document and present the algorithm's, flowcharts and programs in form of user-manuals. **(K3)**

List of Exercises

1. Study of OS Commands
2. Write a simple C program to find the Area of the triangle.
3. Write a simple C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a simple C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units
   for an input of 172.
5. Write a simple C program to check whether a given character is vowel or not using Switch – Case statement.
6. Write a simple C program to print the numbers from 1 to 10 along with their squares.
7. Write a simple C program to find the sum of 'n' numbers using for, do – while statements.
8. Write a simple C program to find the factorial of a given number using Functions.
9. Write a simple C program to swap two numbers using call by value and call by reference.
10. Write a simple C program to find the smallest and largest element in an array.
11. Write a simple C program to perform matrix multiplication.
12. Write a simple C program to demonstrate the usage of Local and Global variables.
13. Write a simple C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a simple C program to remove all characters in a string except alphabets.
15. Write a simple C program to find the sum of an integer array using pointers.
16. Write a simple C program to find the Maximum element in an integer array using pointers.

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17. Write a simple C program to create student details using Structures.
18. Write a simple C program to display the contents of the file on the monitor screen.
19. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a simple C program to pass the parameter using command line arguments.

Reference Books

1. Vikas Verma, “A Workbook on C “, Cengage Learning, Second Edition, 2012
2. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Impression, 2008.
3. Kernighan, B.W and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.
4. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, 4th Reprint, 2007
5. Stephen G. Kochan, “Programming in C”, Third Edition, Pearson Education, 2007

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2. https://www.studytonight.com/c/programs/array/largest-and-smallest-element-in-array
3. https://www.programiz.com/c-programming/examples/information-structure-array
4. https://www.geeksforgeeks.org/c-program-print-contents-file/
5. https://www.studytonight.com/c/command-line-argument.php

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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P102

ENGINEERING GRAPHICS

(Common to all Branches)

L	T	P	C	Hrs
0	0	3	2	45

Course Objectives

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments mode in drawing that are used in real systems
- To develop the role of computer aided design Auto Cad and significance of using these drawings

Course Outcomes

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

CO1 - Understand the basic concepts of engineering drawings. **(K2)**

CO2 - Apply various concepts like dimensioning, conventions and BIS codes, the theory and methods of projection. **(K3)**

CO3 - Improve their imagination and visualization skills to design new products. **(K4)**

CO4 - Create engineering drawing of physical object representing engineering systems. **(K4)**

CO5 - Analysis the different views and computer aided drafting tools. **(K3)**

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning

UNIT I (9 Hrs)

Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes

UNIT II (9 Hrs)

Projection of Solids and Sections of solids.

UNIT III (9 Hrs)

Development of surfaces – Intersection of surfaces (Cylinder-Cylinder, cylinder-cone)

UNIT IV (9 Hrs)

Isometric projections and Orthographic projections

UNIT V (9 Hrs)

Computer Aided Drafting: Introduction to computer Aided Drafting hardware- overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. Dhananjayan A. Jolhe, Engineering Drawing with introduction to Autocad, Tata McGraw Hill Publishing company limited, 2008.
3. Basant Agrwal and Agarwal C W., Engineering Drawing, Tata Tata McGraw Hill Publishing company limited, 2008.

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1. N.D. Bhatt, Engineering Drawing, 49th Edition, Chorotar Publishing House, 2006.
2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th Edition, New Age International Publication Ltd., 2004.
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edition, 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989.
5. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & Colleges, 1992.

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3. https://nptel.ac.in/courses/105/104/105104148/
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5. https://www.btechguru.com/courses--nptel--engineering-drawing----video-lecture.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	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
2	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
3	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
4	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
5	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-

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

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P103

BASIC ELECTRICAL AND ELECTRONICS LABORATORY

(Common to all Branches)

L	T	P	C	Hrs
0	0	3	2	45

Course Objectives

- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications.
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications devices such as PN junction diode and transistor
- To gain a practical knowledge on the functions and application of basic logic gates and flip flops

Course Outcomes

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

CO1 - Follow the safety procedures when working with electricity and various tools. **(K4)**
CO2 - Do line diagram and wiring practices for domestic application. **(K5)**
CO3 - Use the protection circuits for electrical networks**. (K3)**
CO4 - Design and verify the kirchoff's law. **(K4)**
CO5 - Analyze the characteristics of PN diode and use it for rectifier applications. **(K4)**
CO6 - Gain knowledge on digital electronics to solve problems related to boolean algebra. **(K4)**

ELECTRICAL LAB

List of Experiments

1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring.
7. Go down wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuit breakers and A.C and D.C meters.

ELECTRONICS LAB

List of Experiments

1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)
2. Verification of Kirchoff's Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff"s laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan's theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops - JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.

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Reference Books

1. Kothari D P and Nagrath I J, “Basic Electrical Engineering”, Tata McGraw Hill, 2009.
2. R. Muthusubramaniam, S. Salivahanan and K.A. Mureleedharan, “Basic Electrical Electronics and Computer Engineering”, Tata McGraw Hill, 2004
3. Sudhakar and S. P. Shyam Mohan, “Circuits and Networks Analysis and Synthesis”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2010.
4. Rajendra Prasad, “Fundamentals of Electronic Engineering”, Cengage learning, New Delhi, 1st Edition, 2011.
5. Donald P Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 6th Edition, 2008.
6. Morris Mano, “Digital design”, PHI Learning, 4th Edition, 2008
7. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, “Electrical and Electronics Technology”, Pearson Education Limited, New Delhi, 10th Edition, 2010.

Web References

1. https://www.electrical4u.com/
2. https://www.allaboutcircuits.com/
3. https://www.circuitlab.com/
4. http://www.electronics-tutorials.ws
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
6. https://nptel.ac.in/courses/117/102/117102059/

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

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

(DR.S. ANBUMALAR)

P107	NSS / NCC (Common to all Branches)	L	T	P	C	Hrs
		0	0	0	-	-

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 fail, 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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U19EET31	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 and 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 Publications, New Delhi, 4th Edition, 2017.

Reference Books

1. C. B. Gupta, 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)

U19EET32	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.

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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)

U19EET33	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 the concepts of electromagnetic waves and wave propagation

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 that is often used to produce magnetic field and used as filter element. **(K4)**

CO5 - Compute the concept of 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. Application - 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 - method of images, 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 l– Stoke's theorem-Micro magnetic, 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 and mutual inductance-Inductance of solenoids, toroid's and transmission lines –Faraday's Law, Time varying magnetic field – 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, 5th Edition, 2010.
4. Bhag Singh Guru and Hüseyin R. Hiziroglu, "Electromagnetic field theory Fundamentals", Cambridge University Press; 2nd Revised Edition, 2009.

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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	-	-	-	-	-	-	-	3	2	2

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

(DR.S. ANBUMALAR)

U19EET34 **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	-	1	-	-	-	-	-	-	1	3	3	2
2	3	2	2	-	1	-	-	-	-	-	-	1	3	3	2
3	3	3	2	-	1	-	-	-	-	-	-	1	3	3	2
4	3	3	3	-	1	-	-	-	-	-	-	1	3	3	2
5	3	3	3	-	1	-	-	-	-	-	-	1	3	3	2

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

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U19EET35	ELECTRONIC DEVICES AND CIRCUITS	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 impart knowledge on frequency response of small signal and large signal amplifiers.
- To explore the working of amplifiers with positive and negative feedback systems.

Course Outcomes

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

CO1 - Use the PN junction diode for applications like rectifiers, clippers, clampers and Zener as regulator circuits.**(K2)**

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 and optoelectronics devices for various applications as variable capacitance, oscillator, isolator, light intensity measurement and display devices. **(K3)**

CO5 - Design the transistor amplifiers using its small signal model and evaluate the performance analysis of large signal amplifier. **(K4)**

CO6 - Design oscillators for different types of signal generation and analyse the frequency response of negative feedback amplifiers. **(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 AND FIELD EFFECT 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 –BJT as a switch – FET: JFET – Drain and transfer characteristics – Shockley's equation – Comparison between JFET and BJT – Biasing of FETs. – MOSFET: Types and characteristics – MOSFET as a switch – Selection of devices using specification sheets – Introduction to SJT and SiC MOSFET

UNIT III OPTO ELECTRONIC DEVICES (9 Hrs)

Opto electronic devices: 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 as optocoupler -Opto isolator.

UNIT IV SMALL AND LARGE 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 – Comparison – Transistor R_e model - Cascading amplifier – Direct and RC coupled two stage CE amplifiers – Darlington pair – Cascode amplifier – Tuned amplifier – Classification of Power amplifiers – Class A , Class B , Class AB , Class C , Class D and Class E amplifier – Conversion efficiency calculations– Power transistor heat–Low frequency FET model – Source follower – Analysis of CS and CD circuits.

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UNIT V POSTIVE AND NEGATIVE FEEDBACK AMPLIFIERS (9 Hrs)

Feedback concept – Gain with feedback – General characteristics of negative feedback amplifiers – Four basic types of feedback – Multistage feedback amplifiers – Two stage CE amplifier with series voltage negative feedback – Schmitt trigger - Frequency response and stability – 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 and Design”, Cengage learning Inc, 2nd Edition 2011.
3. G.S. Tomar, Ashish Bagwari, “Fundamentals of Electronic Devices and Circuits”, Springer Nature, 1st Edition, 2019.
4. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit theory”, Pearson Education, 9th Edition, 2007.
5. Dr. R. S. Sedha, “A textbook of Applied Electronics”, S. Chand Publications, Multicolor Edition, 2019.

