You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119.

Faculty of Electrical Engineering

REGULATIONS – 2021

CURRICULUM

B.E.-ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

I-VIII Semesters

For the students admitted in 2021 - 2025 Batch

Vision of the department

- To promote the department of Electrical and Electronics Engineering as a pioneer in education and research by imparting quality education, creating and upgrading the academic facilities and inculcating professional values to the students to face the challenges in the dynamic global society.

Mission of the department

- To attain utmost qualities of teaching-learning process and provide a vibrant environment for the students to exhibit their fullest potential in the field of Electrical and Electronics Engineering.
- To improve research and development skills among students towards providing technical solutions with ethical values to meet social challenges.
- To develop the students to face the technological requirements of the industry with professional values and make them employable and to impart the spirit of entrepreneurship for their successful career.

Program Education Objectives (PEOs)

PEO1: To provide a strong foundation for students to have a successful career in electrical and its related fields and to pursue higher education and research.

PEO2 : To improve their mathematical and scientific knowledge to solve emerging real world problems related to power, electronics, control systems, field theory and signal processing and will use their communication and intellectual skills for execution of complex technological solutions.

PEO3: Tofulfil the needs of society in solving technical problems using engineering principles, tools and practices, in an ethical and responsible manner, in service to the society.

PEO4: To develop their self-learning capability and adaptability to encounter various complex practical problems in multi-disciplinary engineering projects effectively and undertake leadership roles when appropriate.

PEO5: To promote students' awareness of lifelong learning to enhance and maintain professional skills.

Program Specific Outcomes (PSOs)

Our Graduate will be able to:

PSO1: Identify, understand and analyze the problems in the field of electrical and electronics engineering by applying the principles of mathematics, science and engineering.

PSO2: Apply the acquired knowledge of hardware and software tools along with the analytical skills to work with electrical and electronic equipment and arrive at optimal solutions to suit industrial needs.

PSO3: Demonstrate core competencies and solve engineering problems by performing research in the areas of electrical drives, control and power systems for the sustainable development of the society.

PSO4: To take up roles in a team, develop managerial skills, and contributes towards the electrical community globally.

Program Outcomes (POs):

a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b) **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **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.

d) **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.

e) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **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.

g) **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.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engieering practice.

i) **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) **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.

k) **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.

l) **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.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

PO/UNDERGRADUATE SUBJECTS MAPPING

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES (PO)											
		a	b	c	d	e	f	g	h	i	J	k	l
SEM I	**THEORY**												
	Communicative English									✓	✓		✓
	Engineering Mathematics- I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Problem solving and Python Programming	✓	✓	✓	✓	✓							
	Engineering Graphics			✓	✓								
	PRACTICALS												
	Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
SEM II	**THEORY**												
	Professional English									✓	✓		✓
	Engineering Mathematics – II	✓	✓	✓		✓							✓
	Physics for Electronics Engineering	✓	✓	✓		✓		✓					✓
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Principles of Electrical, Electronics and Communication Engineering	✓	✓	✓	✓	✓							✓
	PRACTICALS												
	Engineering Practice Laboratory	✓		✓	✓	✓	✓				✓		
	Principles of Electrical and Electronic devices Laboratory	✓	✓	✓	✓	✓							✓
SEM III	**THEORY**												
	Transforms and Partial Differential Equations	✓	✓			✓							✓
	Electromagnetic Theory	✓	✓	✓	✓	✓					✓		✓
	Measurements and Instrumentation	✓	✓	✓	✓	✓							✓
	Electric Circuit Analysis	✓	✓	✓	✓	✓							✓
	Analog Electronics	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	PRACTICALS												
	Electric Circuits Laboratory	✓	✓	✓	✓	✓							✓
	Analog and Digital Electronics Laboratory	✓			✓	✓						✓	✓