Reference Books

1. Thomas L. Floyd, “Electronic devices”, Pearson prentice hall, 10thEdition, 2017.
2. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rdEdition, 2003.
3. Robert L. Boylestad, “Electronic devices and circuit theory”, Pearson Prentice Hall, 10thEdition, 2009.
4. Mahesh B. Patil, “Basic electronic devices and circuits”, PHI Learning Pvt. Ltd., 1st Edition, 2013.
5. 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	2	3	3	3	1	-	-	-	-	-	-	1	2	3	3
2	2	3	3	3	2	-	-	-	-	-	-	1	2	3	3
3	1	1	3	2	1	-	-	-	-	-	-	1	2	3	3
4	3	3	2	3	2	-	-	-	-	-	-	1	2	3	3
5	3	3	2	3	3	-	-	-	-	-	-	1	2	3	3
6	3	3	2	3	3	-	-	-	-	-	-	1	2	3	3

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

(DR.S. ANBUMALAR)

U19EET36	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. LizyLizyKurian 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)

U19EEP31	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 Electrical 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. 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. J. Nagrath and Kothari, "Theory and Problems of Basic Electrical Engineering", PHI Learning Private Limited, Delhi, 2nd Edition, 2016.

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

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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)

U19EEP32	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

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.

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4. A. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata McGraw Hill, New Delhi, 7th Edition, 2013.
5. Stephen J. Chapman, “Electric Machinery Fundamentals”, McGraw Hill Education Pvt. Ltd, 5th Edition, 2012.
6. Vincent Del Toro, “Basic Electric Machines”, Pearson India Education, 1st Edition, 2016.Irving. L. Kosow, “Electrical Machines and Transformers”, PHI, 2nd Edition, 2007.
7. Albert E. Clayton, “The performance and design of direct current machines”, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2004.

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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)

U19EEP33	ELECTRONICS LAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the characteristics of various electronic devices.
- To study and implement diode applications for 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 understand the effects of negative feedback on amplifier circuits

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 clipper, clamper, and rectifier using PN and regulator circuits using zener diodes. **(K5)**
CO3 - Demonstrate the characteristics of opto electronic devices. **(K3)**
CO4 - Experiment the characteristics of various special devices. **(K4)**
CO5 - Design oscillator circuits for signal generation and evaluate the frequency response of amplifier circuits. **(K5)**

List of Experiments

1. Determination of dynamic resistance of PN Junction diode and construct the half wave and full wave rectifiers.
2. Design and implementation of clipping and clamping circuits.
3. Design a voltage regulator using zener diode and verify its characteristics.
4. Determination of characteristic parameters of BJT for Common Emitter configuration.
5. Design the Biasing Circuits for BJT (Fixed bias, collector to base bias, potential divider).
6. Design the Biasing Circuits for FET (Self bias, potential divider)
7. Determination of characteristic parameters of FET/MOSFET and application of MOSFET as a switch.
8. Verify the characteristics of photo diode and photo transistor.
9. Verify the characteristics of LED/LCD/LDR.
10. Verify the Characteristics of UJT.
11. Design the common emitter BJT amplifier and analyze the frequency response characteristics.
12. Design the common source FET amplifier and analyze the frequency response characteristics.
13. Design a UJT relaxation oscillator.
14. Design a wein bridge and Phase shift oscillators using BJT.
15. Design and verify the Schmitt trigger using BJT.

Reference Books

1. Louis E. Frenzel, "Practical Electronic Design for Experimenters", McGraw Hill Professional, 1st Edition, 2020.
2. A. P. Malvino and D. Bates, "Electronic Principles", Tata McGraw-Hill, 8th Edition, 2016.
3. David A. Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual", Oxford University higher education, 5th Edition, 2009.
4. David A. Bell, "Laboratory Manual for Electronic Devices and Circuits", Oxford University higher education, 4th Edition, 2001.
5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit theory", Pearson Prentice Hall, 9th Edition, 2007.
6. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge Univ. Press, 3rd Edition, 2015.
7. Thomas L. Floyd, "Electronic devices", Pearson prentice hall, 10th Edition, 2017.
8. Robert L. Boylestad, "Electronic devices and circuit theory", Pearson Prentice Hall, 10th Edition, 2009

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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/

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

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

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U19EEC3X	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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U19EES31

SKILL DEVELOPMENT COURSE 1
GENERAL PROFICIENCY – I
(Common to all Branches)

L	T	P	C	Hrs
0	0	2	-	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, 2004.
3. Bailey, Stephen. “Academic writing: A practical guide for students”. Psychology Press, 2003.
4. R. S. Aggarwal, “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.

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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

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U19EES32	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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U19EEM31	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.

(DR.S. ANBUMALAR)

U19EET41

PROBABILITY AND STATISTICS
(Common to EEE, 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 – 1, 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, 15th Edition, 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. EhsanesSaleh, “An Introduction to Probability and Statistics”, Wiley, 2008.
5. E. Rukmangadachari, “Probability and Statistics”, Pearson Education India , 2012.

(DR.S. ANBUMALAR)

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	2
2	3	2	1	1	-	-	-	-	-	-	-	1	3	1	2
3	2	1	-	-	-	1	-	-	-	-	-	1	3	1	2
4	3	2	1	1	-	1	-	-	-	-	-	1	3	1	2
5	3	2	1	1	-	1	-	-	-	-	-	1	3	1	2

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

(DR.S. ANBUMALAR)

U19EET42	DATA STRUCTURE AND OBJECT ORIENTED PROGRAMMING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the fundamentals of algorithm, various searching and sorting techniques.
- To study the basic concept about stack, queue and linked list
- To understand the implementation and various operation on trees and graphs.
- To understand the programming principles using C++.
- To study about File Management Operations, inheritance, templates and exception handling in C++.

Course Outcomes

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

CO1 - Summarize searching and sorting techniques.**(K2)**
CO2 - Demonstrate, apply and Analyze stack, queue, linked list and its operation. **(K3)**
CO3 - Construct the tree, graph and its various applications.**(K3)**
CO4 - Write a maintainable C++ Program for a given algorithm and implement the same. **(K3)**
CO5 - Demonstrate the use of inheritance, templates, files, templates and its relevant applications. **(K3)**

UNIT I INTRODUCTION TO ALGORITHM, SEARCHING AND SORTING TECHNIQUES (9 Hrs)

Introduction to Algorithm – Programming principles – Creating programs– Analyzing programs. Arrays: One dimensional array, multidimensional array. Pointers – Searching: Linear search, Binary Search. Sorting techniques: Internal sorting –Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Merge Sort and Radix Sort.

UNIT II STACK, QUEUE AND LINKED LIST (9 Hrs)

Stacks: Definition – Operations – Applications of stack. Queues: Definition – Operations – Priority queues – De queues – Applications of queue. Linked List: Singly Linked List, Doubly Linked List, Circular Linked List, linked stacks, Linked queues, Applications of Linked List

UNIT III TREES AND GRAPHS (9 Hrs)

Trees: Binary tree, Terminology, Representation, Traversals, Applications Graph: Terminology, Representation, Traversals – Applications – spanning trees, shortest path and Transitive closure, Hash tables.

UNIT IV INTRODUCTION TO OBJECT ORIENTED PROGRAMMING, CONSTRUCTOR, DESTRUCTOR AND OPERATOR OVER LOADING (9 Hrs)

Principles of Object Oriented Programming – Beginning With C++ – Tokens - Expressions-control Structures – Functions in C++, classes and objects, constructors and destructors, operators overloading and type conversions.

UNIT V INHERITANCE, FILES, TEMPLATES AND EXCEPTION HANDLING (9 Hrs)

Inheritance: Extending classes, Pointers, Virtual functions and polymorphism, File Handling Templates, Templates – Exception Handling.

Text Books

1. Ellis Horowitz and SartajSahni, “Fundamentals of Data Structures”, Universities Press, 2nd Edition, 2004.
2. D. Samanta, “Classic Data Structures, Prentice-Hall of India Pvt. Ltd., India, 2nd Edition, 2012.
3. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education, 6th Edition, 2013.

Reference Books

1. Robert Kruse, C. L. Tondo and Bruce Leung, “Data Structures and Program Design in C”, Prentice-Hall of India, 2nd Edition, 2007.
2. Seymour Lipschutz, “Data Structures”, McGraw Hill Education, Revised 1st Edition, 2014.
3. Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to data structures with applications”, McGraw Hill, 2nd Edition, 2017.
4. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Addison-Wesley, 4th Edition, 2013.

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Web References

1. http://www.cse.unt.edu
2. http://nptel.iitm.ac.in
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.tutorialspoint.com/cplusplus/index.htm
5. https://www.javatpoint.com/data-structure-tutorial

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	2	-	-	-	-	-	-	-	2	3
2	3	3	3	3	2	1	-	-	-	-	-	-	-	2	3
3	3	3	3	3	2	1	-	-	-	-	-	-	-	2	3
4	3	3	3	3	2	1	-	-	-	-	-	-	-	2	3
5	3	3	3	3	2	1	-	-	-	-	-	-	-	2	3

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

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U19EET43 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 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 special machines.

Course Outcomes

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

CO1 - Evaluate and analyze the performance of 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 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.

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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

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U19EET44	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 Wien bridge 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

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Code	Course Title	L	T	P	C	Hrs
U19EEP41	**DATA STRUCTURE AND OBJECT ORIENTED PROGRAMMING LAB**	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To understand the fundamentals of algorithm, various searching and sorting techniques.
- To study the basic concept about stack, queue and linked list
- To understand the implementation and various operation on trees and graphs.
- To understand the programming principles using C++.
- To study about File Management Operations, inheritance, templates and exception handling in C++.

Course Outcomes

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

CO1 - Compare different type of searching and sorting techniques. **(K2)**
CO2 - Design the different type of stack, queue and linked list. **(K4)**
CO3 - Construct the tree, graph and its various applications. **(K4)**
CO4 - Formulate a maintainable C++ Program for a given algorithm and implement the same. **(K4)**
CO5 - Describe the use of inheritance, templates, files, templates and its relevant applications. **(K2)**

List of Experiments

C language

1. Searching Techniques
2. Sorting Techniques
3. Single Linked List and Doubly Linked list and its applications
4. Stack and its applications
5. Binary tree traversal
6. Graph Traversal
7. Minimum Spanning Tree
8. Shortest path algorithms

C++ language

9. Programs to implement classes and objects with constructor and destructors
10. Programs to implement different types of inheritance like multiple, multilevel and hybrid inheritance
11. Programs to implement virtual function to demonstrate the use of run time polymorphism
12. Program to implement template
13. Programs to implement Exception handling
14. Programs to implement queue and its applications

Reference Books

1. Ellis Horowitz and SartajSahni, “Fundamentals of Data Structures”, Universities Press, 2nd Edition, 2004.
2. D. Samanta, “Classic Data Structures, Prentice-Hall of India Pvt. Ltd., India, 2nd Edition, 2012.
3. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education, 6th Edition, 2013.
4. Robert Kruse, C. L. Tondo and Bruce Leung, “Data Structures and Program Design in C”, Prentice-Hall of India, 2nd Edition, 2007.
5. Seymour Lipschutz, “Data Structures”, McGraw Hill Education, Revised 1st Edition, 2014.
6. Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to data structures with applications”, McGraw Hill, 2nd Edition, 2017.
7. Bjarne Stroustrup, “The C++ Programming Language”, Pearson Addison-Wesley, 4th Edition, 2013.

Web References

1. http://www.cse.unt.edu
2. http://nptel.iitm.ac.in
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.tutorialspoint.com/cplusplus/index.htm
5. https://www.javatpoint.com/data-structure-tutorial

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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	2	-	-	1	-	-	-	-	2	3
2	3	3	3	3	2	1	-	-	3	-	-	-	-	2	3
3	3	3	3	3	2	1	-	-	3	-	-	-	-	2	3
4	3	3	3	3	2	1	-	-	3	-	-	-	-	2	3
5	3	3	3	3	2	1	-	-	3	-	-	-	-	2	3

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

(DR.S. ANBUMALAR)

U19EEP42	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 and electrical braking of 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, 2^{nd} Edition, 2017.
2. D.R. Kohli and S.K Jain, “A laboratory course in electrical machines”, New Chand & Bros, Roorkee, 2^{nd} Edition, 2000.
3. Dr. D. K. Chaturvedi, “Electrical Machines Lab Manual with MATLAB Programs”, Laxmi Publications Pvt Limited, 1^{st} Edition, 2015.
4. A. E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, Tata McGraw Hill, New Delhi, 7^{th} Edition, 2013.

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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.

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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

(DR.S. ANBUMALAR)

U19EEP43	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 (I^{st} order and II^{nd} 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, 2^{nd} Edition, 2003.
3. Walt Jung, "Op Amp Applications Handbook", Newnes, 1^{st} Edition, 2005.
4. Ramakant A. Gayakward, "Op-amps and Linear Integrated Circuits", Pearson Education, 5^{th} Edition, 2015.
5. James M. Fiore, "Opamps and Linear Integrated Circuits Concepts and Applications", Cengage learning, 1^{st} Edition, 2010.
6. Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson Education, 2^{nd} Edition, 2013.
7. Jacob Millman, Christos C. Halkias, "Integrated Electronics - Analog and Digital circuits system", Tata McGraw Hill, 2^{nd} Edition, 2009.
8. Robert F. Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", PHI Learning, 6^{th} 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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U19EEC4X	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.

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U19EES41	SKILL DEVELOPMENT COURSE 3: GENERAL PROFICIENCY– II (Common to all Branches)	L	T	P	C	Hrs
		0	0	2	-	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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U19EES42	SKILL DEVELOPMENT COURSE 4 (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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U19EEM41	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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		L	T	P	C	Hrs
U19EET51	**MEASUREMENTS AND INSTRUMENTATION FOR ELECTRICAL ENGINEERING**	**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 - Systematic and random errors, propagation of errors, Limiting errors of instruments.

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 - Principle of operation, construction, Torque equation, types, testing and Calibration using direct and phantom loading - Measurement of active and reactive powers in balanced and unbalanced systems - Instrument Transformers - Construction, phasor diagrams, testing, application of current transformer and potential transformer - Magnetic measurements – Determination of B-H curve and measurement 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) - Decibel meters - Q meter - tan-delta meter - Modulation index meter - Sampling theory and its applications in current, voltage, power, energy measurements - Signal analyzers - wave, network, harmonic distortion, 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 low and high resistances – D.C potentiometer - Wheat stone, Kelvin and Kelvin Double bridge - A.C bridges for measurement of L and C - General principles, sensitivity analysis, Maxwell, Anderson bridge, Hays, Owens and Heavy side Campbell bridges for inductance; Maxwell, De Sauty and Wein bridges for capacitance - Measurement of earth resistance - localization of cable faults by Murray and Varley loop test - Methods of reducing bridge errors - Wagner Earthing Device.

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, stroboscope, gyroscope – Force: Strain gauge – Torque: magnetostricitive, strain gauge – Position: synchro Transmitter and receiver – speed: Magnetic and photo electric pickup transducer - Pressure: Manometers, Bourdon – Temperature: Thermistors, thermocouple – Flow: Electromagnetic, Ultrasonic – Level: Differential Pressure cell, Ultrasonic – Density: Hydrometer - Voltage, current and power: Hall Effect transducer

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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.

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

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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

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U19EET52	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 – Feedback control system characteristics - Mathematical modeling of Electrical, Mechanical and Electro-Mechanical systems - electrical analogues systems - Block diagrams reduction techniques - Signal flow graphs - Transfer functions.

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.

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

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

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U19EET53	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. R. Padiyar, "HVDC Power Transmission Systems – Technology and System Interactions", New Age International Publishers, 2012.
2. S.N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd, New Delhi, 2nd Edition, 2011.
3. A. K. Theraja and B. L. Theraja, "Text Book of Electrical Technology: Volume 3: Transmission, Distribution and Utilization", S. Chand Publication, 23rd Edition, 2004.
4. V. K. Metha and Rohit Metha, "Principles of Power System", S. Chand Publication, 3rd Edition, 2005.

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Reference Books

1. Hadi Saadat, “Power System Analysis”, PSA Publishing, 3rd Edition, 2010.
2. J. Brian, Hardy and Colin R. Bayliss, “Transmission and Distribution in Electrical Engineering”, Newnes, 4th Edition, 2012.
3. Luces M.Fualken berry Walter Coffer, “Electrical Power Distribution and Transmission”, Pearson Education, 2007.

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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

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U19EET54	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, Need for Assembly language – Development of Assembly language programs – Machine cycles and Timing diagrams, Programming and Interfacing. Application: Interfacing of stepper motor control with 8085 microprocessor.

UNIT II INTRODUCTION TO 8 and 16 BIT MICROCONTROLLER (9 Hrs)

Microprocessor and Microcontroller difference, RISC and CISC programmer's model, Criteria for selecting microcontroller. Overview of PIC family, PIC Microcontroller architecture, status register, Special function registers, RAM, ROM and EEPROM space, On-Chip peripherals, PIC16F877A and PIC24F pin configuration and function of each pin, Fuse bits of PIC – Case study on traffic light control using PIC Microcontroller

UNIT III PIC24F ASSEMBLY LANGUAGE PROGRAMMING AND PROGRAMMING IN C (9 Hrs)

PIC24F data types and assembler directives, Addressing modes of PIC24F, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, MPLABX setup for assembly language programming, PIC24F I/O Port Programming, Time delay loop, Look-up table, Bit addressability, MACROs, Intel HEX file.

Timer programming, Input capture and Wave Generator, PWM programming External Interrupt programming, ADC programming, EEPROM programming – Program using PIC24F Timer to generate waveforms

UNIT IV SERIAL COMMUNICATION PROTOCOLS AND PERIPHERAL INTERFACING (9 Hrs)

Serial communication protocols: Introduction to UART protocol, I^2C protocol and its Programming, SPI protocol and its Programming, Serial Port programming using polling and interrupt.

Peripheral interfacing and its programming : LCD and Keyboard Interfacing, Relay interfacing, Stepper and DC Motor control, RTC Interfacing, LM35 Temperature sensor interfacing, MAX7219 display controller interfacing – Program using PIC24F microcontroller for interfacing ultrasonic sensors.

UNIT V ADVANCED MICROCONTROLLER (9 Hrs)

dsPIC33EV: Block diagram, Clock Distribution System, interrupt, Timer, PWMX control registers, high-speed PWMX module register- interconnection diagram, ADC-signal processing and conditioning.

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.