SEM IV	**THEORY**												
	Statistics and Numerical Methods	✓	✓	✓									✓
	Electrical Machines – I	✓	✓	✓	✓	✓					✓		
	Generation,Transmission and Distribution	✓	✓	✓	✓	✓		✓					✓
	Control Systems	✓	✓	✓	✓	✓							✓
	Fundamentals of Data Structures in C (Lab Integrated)			✓	✓	✓							✓
	Open Elective - I												
	Audit Course*												
	PRACTICALS												
	Electrical Machines Laboratory – I	✓			✓	✓						✓	✓
	Control and Instrumentation Laboratory			✓	✓	✓	✓			✓	✓		
	Professional Skills Laboratory									✓	✓	✓	
SEM V	**THEORY**												
	Electrical Machines – II	✓	✓	✓	✓	✓		✓					✓
	Power System Analysis	✓	✓	✓	✓	✓		✓					✓
	Power Electronics	✓	✓	✓	✓	✓		✓					
	Microprocessors and Microcontrollers	✓		✓		✓			✓	✓		✓	✓
	Professional Elective- I												
	PRACTICALS												
	Electrical Machines Laboratory– II	✓	✓	✓	✓	✓							✓
	Power Electronics and Drives Laboratory	✓		✓	✓						✓	✓	✓
	Microprocessors and Microcontrollers Laboratory	✓		✓	✓						✓	✓	✓
SEM VI	**THEORY**												
	Solid State Drives	✓	✓	✓	✓	✓		✓					
	Renewable Energy Systems	✓	✓	✓	✓	✓		✓					✓
	Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Embedded Systems (Lab Integrated)	✓		✓		✓			✓	✓		✓	✓
	Object Oriented Programming (Lab Integrated)			✓	✓	✓							✓
	Professional Elective- II												
	PRACTICALS												
	Renewable Energy Systems Laboratory	✓		✓	✓						✓	✓	✓
	Mini Project	✓		✓	✓						✓	✓	✓

SEM VII	THEORY												
	High Voltage Engineering	✓	✓	✓	✓	✓		✓					✓
	Power System Operation and Control	✓	✓	✓	✓	✓		✓					✓
	Protection and Switchgear	✓		✓		✓	✓					✓	✓
	Electric Vehicle Mechanics and Control(Lab Integrated)	✓	✓	✓	✓	✓		✓					✓
	Professional Elective- III												
	Open Elective - II												
	PRACTICALS												
	Power System Simulation Laboratory	✓		✓	✓						✓	✓	✓
	Project Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VIII	THEORY												
	Professional Elective- IV												
	Professional Elective- V												
	PRACTICALS												
	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVE

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES (PO)											
		a	b	c	d	e	f	g	h	i	j	k	l
ELECTIVE I	Biomedical Instrumentation	✓		✓	✓	✓	✓						
	Advanced Control System		✓	✓					✓	✓			
	Principles of Robotics	✓		✓		✓							
	Power plant Engineering			✓	✓	✓		✓	✓	✓			
	Visual Programming	✓	✓		✓	✓							
	Fundamentals of Operating Systems												
	Intellectual Property Rights								✓		✓		✓
	Disaster Management			✓	✓	✓	✓						
ELECTIVE II	Design of Electrical Apparatus	✓		✓	✓	✓		✓					
	Special Electrical Machines	✓		✓	✓	✓			✓				
	Modern Power Converters	✓		✓	✓	✓		✓					
	EHVAC Transmission	✓		✓	✓	✓			✓				✓
	Power Systems Stability				✓	✓							
	Line Commutated and Active Rectifiers	✓		✓	✓	✓			✓				✓
	Soft Computing Techniques	✓		✓		✓							
	Human Rights	✓	✓	✓					✓	✓			✓

ELECTIVE III	System Identification and Adaptive Control	✓	✓	✓		✓							
	Advanced Electrical Drives	✓	✓	✓	✓	✓		✓					✓
	Power Systems Transients		✓		✓	✓							
	Artificial Intelligence and Machine Learning	✓		✓		✓							
	Computer Architecture	✓		✓		✓							
	CMOS VLSI Design	✓	✓	✓			✓	✓					
	Operational Research		✓	✓					✓	✓			
ELECTIVE IV	Electric Energy Utilization and Conservation	✓	✓	✓	✓	✓		✓					✓
	Flexible AC Transmission Systems	✓	✓	✓		✓					✓		✓
	Power Quality	✓		✓	✓	✓			✓				✓
	SMPS and UPS	✓		✓		✓							
	Micro Electro Mechanical Systems	✓		✓		✓							
	Professional Ethics in Engineering	✓	✓		✓			✓				✓	✓
	Principles of Management					✓	✓			✓			
ELECTIVE V	Energy Management and Auditing		✓			✓	✓	✓	✓	✓	✓		
	High Voltage Direct Current Transmission	✓	✓	✓					✓	✓			✓
	Microcontroller Based System Design	✓	✓	✓					✓	✓			✓
	Smart Grid	✓	✓	✓					✓	✓			✓
	Testing of Electric Vehicles												
	Intelligent Control of Electric Vehicles												
	Data Exploration and Visualization	✓	✓	✓			✓	✓					
	Fundamentals of Nano Science	✓	✓	✓			✓	✓					

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**30**	**17**	**1**	**12**	**24**
Induction Training			**MAC**	**2 Weeks**				

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6.	EE1271	Principles of Electrical, Electronics and Communication Engineering	PCC	3	3	0	0	3
PRACTICALS								
7.	GE1207	Engineering Practice Laboratory	ESC	4	0	0	4	2
8.	EE1278	Principles of Electrical and Electronic devices Laboratory	PCC	4	0	0	4	2
TOTAL				**27**	**18**	**1**	**8**	**23**
Personality & Character Development			**MAC**	**1 Week**				

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2.	EE1301	Electromagnetic Theory	PCC	3	2	1	0	3
3.	EE1302	Measurements and Instrumentation	PCC	3	3	0	0	3
4.	EE1371	Electric Circuit Analysis	PCC	3	2	1	0	3
5.	EE1372	Analog Electronics	PCC	3	3	0	0	3
6.	EE1373	Digital Logic Circuits	PCC	3	2	1	0	3
PRACTICALS								
8.	EE1381	Electric Circuits Laboratory	PCC	4	0	0	4	2
9.	EE1391	Analog and Digital Electronics Laboratory	PCC	4	0	0	4	2
TOTAL				**27**	**15**	**4**	**8**	**23**
Career Competency Development- I: BEC Training				**1 Week**				

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1401	Statistics and Numerical Methods	BSC	4	3	1	0	4
2.	EE1401	Electrical Machines – I	PCC	3	2	1	0	3
3.	EE1402	Generation, Transmission and Distribution	PCC	3	3	0	0	3
4.	EE1471	Control Systems	PCC	3	2	1	0	3
5.	CS1406	Fundamentals of Data structures in C (Lab Integrated)	ESC	5	3	0	2	4
6.		Open Elective- I	OEC	3	3	0	0	3
7.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
PRACTICALS								
8.	EE1481	Electrical Machines Laboratory– I	PCC	4	0	0	4	2
9.	EE1482	Control and Instrumentation Laboratory	PCC	4	0	0	4	2

10.	HS1310	Professional Skills Laboratory	HSMC	2	0	0	2	1
TOTAL				**33**	**18**	**3**	**12**	**25**
Career Competency Development- II: C Programming				**1 Week**				

*Audit course is a Non-credit Course (Student shall select one course from the list given under AC).

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1501	Electrical Machines – II	PCC	3	2	1	0	3
2.	EE1502	Power System Analysis	PCC	3	2	1	0	3
3.	EE1571	Power Electronics	PCC	3	3	0	0	3
4.	EE1572	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
5.		Professional Elective- I	PEC	3	3	0	0	3
PRACTICALS								
6.	EE1581	Electrical Machines Laboratory– II	PCC	4	0	0	4	2
7.	EE1582	Power Electronics and Drives Laboratory	PCC	4	0	0	4	2
8.	EE1591	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
9.	EE1592	Internship –I (2 Weeks)#	EEC					1
TOTAL				**27**	**13**	**2**	**12**	**22**
Career Competency Development- III: (Advanced C Programming)				**1 Week**				

#Students should undergo 2 Weeks Internship during IV Semester summer vacation which will be evaluated during V Semester.