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Reference Books

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

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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	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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U19EEP51	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

CO 1 - Solve polynomial equation.**(K3)**
CO 2 - Find out the root of the Algebraic and Transcendental equations. **(K3)**
CO 3 - Know the applications of interpolation. **(K1)**
CO 4 - Apply the Trapezoidal formula. **(K3)**
CO 5 - 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

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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	3	2	2	-	-	-	-	-	1	-	-	1	1	2	2
3	2	2	2	-	-	-	-	-	1	-	-	1	1	2	2
4	2	2	2	-	-	-	-	-	1	-	-	1	1	2	2
5	2	2	2	-	-	-	-	-	1	-	-	1	1	2	2

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

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		L	T	P	C	Hrs
U19EEP52	**MEASUREMENTS AND INSTRUMENTATION LAB**	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To give the students an insight into the constructional and working principles of various measuring instruments.
- To demonstrate various Bridges for the measurement of resistance, inductance and capacitance using simulation and hardware set ups.
- To provide the concept of magnetism and methods used for calculation of magnetic losses.
- To provide the procedure for calibration on measuring instruments.
- To apply different types of sensors for the measurement of physical quantities.

Course Outcomes

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

CO1 - Realize the advantages and necessity of measurement systems. **(K2)**
CO2 - Measure the Resistance, Inductance and capacitance using AC and DC bridges. **(K3)**
CO3 - Determine the magnetization characteristics and hysteresis losses using BH curve. **(K3)**
CO4 - Calibrate the measuring instruments used in domestic and commercial applications. **(K3)**
CO5 - Determine the characteristics of various transducers and to apply for the measurement of physical quantities. **(K3)**

List of Experiments:

1. (a) Measurement of resistance using Wheatstone bridge
   (b) Measurement of insulation resistance using Megger
2. (a) Measurement of inductance and Q-factor using Anderson's Bridge.
   (b) Measurement of capacitance using Schering Bridge.
3. Extension range of voltmeter and ammeter.
4. Calibration of single phase and three phase Energy meter using loading method.
5. Measurement of magnetic system (B-H loop and magnetic losses).
6. Calibration of Current Transformer and Potential Transformer
7. Characteristic of Temperature transducers (LDR / thermistor / thermocouple).
8. Measurement using R/L/C transducers
9. Measurement of Voltage, current and power using Hall Effect transducer.
10. Characteristics of Optical Transducers (LDR/Phototransistor/Photovoltaic/photoconductive cells)
11. Measurement of speed using Magnetic and photo electric pickup transducers.
12. Measurement of Position using synchro Transmitter and receiver

Reference Books

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

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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

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

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U19EEP53	CONTROL SYSTEMS LAB	L	T	P	C	Hrs
		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. Simulation of a RC lead/lag compensating network /second order systems for the given specifications and to obtain its frequency response.
3. Determinations of Transfer function of a separately excited DC Motor.
4. Design and implementation of PID controller for DC motor
5. Stability analysis of a system using Root Locus
6. Determination of transfer functions of a physical system using frequency response and Bode's asymptotes.
7. Position and speed control of DC servo motor
8. Design of Lead/Lag/Lead-Lag Compensator for DC Motor
9. Design of P/I/D Controllers for Temperature control system
10. Design of P/I/D Controllers for Level control system
11. Simulation of Controllability and Observability of a system
12. Simulation of open loop and closed loop speed control of 3 phase induction motor.
13. Simulation of open loop and closed loop control DC buck converter.

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

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

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U19EEP54	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 using polling and interrupt
   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 USART 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 PIC18
9. Stepper motor interfacing with PIC18
10. DS1307 RTC Interfacing with PIC18
11. MAX7219 LED matrix driver Interfacing with PIC24F using SPI protocol
12. Interface to peripherals and use of the I2C bus
13. Design of zero crossing detector
14. a.) Design Frequency Counter which displays frequency of unknown pulse on 16x2 LCD using PIC24F on-chip Timer.
    b.) Design Pulse period meter which displays ON-time of unknown pulse on 16x2 LCD using PIC24F on-chip Timer
15. Design Bluetooth controlled 2-ch variable frequency square wave generator using PIC24F UART and on-chip Timer.
16. Design 4 Channel Data Logger which measures Voltage between 0-5V on 4 ADC Channels of PIC24F and transmit it to Host PC at every 1 second where it stored in excel sheet with timestamp for future analysis.

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Reference 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.
3. Sunil Mathur, Jeebananda Panda, “Microprocessor and microcontroller”, PHI Learning Private Limited, New Delhi, 1st Edition, 2016.
4. dsPIC33EV data sheet.

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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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U19EEC5X	**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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U19EES51	SKILL DEVELOPMENT COURSE 5 (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

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U19EES52	SKILL DEVELOPMENT COURSE 6: (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

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

Teaching tools

- Different ways to create audio-visual activities.
- Handle audio-visual editors.
- Collaborative working.
- Individualize learning experience.
- 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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U19EEM51	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 & 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, 2006
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

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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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U19EET61	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 Cortex M series Controller.
- To learn about the different programming techniques for ARM Cortex M series Controller
- To impart knowledge on ARM Cortex M series Controller 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 Cortex M0 using Embedded C in IDE software. **(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 and Synchronous and Asynchronous Communication – Serial Communication devices and Protocols: I^{2}C, SPI, UART - Parallel Device Ports.

UNIT II ARM ARCHITECTURE (9 Hrs)

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

UNIT III ARM CORTEX M SERIES CONTROLLER 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 CORTEX M SERIES CONTROLLER PERIPHERALS (9 Hrs)

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

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.

Textbooks

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

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

(DR.S. ANBUMALAR)

U19EET62	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 SCR. 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, 6^{th} Edition, 2018.
2. M.H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, New Delhi, 4^{th} 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.

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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	3	3	3
2	3	2	3	3	2	-	-	-	-	-	-	1	3	3	3
3	3	2	3	3	2	-	-	-	-	-	-	1	3	3	3
4	3	2	3	3	2	-	-	-	-	-	-	1	3	3	3
5	3	2	3	3	2	-	-	-	-	-	-	1	3	3	3

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

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U19EET63	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 scenario in India - 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 - Contingency selection and ranking for the power system.

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.

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.

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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	3	2	2
2	3	2	2	2	3	-	-	-	-	-	-	1	3	2	2
3	3	3	2	2	3	-	-	-	-	-	-	1	3	2	2
4	3	3	2	2	3	-	-	-	-	-	-	1	3	2	2
5	3	3	2	2	3	-	-	-	-	-	-	1	3	2	2

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

(DR.S. ANBUMALAR)

U19EET64 **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 AND BLDC MOTORS (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, 6^{th} Edition, 2016.
2. M. V. Deshpande, "Design and Testing of Electrical Machines", PHI learning Pvt. Ltd, 3^{rd} Edition, 2010.
3. S. K. Sen, "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2^{nd} Edition, 2009.

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Reference Books

1. 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.

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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	3	2	2
2	3	2	2	3	2	-	-	-	-	-	-	1	3	2	3
3	3	3	2	3	2	-	-	-	-	-	-	1	3	3	3
4	3	3	3	3	2	-	-	-	-	-	-	1	3	2	3
5	3	3	3	2	2	-	-	-	-	-	-	1	2	3	3

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

(DR.S. ANBUMALAR)

U19EEP61	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 ARM Cortex M series microcontroller.
- 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 Cortex M series microcontroller, FPGA, and raspberry pi. **(K3)**
CO2 - Interface ARM Cortex M series microcontroller, FPGA, and raspberry pi Microcontrollers with external Peripheral devices. **(K4)**
CO3 - Handle interrupts for real time control applications using ARM Cortex M series Controller. **(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 SPI Flash with interrupt
   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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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	-	-	1	3	2	3
2	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
3	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
4	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
5	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3

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

(DR.S. ANBUMALAR)

U19EEP62	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, TRIAC, MOSFET and IGBT.
2. Analyzing frequency spectra of periodic and non-periodic signals using Spectrum analyzer.
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. Microcontroller based control schemes for Stepper Motor.
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, 2^{nd} Edition, 2010.
2. M. H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI, New Delhi, 4^{th} Edition, 2017
3. P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 6^{th} Edition, 2018.
4. M. D. Singh and K. B. Khachandani, "Power Electronics", McGraw-Hill Education, 2^{nd} Edition, 2017.
5. R .Krishnan, "Electric Motor Drives - Modeling, Analysis, and Control", Pearson Education India, 1^{st} Edition, 2015.
6. John F. Wakerly, "Digital Design Principles and Practices", Pearson prentice hall, 4^{th} Edition, 2009.

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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	-	-	-	2	-	-	1	3	2	3
2	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
3	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
4	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3
5	3	3	2	2	3	-	-	-	2	-	-	1	3	2	3

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

(DR.S. ANBUMALAR)

U19EEP63 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 Economic load dispatch in power system.
9. Load curve and load duration curve
10. Numerical Integration of Swing equation
11. Modeling and Analysis of Load frequency control
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	-	1	-	-	-	3	-	1	2	3	2	2
2	1	3	2	-	1	-	-	-	3	-	1	2	3	2	2
3	1	3	2	-	1	-	-	-	3	-	1	2	3	2	2
4	1	3	2	-	1	-	-	-	3	-	1	2	3	2	2
5	1	3	2	-	1	-	-	-	3	-	1	2	3	2	2

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

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U19EEC6X	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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U19EES61

SKILL DEVELOPMENT COURSE 7

(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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U19EES62	SKILL DEVELOPMENT COURSE 8 (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.**(K2)**
CO2 - Face the placement interviews. **(K2)**

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 at least 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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U19EES63	SKILL DEVELOPMENT COURSE 9 (NPTEL / MOOC - I)	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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U19EEM61 **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 and 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

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

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U19EET71 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 and IoT.