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1601	Solid State Drives	PCC	3	3	0	0	3
2.	EE1602	Renewable Energy Systems	PCC	3	3	0	0	3
3.	EE1671	Digital Signal Processing	PCC	3	2	1	0	3
4.	EE1672	Embedded Systems (Lab Integrated)	ESC	5	3	0	2	4
5.	DS1302	Object Oriented Programming (Lab Integrated)	ESC	5	3	0	2	4
6.		Professional Elective- II	PEC	3	3	0	0	3

PRACTICALS								
7.	EE1681	Renewable Energy Systems Laboratory	PCC	4	0	0	4	2
8.	EE1682	Mini Project	EEC	4	0	0	4	2
TOTAL				**30**	**17**	**1**	**12**	**24**
Value Added Course**						**1 Week**		**2**
Career Competency Development-IV:(Aptitude & Data Structures)						**4 Weeks**		

****Students have to undergo Value added Course(VAC) during VI Semester and the credits earned through VAC shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree.**

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1701	High Voltage Engineering	PCC	3	3	0	0	3
2.	EE1702	Power System Operation and Control	PCC	3	3	0	0	3
3.	EE1703	Protection and Switchgear	PCC	3	3	0	0	3
4.	EE1704	Electric Vehicle Mechanics and Control (Lab Integrated)	PCC	5	3	0	2	4
5.		Professional Elective- III	PEC	3	3	0	0	3
6.		Open Elective – II	OEC	3	3	0	0	3
PRACTICALS								
7.	EE1781	Power System Simulation Laboratory	PCC	4	0	0	4	2
8.	EE1782	Project Phase I	EEC	2	0	0	4	2
TOTAL				**26**	**18**	**0**	**10**	**23**
Career Competency Development- V: (Company specific Training)						**1 Week**		

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective- IV	PEC	3	3	0	0	3
2.		Professional Elective- V	PEC	3	3	0	0	3
PRACTICALS								
3.	EE1881	Project Phase II	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL CREDITS-180

PROFESSIONAL ELECTIVE - I (V SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1501	Biomedical Instrumentation	PE	3	3	0	0	3
2.	EE1512	Advanced Control System	PE	3	3	0	0	3
3.	EE1513	Principles of Robotics	PE	3	3	0	0	3
4.	ME1703	Power Plant Engineering	PE	3	3	0	0	3
5.	CS1516	Visual Programming	PE	3	3	0	0	3
6.	CS1520	Fundamentals of Operating systems	PE	3	3	0	0	3
7.	GE1001	Intellectual Property Rights	PE	3	3	0	0	3
8.	CE1025	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - II (VI SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1621	Design of Electrical Apparatus	PE	3	3	0	0	3
2.	EE1622	Special Electrical Machines	PE	3	3	0	0	3
3.	EE1623	Modern Power Converters	PE	3	3	0	0	3
4.	EE1624	EHVAC Transmission	PE	3	3	0	0	3
5.	EE1625	Power Systems Stability	PE	3	3	0	0	3
6.	EE1626	Line Commutated and Active Rectifiers	PE	3	3	0	0	3
7.	EE1627	Soft Computing Techniques	PE	3	3	0	0	3
8.	GE1002	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - III (VII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1731	System Identification and Adaptive Control	PE	3	3	0	0	3
2.	EE1732	Advanced Electrical Drives	PE	3	3	0	0	3
3.	EE1733	Power Systems Transients	PE	3	3	0	0	3
4.	EE1734	Artificial Intelligence and Machine Learning	PE	3	3	0	0	3
5.	CS1304	Computer Architecture	PE	3	3	0	0	3
6.	EC1731	CMOS VLSI Design	PE	3	3	0	0	3
7.	MG1002	Operational Research	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - IV (VIII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1841	Electric Energy Utilization and Conservation	PE	3	3	0	0	3
2.	EE1842	Flexible AC Transmission Systems	PE	3	3	0	0	3
3.	EE1843	Power Quality	PE	3	3	0	0	3
4.	EE1844	SMPS and UPS	PE	3	3	0	0	3
5.	EE1845	Micro Electro Mechanical Systems	PE	3	3	0	0	3
6.	GE1003	Professional Ethics in Engineering	PE	3	3	0	0	3
7.	MG1001	Principles of Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - V (VIII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1851	Energy Management and Auditing	PE	3	3	0	0	3
2.	EE1852	High Voltage Direct Current Transmission	PE	3	3	0	0	3
3.	EE1853	Microcontroller Based System Design	PE	3	3	0	0	3
4.	EE1854	Smart Grid	PE	3	3	0	0	3
5.	EE1855	Testing of Electric Vehicles	PE	3	3	0	0	3
6.	EE1856	Intelligent control of Electric Vehicles	PE	3	3	0	0	3
7.	DS1816	Data Exploration and Visualization	PE	3	3	0	0	3
8.	GE1004	Fundamentals of Nano Science	PE	3	3	0	0	3