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 - Gain knowledge on fundamentals of IoT. **(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 INTRODUCTION TO IoT (9 Hrs)

IoT fundamentals, IoT Architecture and protocols, Various Platforms, IoT components and Communication Technologies, Challenges in IoT, Case study.

Text Books

1. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, 4^{th} Edition , 2011
2. Mini S. Thomas, “Power System SCADA and Smart Grids”, CRC Press, 3^{rd} Edition April 2015.
3. S. Mukhopadhyay, S. Sen and A. K. Deb, “Industrial Instrumentation, Control and Automation”, Jaico Publishing House, 1^{st} Edition, 2013.
4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, 1^{st} Edition, 2018.

Reference Books

1. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill, 4^{th} Edition , 2011
2. Mini S. Thomas, “Power System SCADA and Smart Grids”, CRC Press, 3^{rd} Edition April 2015.
3. S. Mukhopadhyay, S. Sen and A. K. Deb, “Industrial Instrumentation, Control and Automation”, Jaico Publishing House, 1^{st} Edition, 2013.
4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, 1^{st} Edition, 2018.

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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	-	-	-	-	-	-	-	1	3	3	3
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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U19EET72	**ELECTRIC AND HYBRID VEHICLE**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To familiarize with the fundamental concept of electric vehicle
- To overview the energy storage technologies used for electric and hybrid vehicle.
- To determine various electric drives suitable for electric vehicles.
- To understand about the different power converter topologies used in electric vehicle
- To understand the concept of hybrid and electric vehicle architecture, component sizing and electric motor drive.

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 - Combine the different energy storage technologies and its implementation in hybrid vehicle. **(K4)**
CO3 - Develop the hybrid electric vehicle with different power converter topology. **(K2)**
CO4 - Review the working of different configurations of electric vehicle and its concepts **(K2)**
CO5 - Describe the working of different configurations of hybrid vehicles. **(K2)**

UNIT I INTRODUCTION TO EV (9 Hrs)

History of hybrid and 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 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.

UNIT III ELECTRIC PROPULSION DRIVE SYSTEMS (9 Hrs)

Electric drives used in EV/HEV: Induction motor drives - DC motor drives - Permanent magnet motor drives - their Configuration - SRM Drives.

UNIT IV ELECTRIC VEHICLE (9 Hrs)

Configurations of EV - advantages - EV transmission configuration: Transmission components - gear ratio - EV motor sizing - EV market.

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.

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

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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	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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U19EEP71 **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
1	1	2	1	2	1	1	3	3	2	3	1	2	1	2	1
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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U19EEP72	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 using IoT.
- 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 monitoring and control system for real time applications using IoT.**(K3)**
CO5 - Diagnose the fault in Power generation and distribution networks, etc. **(K3)**

List of Experiments

1. Study of basic programming of PLC
2. Arithmetic operation, Timer, Counter operation using PLC
3. PLC based control of Level Process, Temperature Process and Speed.
4. Annunciator system using PLC
5. PLC based control of batch process system
6. Bottle filling system using PLC
7. a. Interfacing of lamp and button with PLC for ON/OFF operation.
   b. Perform Delayed Operation of Lamp By Using Push Button.
8. Combination of Counter and Timer for Lamp ON/OFF operation.
9. DOL Starter and Star Delta Starter operation by using PLC.
10. Develop/ Execute ladder program for the Control of automatic bottle filling system.
11. Develop/ Execute ladder program for Traffic Light Control
12. Develop/ Execute ladder program for Reversal of DC Motor Direction
13. Develop/ Execute ladder program for Stair case lighting
14. IoT - based Street light monitoring and control
15. 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. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, 1st Edition, 2014
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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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	-	-	-	-	-	-	-	1	3	3	3
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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U19EEP73	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.

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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	–	–	–	1	–	–	1	3	3	3
2	3	3	3	3	3	–	–	–	1	–	–	1	3	3	3
3	3	3	3	3	3	–	–	–	1	–	–	1	3	3	3
4	3	3	3	3	3	–	–	–	1	–	–	1	3	3	3
5	3	3	3	3	3	–	–	–	1	–	–	1	3	3	3

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

(DR.S. ANBUMALAR)

U19EEW71	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

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U19EEW72	**INTERNSHIP/ INPLANT TRAINING**	-	-	-	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)

U19EET81	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.

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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

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U19EEP81	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.

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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

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U19EEP82	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)

U19EEW81	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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		L	T	P	C	Hrs
U19EES81	**SKILL DEVELOPMENT COURSE 10:** (NPTEL / MOOC - II)	**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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PROFESSIONAL ELECTIVE PAPERS

		L	T	P	C	Hrs
U19EEE41	**ELECTRICAL SAFETY ENGINEERING**	**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

UNITII 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 CapelliSchellpfeffer, 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

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Course Code	Course Title	L	T	P	C	Hrs
U19EEE42	**COMPUTER AIDED DESIGN FOR ELECTRICAL APPARATUS**	**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.

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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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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

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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

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U19EEE43	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.

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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

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U19EEE44	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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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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U19EEE45	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 - Demand for Portable Energy - Demand and scale requirements - Environmental and sustainability issues.

UNIT II ENERGY STORAGE TYPES (9 Hrs)

Electrical and Magnetic energy storage, Capacitors, electromagnets - Chemical Energy storage - Thermo-chemical, photo-chemical, bio-chemical, electro-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 - Case study on Flexible fiber - shaped metal - 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 – Case study on Hybridization of different energy storage devices.

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. DetlefStolten, “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. AbulMasrur, David Wenzhong Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, Wiley, 1st Edition, 2011.

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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

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	-	-	-	-	-	-	-	3	3	3
2	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

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U19EEE51	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 (for residential, industrial, commercial, health care, street lightings, sports, administrative complexes) – 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: Electric iron, Electric toaster – 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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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

(DR.S. ANBUMALAR)

U19EEE52	RENEWABLE ENERGY SOURCES	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 OVERVIEW AND SOLAR ENERGY (9 Hrs)

Overview: Limitations of conventional energy resource - Importance of renewable sources - Types – Limitations - Present Indian and international energy scenario. Solar Energy: radiation – extra-terrestrial - spectral distribution - solar constant - solar radiation on earth – measurements. Solar thermal system – solar thermal power and its conversion - solar collectors - types and applications. Photovoltaic (PV) technology - photovoltaic effect - efficiency of solar cells - semi-conductor materials – 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 - power extracted - wind distribution and speed prediction - wind map of India - wind turbines and electric generators - fundamentals – types of machines and their characteristics - horizontal and vertical wind mills - wind energy farms - off-shore plants- Selection factors. Case study on Wind power generation using micro wind turbine for residential purpose - 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, gasification, anaerobic digester, fermentation, gaseous fuel; Geothermal: resources, hot spring, steam system, site selection, associated problems in development. 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.

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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.

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

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

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

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U19EEE53	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 equipments. **(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.

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References Books

1. P. Venkataseshaiah K.V. Sharma, "Energy Management and Conservation", Dreamtech Press, 1st Edition, 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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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)

U19EEE54	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 - Analyze 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.

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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.

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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)

U19EEE55	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 (09 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.

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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)		
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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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U19EEE61	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 - Renewable Energy Technologies – Micro grids – Storage Technologies - 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 - 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.

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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

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	1	2
2	3	2	2	3	-	-	-	-	-	-	-	2	2	1	2
3	3	2	2	3	-	-	-	-	-	-	-	2	2	1	2
4	3	2	2	3	-	-	-	-	-	-	-	2	2	1	2
5	3	2	2	3	-	-	-	-	-	-	-	2	2	1	2

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

(DR.S. ANBUMALAR)

U19EEE62	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. Ravindra Arora, 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.

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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	3	1	2
2	3	3	2	1	1	-	-	-	-	-	-	1	2	1	2
3	3	3	3	1	1	-	-	-	-	-	-	1	2	1	2
4	3	3	3	1	1	-	-	-	-	-	-	1	3	2	2
5	3	3	3	1	1	-	-	-	-	-	-	1	3	2	2

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

(DR.S. ANBUMALAR)

U19EEE63	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.

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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	3	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

(DR.S. ANBUMALAR)

U19EEE64	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.

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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

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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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U19EEE65	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.

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5. S. K. Pillai, “A first course on electric drives”, New age publisher, 3^{rd} Edition, 2012.
6. Vedam Subrahmanyam, “Electric Drives”, Mc Graw Hill Education, New Delhi, 2^{nd} Edition, 2017.
7. W. Shepherd, L. N. Hulley and D. T. Liang, “Power Electronics and motor control”, Cambridge University Press, 2^{nd} Edition, 1995.

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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
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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U19EEE71	COMMUNICATION ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce different methods of analog communication systems and their significance.
- To introduce Digital Communication methods for high bit rate transmission.
- To introduce MAC used in communication systems for enhancing the number of users.
- To explain the various media for digital communication.
- To deliberate the use of Power Lines for communication.

Course Outcomes

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

CO1 - Comprehend the basic Characteristics of the signals and analog modulation techniques. **(K2)**
CO2 - Comprehend the needs of modulation and various Digital modulation techniques. **(K3)**
CO3 - Describe multiple access techniques and its applications. **(K2)**
CO4 - Explain the advanced communication systems. **(K2)**
CO5 - Explore the role of Communication Engineering in the realization of Smart grids **(K2)**

UNIT I ANALOG COMMUNICATION (9 Hrs)

Modulation –need for modulation - AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB AM Transmitter and Receiver; FM and PM – frequency spectrum – power relations: NBFM and WBFM, Generation of FM and PM, Armstrong method and Reactance modulator:

UNIT II DIGITAL COMMUNICATION (9 Hrs)

Pulse modulations: PAM, PWM, PPM - Sampling theorems - quantization, PCM, DM, DPCM - Digital modulations: ASK, FSK, PSK, BSK, applications of Data communication.

UNIT III MULTIPLE ACCESS TECHNIQUES (9 Hrs)

SS and MA techniques: FDMA, TDMA, CDMA, SDMA application in wire and wireless communication: Advantages (merits).

UNIT IV SATELLITE AND FIBRE OPTIC COMMUNICATION (9 Hrs)

Orbital aspects-Geostationary satellites-Satellite Uplink - Satellite Downlink - Satellite Transponder - Modulation techniques for satellite links - Satellite Earth station

Principle of light propagation in fibre - Index profiles - Modes of propagation - Losses in fibre -Dispersion -Light sources and detectors- Fibre optic communication link

UNIT V POWER LINE COMMUNICATION (9 Hrs)

Power Supply networks - Narrowband and Broadband PLC – Structure of PLC access network – PLC network elements – connection to core network – structure campus communication network and performance issues – Architecture of smart grid technology.

Text Books

1. Taub & Schiling, “Principles of communication systems”, Tata McGraw hill, 2007.
2. J.Das, “Principles of digital communication”, New Age International, 1986.
3. Halid Harasnica, Ralf Lehneri, “Broad band Power line Communications Design”, John Wiley and Sons, 2005

Reference Books

1. Simon Haykin, “Communication Systems”, Tata McGraw Hill, 4th Edition.
2. Kennedy and Davis, “Electronic Communication Systems”, Tata McGraw hill, 4th Edition, 1993.
3. Sklar, “Digital Communication Fundamentals and Applications”, Pearson Education, 2001.
4. Baryle, Memuschmidt, “Digital Communication”, Kluwer Publication, 2004.
5. B.P.Lathi, “Modern Digital and Analog Communication Systems”, Oxford University Press, 1998.
6. K. Muralibabu, “Communication Engineering”, Lakshmi Publications, 2013.

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3. yoonc01.tistory.com/attachment/fk100000000032.ppt
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COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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2	3	1	2	-	2	-	-	-	-	-	1	1	-	2	2
3	3	3	2	-	2	-	-	-	-	-	1	1	-	2	2
4	3	3	2	-	2	-	-	-	-	-	1	1	-	2	2
5	3	1	2	-	2	-	-	-	-	-	1	1	-	2	2

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

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U19EEE72	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. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
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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3. https://www.energy.gov/eere/solar/solar-integration-distributed-energy-resources-and-microgrids
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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	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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U19EEE73	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 sources”, 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.

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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	-	-	-	-	-	-	-	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	3	2	-	-	-	-	-	-	-	3	3	3
5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3

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

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U19EEE74 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.

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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.

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2. http://www.nptelvideos.in/2012/12/power-system-operations-and-control.html
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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

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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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U19EEE75	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, 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.

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.

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5. https://www.coursera.org/specializations/power-electronics

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1	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
2	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
3	3	3	3	2	2	-	-	-	-	-	-	1	3	3	3
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

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U19EEE80 **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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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

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U19EEE81	MODERN POWER ELECTRONIC CONVERTERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquire knowledge on the design of various types of switched mode power supplies and its control techniques.
- To impart the knowledge on working principle of high frequency switching ac – dc converters.
- To understand the characteristics and principle of operation of various types of dc – ac, ac – ac converter and techniques to reduce the harmonics.
- To explain about the matrix and AC- AC converter with and without DC link and to understand the difference between the converters.
- To learn the different soft switching technique available for power converters in order to reduce switching losses and increase converter efficiency

Course Outcomes

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

CO1 - Select and design switched mode regulated power supply for various applications. **(K3)**
CO2 - Design and analyze the operating principle of AC – DC converters and their performance**. (K3)**
CO3 - Develop different topologies of Inverter circuits**. (K4)**
CO4 - Interpret the operating issues of matrix converter, AC – AC converters and its importance. **(K3)**
CO5 - Design and apply appropriate soft switching techniques for power converters**. (K3)**

UNIT I SWITCHED MODE POWER SUPPLIES (9 Hrs)

DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

UNIT II AC-DC CONVERTERS (9 Hrs)

Switched mode AC-DC converters - synchronous rectification - single and three phase topologies - switching techniques - high input power factor - reduced input current harmonic distortion - improved efficiency - with and without input-output isolation - performance indices design examples

UNIT III DC-AC CONVERTERS (9 Hrs)

Multi-level Inversion: concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters - Modulation schemes.

UNIT IV AC- AC CONVERTERS WITH AND WITHOUT DC LINK (9 Hrs)

Matrix converters: Basic topology - Commutation – current path. Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

UNIT V SOFT-SWITCHING POWER CONVERTERS (9 Hrs)

Soft switching techniques - ZVS, ZCS, quasi resonance operation - Performance comparison - hard switched and soft switched converters - AC-DC converter, DC-DC converter, DC-AC converter - Resonant DC power supplies.

Text Books

1. M. H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, New Delhi, 4th Edition, 2017.
2. Fang Lin Luo and Fang Lin Luo, “Advanced DC/DC Converters”, CRC Press, New York, 1st Edition, 2013.
3. Andrzej M. Trzynadlowski, “Introduction to Modern Power Electronics”, Wiley Publication, 3rd Edition, 2016.
4. Simon Ang, Alejandro Oliva, “Power-Switching Converters”, CRC Press, 3rd Edition, 2010.

Reference Books

1. FredeBlaabjerg and Zhe Chen, “Power Electronics for Modern Wind Turbines”, Morgan & Claypool Publishers series, United States of America, 1st Edition, 2006.
2. Jai P. Agarwal, “Power Electronics: Converters, Applications, and Design”, Prentice Hall, 3rd Edition, 2000.
3. M. D. Singh and K. B Khachandani, “Power Electronics”, McGraw-Hill Education, 2nd Edition, 2017.

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3. https://storage.googleapis.com/uniquecourses/online.html.
4. https://www.tutorialspoint.com/power_electronics/power_electronics_matrix_converters.htm
5. https://www.youtube.com/user/cecedusat

COs/POs/PSOs Mapping

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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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U19EEE82	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 on 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 different 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 and 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 - Features - 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.

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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.

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4. C. L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International, 3^{rd} Edition, 2015.
5. J.B. Gupta, “Utilization of Electrical Power and Electric Traction”, S. K. Kataria & Sons publications, 10^{th} Edition, 2019.
6. R. B. Brooks, “Electric Traction Hand Book”, Sir Isaac Pitman and sons Ltd, London, 1^{st} Edition, 1954.

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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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U19EEE83

SOFT COMPUTING TECHNIQUES

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To gain knowledge on the basics of artificial neural network.
- To model and control neural control schemes.
- To study about Fuzzy Logic, Various fuzzy systems and their functions
- To Understand different soft computing tools to solve real life problems
- To learn about feature hybrid control schemes.

Course Outcomes

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

CO1 - Survey various neural network architectures. **(K3)**
CO2 - Get knowledge on modelling and control of systems using neural network. **(K2)**
CO3 - Gain knowledge on basics of fuzzy systems. **(K1)**
CO4 - Acquire knowledge on modelling and control of fuzzy control schemes. **(K2)**
CO5 - Implement hybrid control schemes for real time applications. **(K2)**

UNIT I ARTIFICIAL NEURAL NETWORK (9 Hrs)

Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

UNIT II NEURAL NETWORKS FOR MODELING AND CONTROL(9 Hrs)

Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox.

UNIT III FUZZY SET THEORY (9 Hrs)

Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

UNIT IV FUZZY LOGIC FOR MODELING AND CONTROL (9 Hrs)

Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox

UNIT V HYBRID CONTROL SCHEMES (9 Hrs)

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine– Case study – Familiarization with ANFIS toolbox.

Text Books

1. Laurence Fausett, “Fundamentals of Neural Networks”, Pearson Education India, 1st Edition, 2004.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 3rd Edition, 2011.

Reference Books

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989.
2. W. T. Millon, R. S. Sutton, P. J. Webrose, “Neural Networks for Control”, MIT press, 2nd Edition, 2010.
3. EthemAlpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series”', MIT Press, 2nd Edition, 2010.
4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2006

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

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

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U19EEE84	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.

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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

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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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U19EEE85	PRINCIPLES OF VIRTUAL INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the various techniques of interfacing of external instruments of PC.
- To study the various graphical programming environment in virtual instrumentation.
- To study a 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 using LabVIEW. **(K4)**
CO3 - Create simple measurement system using LabVIEW programs. **(K4)**
CO4 - Demonstrate the program in LabVIEW for system monitoring, processing and controlling operations **(K4)**
CO5 - Comply the basics of interfacing and programming using related hardware **(K3)**

UNIT I INTRODUCTION (9 Hrs)
Virtual Instrumentation and LabVIEW - Evolution of LabVIEW - Difference between LabVIEW and conventional languages - Sequencing and data flow - Graphical programming.

UNIT II LABVIEW PROGRAMMING TECHNIQUES (9 Hrs)
Front panel - Block diagram - VIs - Sub-VIs - Simple examples - Looping: For loop, while loop - Shift registers - case and sequence; structures, formula nodes. Arrays - Clusters, charts and graphs - Local and global variables - Property node, string and file I/O. publishing measurement data in the web

UNIT III DATA ACQUISITION (9 Hrs)
DAQ – Components - Buffers - Triggering - Analog I/O - Digital I/O - Counters and timers - DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

UNIT IV INSTRUMENT CONTROL (9 Hrs)
VI Chassis requirements. Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, compact RIO - Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office - Industrial applications, VISA and IVI.

UNIT V APPLICATION OF VIRTUAL INSTRUMENTATION (9 Hrs)
VI toolsets, Distributed I/O modules 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. Sanjay Gupta, Joseph John, “Virtual Instrumentation using LabVIEW”, Tata McGraw-Hill, 2nd Edition, 2010.
2. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, PHI Learning, 1st Edition, 2010.

Reference Books

1. Lisa K Wells, Jeffrey Travels, “LabVIEW for everyone”, Prentice Hall, 3rd Edition, 2009.
2. S. Gupta, J.P. Gupta, “PC interfacing for data acquisition and process control”, Instrument Society of America, 2nd Edition, 1994.
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COs/POs/PSOs Mapping

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2	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2
3	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2
4	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2
5	3	3	3	3	2	-	-	-	-	-	-	1	3	3	2

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

(DR.S. ANBUMALAR)

U19EEE86	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.

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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.

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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

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	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)

U19EEE87	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.

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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

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	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

(DR.S. ANBUMALAR)

U19EEE88	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.

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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.

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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

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	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

(DR.S. ANBUMALAR)

U19EEE89	ROBOTICS AND CONTROL	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce basic robotic terminologies.
- To illustrate the functions of the basic components of a Robot.
- To introduce manipulator dynamics and gripper types.
- To illustrate kinematics and path planning.
- To introduce dynamics and control operation.

Course Outcomes

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

CO1 - Outline the anatomy of the Robot. **(K2)**
CO2 - Represent the kinematic mathematical modeling of robot. **(K2)**
CO3 - Gain knowledge on manipulator and gripper operation. **(K2)**
CO4 - Develop kinematic and path planning equations for standard configurations. **(K5)**
CO5 - Familiarize in various control schemes of Robotics control. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II MODELING OF ROBOTS (9 Hrs)

Mechanical structure and notations – Description of links and joints – kinematics modeling of the manipulator – Denavit - Haternberg notation – Kinematic relationship between adjacent links – Manipulator transformation matrix – Inverse matrix

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION (9 Hrs)

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING (9 Hrs)

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS (9 Hrs)

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model –Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Multiple robots – machine interface – robot cell design – selection of robot – applications.

Text Books

1. Saeed B Niku, "Introduction to Robotics Analysis, Control, Applications", John Wiley and Sons, 2nd Edition 2010.
2. Mittal R K and Nagarath I J, "Robotics and Control", Tata McGraw Hill, 1st Edition 2005.
3. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.

Reference Books

1. Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, 6th Edition 2010.
2. Spyros G Tzafestas, "Introduction to Mobile Robot Control", Elsevier Science, 1st Edition 2018
3. K. K.AppuKuttan, "Robotics", I K International Publication, 1st Edition 2007.
4. Bijoy K. Ghosh, T. J. Tarn, Ning Xi, "Control in Robotics and Automation: Sensor Based Integration", Academic Press, 2nd Edition, 2011
5. Richard D Klafter, Thomas A.Chmielewski and Michael Negin, "Robotic Engineering: An Integrated approach", Prentice Hall of India, New Delhi, 1st Edition, 1989.
6. John J. Craig, "Introduction to Robotics, Mechanics and Control", Addison – Wesley Publication, 3rd Edition 2018

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2. https://robotacademy.net.au/masterclass/introduction-to-robotics/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/
4. https://see.stanford.edu/course/cs223a
5. https://www.coursera.org/learn/mobile-robot#syllabus

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	2	1	1
2	3	2	2	3	-	-	-	-	-	-	-	1	2	1	1
3	3	2	2	3	-	-	-	-	-	-	-	1	2	1	1
4	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1
5	3	2	2	3	-	-	-	-	-	-	-	1	1	1	1

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

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OPEN ELECTIVE

U19ECO41	ENGINEERING COMPUTATION WITH MATLAB (Common to ICE, EEE, MECH, CIVIL, BME, 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 Little Field, "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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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

(DR.S. ANBUMALAR)

		L	T	P	C	Hrs
U19ECO42	**CONSUMER ELECTRONICS** (Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	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”, Pearson Education India, copyright 2008.
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”, New Age International Publication (P) Ltd, 5th Edition, 2015.

Reference Books

1. Gupta R.G., “Audio video systems”, Tata McGraw Hill, New Delhi, India, 2nd Edition, 2017.
2. Whitaker Jerry & Benson Blair, “Mastering Digital Television”, McGraw-Hill Professional, 2006
3. Whitaker Jerry & Benson Blair, “Standard handbook of Audio engineering”, 2nd Edition, McGraw-Hill Professional, 2002.

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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
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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

(DR.S. ANBUMALAR)

U19CSO41	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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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

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	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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U19CSO42	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, 3rd Edition, 2009.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 3rd 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, 3rd Edition, 2011.
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.

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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

(DR.S. ANBUMALAR)

U19CSO43	PROGRAMMING IN JAVA (Common to ECE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain and explore the knowledge of Java programming.
- To know the principles of inheritances and packages.
- To learn about the usage of interfaces in Java.
- To gain and explore the event handling in Java.
- To get familiarized to the interfaces generic programming, multithreading concepts.

Course Outcomes

After completion of the course, the 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 and package in relevant applications. **(K3)**
CO3 - Construct Java programs using interfaces. **(K3)**
CO4 - Build Java applications using Event Handling. **(K3)**
CO5 - Create Java applications using multithreading and generic programming. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (9 Hrs)

The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – Operators - Control statements - Type conversion and casting – Objects and classes in Java – Defining classes – Methods - Access specifiers – Static members – Constructors – Finalize method.

UNIT II INHERITANCE AND PACKAGES (9 Hrs)

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – Class hierarchy – Polymorphism – Dynamic binding – Final keyword – Abstract classes

UNIT III INTERFACES (9 Hrs)

The Object class – Reflection – Interfaces – Object cloning – Inner classes – Proxies - I/O Streams - Graphics programming – Frame – Components – Working with 2D shapes.

UNIT IV EVENT HANDLING (9 Hrs)

Basics of event handling – Event handlers – Adapter classes – Actions – Mouse events – AWT event hierarchy – Introduction to Swing – Model-View-Controller design pattern – Buttons – Layout Management – Swing Components – Exception handling – Exception hierarchy – Throwing And catching exceptions.

UNIT V GENERIC PROGRAMMING AND MULTITHEARDING (9 Hrs)

Motivation for generic programming – Generic classes – Generic methods – Generic code and virtual machine – Inheritance and generics – Reflection and generics - Multi-threaded programming – Interrupting threads – Thread States – Thread properties – Thread synchronization – Executors – Synchronizers. Enumeration **–** Autoboxing – Generics.

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. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Sun Microsystems Press, Eighth Edition, 2008.
4. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.

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1. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.
2. H.M.Dietel and P.J.Dietel, “Java How to Program”, Pearson Education/PHI, 11th Edition, 2017.
3. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education,8th Edition, 2008.
4. Java for Programmers, P.J. Dietel and H.M Dietel, Pearson Education (OR) JAVA:
5. Programming in Java, S.Malhotra and S.Choudary, Oxford Univ. Press.

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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)		
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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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U19ITO41	DATABASE SYSTEM: DESIGN & DEVELOPMENT (Common to EEE, ECE, ICE, 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, 7th Edition – McGraw-Hill Higher Education, International Edition, 2019.
2. RamezElmasri 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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1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.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
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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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U19ITO42	R PROGRAMMING (Common to EEE, ECE, ICE, 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.

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2. https://www.r-project.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	-	-	-	-	-	-	-	-	2	-	1
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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U19MEO41	RAPID PROTOTYPING (Common to EEE, ECE, ICE, CIVIL, BME)	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.

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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

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U19MEO42

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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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

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U19MEO43	POWER PLANTS FOR ELECTRICAL 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.

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1. https://swayam.gov.in/nd1_noc20_me10/preview
2. https://swayam.gov.in/nd1_noc20_me87/preview
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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)

U19CEO41	ENERGY AND ENVIRONMENT (Common to EEE, ECE, MECH, BME, IT, Mechatronics)	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

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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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	3	3	3	2	3	2	3	3	3	3
2	3	3	2	3	2	3	3	3	2	3	2	3	3	3	3
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)

U19CEO42	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, 4th Edition Tata McGraw hill limited ,2005
2. Basic civil engineering : sateeshgopi ,Pearson, 2010
3. Building Science: Concepts and Applications: Jens Pohl, Wiley-Blackwell, 2011

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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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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

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	3	3	3	2	3	3	3	3	3	3
2	3	3	2	3	1	3	3	3	2	3	3	3	3	3	3
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

(DR.S. ANBUMALAR)

U19BMO41	**MEDICAL ELECTRONICS** (Common to EEE, ECE, CSE, IT, ICE, MECH, Mechatronics)	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 McGraw-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. Mandeepsingh, “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.RajaRao, SujoyK.Guha, “Principles of Medical Electronics and Biomedical Instrumentation”, Universities Press, 2010.

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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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U19BMO42	TELEMEDICINE (Common to EEE, ECE, CSE, IT, ICE)	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.

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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)

U19CCO41	**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 ShamkantNavathe, 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.
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.

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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

(DR.S. ANBUMALAR)

Course Code	Course Title	L	T	P	C	Hrs
U19CCO42	**INTRODUCTION TO COMMUNICATION SYSTEMS** (Common to EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics)	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, McGraw 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.

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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

(DR.S. ANBUMALAR)

U19HSO51

PRODUCT DEVELOPMENT AND DESIGN

(Common to all Branches)

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. **(K3)**

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 Edition.
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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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	-	-	2
2	1	-	2	-	3	-	-	-	-	-	-	3	-	-	2
3	1	-	3	-	2	-	-	-	-	-	-	2	-	-	2
4	3	-	1	-	3	-	-	-	-	-	-	1	-	-	2
5	1	-	3	-	3	-	-	-	-	-	-	2	-	-	2

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

(DR.S. ANBUMALAR)

U19HSO52

INTELLECTUAL PROPERTY AND RIGHTS

(Common to all Branches)

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.

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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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U19HSO53	MARKETING MANAGEMENT AND RESEARCH (Common to all Branches)	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.

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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	-	1
2	-	1	2	-	1	-	3	-	-	2	-	1	1	-	1
3	-	-	1	-	1	-	-	-	2	1	-	1	1	-	1
4	-	3	2	2	-	1	-	1	1	2	-	1	1	-	1
5	-	2	2	1	2	2	-	2	2	2	-	1	1	-	1

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

(DR.S. ANBUMALAR)

U19HSO54	PROJECT MANAGEMENT FOR ENGINEERS (Common to all Branches)	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, 6^{th} Edition, 2017.
2. Harold Kerzner, “Project Management: A systems approach to Planning, Scheduling and Controlling”, John Wiley & Sons, 12^{th} 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, 9^{th} Edition, 2019.
3. B C Punmia by K K Khandelwal. “Project Planning and Control with PERT and CPM”, Laxmi Publications Private Limited, 4^{th} Edition, 2016.
4. Hira N Ahuja, S. P. Dozzi, S. M. Abourizk. “Project Management”, Wiley India Pvt Ltd, 2^{nd} Edition, 2013.
5. PMI, “A guide to Project Management Body of Knowledge”, Project Management Institute, 6^{th} Edition, 2017.

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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)

U19HSO55

FINANCE FOR ENGINEERS
(Common to all Branches)

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.

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3. https://finance.yahoo.com/
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6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
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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)

		L	T	P	C	Hrs
U19ECO63	**ELECTRONIC PRODUCT DESIGN AND PACKAGING** (Common to EEE, CSE, IT, ICE, MECH, BME, Mechatronics)	**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 IV 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

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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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	-	-	-	1	-	-	2	1	1
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)

U19ECO64

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

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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

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	-	-	2	1	1
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)

U19CSO64	PLATFORM TECHNOLOGY (Common to EEE, ECE, ICE, MECH, CIVIL, BME)	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 the concept of .NET Framework. **(K2)**
CO2 - Develop, implement and creating Applications with C#. **(K4)**
CO3 - Evaluate various graphics and window forms. **(K5)**
CO4 - Integrating front end applications with Database connectivity**. (K3)**
CO5 - Classifying various Enterprise applications into real world problems. **(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.

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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)

U19CSO65	**GRAPHICS DESIGNING** (Common to EEE, ECE, ICE, MECH, CIVIL, BME)	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.

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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.
4. Peter Bauer, “Photoshop CC for Dummies”, Wiley, 2013.
5. Scott Onstott, “Enhancing CAD Drawings with Photoshop”, Wiley,2006

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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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U19ITO63	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.

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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

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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

(DR.S. ANBUMALAR)

U19ITO64 **MOBILE APP DEVELOPMENT**

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

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. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

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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

(DR.S. ANBUMALAR)

U19MEO64	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

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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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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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U19MEO65	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

1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Dr Paul Trott, “Innovation Management and New Product Development”, Pearson Publication, 6th Edition, 2017.
3. 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.

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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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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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U19CEO63	DISASTER MANAGEMENT (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		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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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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U19CEO64	AIR POLLUTION AND SOLID WASTE MANAGEMENT (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		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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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
2	3	3	2	3	3	3	3	2	3	2	2	3	-	-	1
3	3	3	3	2	2	2	3	3	3	3	2	3	-	-	1
4	2	3	2	3	2	3	2	3	3	2	2	3	-	-	1
5	3	3	3	2	3	3	3	3	3	2	3	3	-	-	1

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

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U19BMO63	**BIOMETRIC SYSTEMS** (Common to EEE, ECE, CSE, IT, ICE, 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.

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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.

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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

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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

(DR.S. ANBUMALAR)

U19BMO64	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

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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.

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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

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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)

U19CCO63	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.

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Reference Books

1. Douglas E. Comer, “Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture”, 6^{th} Edition, Pearson Education, 2013.
2. Nader F. Mir, “Computer and Communication Networks”, 2^{nd} 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”, 2^{nd} Edition , Wiley Publishing Inc, 2011

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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)

U19CCO64	**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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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)

U19ADO61	PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL)	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

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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

(DR.S. ANBUMALAR)

U19ADO62	DATA SCIENCE APPLICATION OF VISION (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, 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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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)

U19ECO75	IOT AND ITS APPLICATIONS (Common to EEE, ICE, CSE, MECH, IT, CIVIL)	L	T	P	C	Hrs
		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 architecture and their elements of IoT.
- To understand the concepts of integration of devices and data's.
- To acquire the knowledge about remotely monitor data and control devices.
- To develop skills required to build real-time IoT based projects.

Course Outcomes

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

CO1 - Understand internet of Things and its hardware and software components.**(K2)**
CO2 - Demonstrate the Interfacing of I/O devices, sensors and communication modules.**(K3)**
CO3 - Understand the concepts of remotely monitor data and control devices.**(K2)**
CO4 - Build and deploy an various architecture with their elements.**(K3)**
CO5 - Can develop real time IoT based projects.**(K3)**

UNIT I INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

The technology of the internet of things, making the internet of things, Elements of an IoT ecosystem, design principles for connected devices, Web thinking for connected devices.

UNIT II ARCHITECTURE OF IOT (9 Hrs)

Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

UNIT III ELEMENTS OF IOT (9 Hrs)

Hardware Components: Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.

Software Components: Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT IV IOT APPLICATION 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, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Text Books

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things, A Hands on Approach", University Press, 3rd Edition, 2018.
2. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2nd Edition, 2017.
3. Dr. SRN Reddy, RachitThukral 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. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications,1st Edition, 2013
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.

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

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

(DR.S. ANBUMALAR)

U19ECO76	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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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

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	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)

U19CSO76	ARTIFICIAL INTELLIGENCE (Common to EEE, ICE, CIVIL, MECH)	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.

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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.

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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

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	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)

U19CSO77	CLOUD TECHNOLOGY AND ITS APPLICATIONS (Common to EEE, ICE, MECH, CIVIL, BME, Mechatronics)	L	T	P	C	Hrs
		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)		
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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	2
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)

U19ITO76	AUTOMATION TECHNIQUES & TOOLS - DEVOPS (Common to EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics)	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)

U19ITO77 **AUGMENTED AND VIRTUAL REALITY**
(Common to EEE, ICE, MECH, CIVIL, BME)

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

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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

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	-	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

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U19ICO75	INDUSTRIAL AUTOMATION (Common to EEE, ECE, CSE, MECH, IT, CIVIL, 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

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	1	-	-	1	-	-	-	1	1	2	2	3	2
2	3	3	1	-	-	1	-	-	-	1	1	2	2	3	2
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

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U19ICO76	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/

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COs/POs/PSOs Mapping

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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)

		L	T	P	C	Hrs
U19MEO76	**PRINCIPLES OF HYDRAULIC AND PNEUMATIC SYSTEM** (Common to EEE, ECE, ICE, CIVIL)	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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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

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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)

U19MEO77	SUPPLY CHAIN MANAGEMENT (Common to EEE, ECE, CIVIL, Mechatronics)	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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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

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U19CEO75

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.

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1. https://nptel.ac.in/courses/105/102/105102175/
2. https://nptel.ac.in/courses/105/102/105102195/
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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	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)

U19CEO76	GLOBAL WARMING AND CLIMATE CHANGE (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	L	T	P	C	Hrs
		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, 2nd 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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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)

U19BMO75

INTERNET OF THINGS FOR HEALTHCARE
(Common to EEE, ECE, ICE)

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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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

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	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)

U19BMO76

TELEHEALTH TECHNOLOGY

(Common to EEE, ECE, ICE)

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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3. https://youtu.be/ZfDheAo4nCo
4. https://youtu.be/d87Iyj4rCNg
5. https://youtu.be/QfAoYUsTvtk

COs/POs/PSOs Mapping

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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)

		L	T	P	C	Hrs
U19CCO75	**DATA SCIENCE USING PYTHON** (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	**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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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

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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)

U19CCO76	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.

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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)

U19ADO73	**DATA SCIENCE APPLICATION OF NLP** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, 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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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	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)

U19ADO74	ARTIFICIAL INTELLIGENCE APPLICATIONS (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, 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

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	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)