OPEN ELECTIVE - I (IV SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEE101	Introduction to PLC Programming	OE	3	3	0	0	3
2.	OCS103	Introduction to Cloud Computing	OE	3	3	0	0	3
3.	OCS104	Fundamentals of Database Design	OE	3	3	0	0	3
4.	OEC101	Introduction to Signals and Systems	OE	3	3	0	0	3
5.	OME101	Automotive Systems	OE	3	3	0	0	3

6.	OEI101	Sensors and Transducers	OE	3	3	0	0	3
7.	OEI104	Internet of Things	OE	3	3	0	0	3
8.	OCE101	Air Pollution and Control	OE	3	3	0	0	3

OPEN ELECTIVE - II (VII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEE102	Drone Technologies	OE	3	3	0	0	3
2.	OEE103	Industrial IoT and Industry 4.0	OE	3	3	0	0	3
3.	OCS105	Data Analytics with R Programming	OE	3	3	0	0	3
4.	OCS106	Data Communications and Networking	OE	3	3	0	0	3
5.	OEC102	Communication Systems	OE	3	3	0	0	3
6.	OME102	Design of Experiments	OE	3	3	0	0	3
7.	OME105	Product Design and Development	OE	3	3	0	0	3
8.	OME106	Testing of Materials	OE	3	3	0	0	3
9.	OME107	Vibration and Noise Control	OE	3	3	0	0	3
10.	OCH102	Process Modelling and Simulation	OE	3	3	0	0	3
11.	OMB104	Quality for Management Science	OE	3	3	0	0	3

AUDIT COURSE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC		2	0	0	0
2.	AD1002	Value Education	AC		2	0	0	0
3.	AD1003	Pedagogy Studies	AC		2	0	0	0
4.	AD1004	Stress Management by Yoga	AC		2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC		2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC		2	0	0	0
7.	AD1007	Essence of Indian knowledge Tradition	AC		2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC		2	0	0	0

VALUE ADDED COURSES

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EVA101	Modelling and Simulation of Solar PV System	VAC		1	0	2	2
2.	EVA102	FPGA and its applications to Power Converters	VAC		1	0	2	2
3.	EVA103	Industrial Power System Analysis Using ETAP	VAC		1	0	2	2
4.	EVA104	Design & Development of Real-Time EV Battery testing system	VAC		1	0	2	2
5.	EVA105	Electronics circuits design for Power Electronics	VAC		1	0	2	2
6.	EVA106	Proteus design suite Simulation Software	VAC		1	0	2	2

SUMMARY

B.E.-ELECTRICAL AND ELECTRONICS ENGINEERING											
S.No	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HSMC	3	6	--	1	--	--	--	--	**10**	**5.55**
2.	BSC	12	7	4	4	--	--	--	--	**27**	**15**
3.	ESC	9	5	--	4	--	8	--	--	**26**	**14.44**
4.	PCC	--	5	19	13	18	11	15	--	**81**	**45**
5.	PEC	--	--	--	--	3	3	3	6	**15**	**8.33**
6.	OEC	--	--	--	3	--	--	3	--	**6**	**3.33**
7.	EEC	--	--	--	--	1	2	2	10	**15**	**8.33**
8.	AC	--	--	--	--	--	--	--	--	**--**	**--**
	TOTAL	**24**	**23**	**23**	**25**	**22**	**24**	**23**	**16**	**180**	**100**

Board Chairman
(Dr.Jayarama Pradeep)

Dean-Academic
(Dr.G.Sreekumar)

Principal
(Dr.Vaddi Seshagiri Rao)

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9
Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		CO1
UNIT II	**GENERAL READING AND FREE WRITING**	**9**
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening **-** long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.		CO2
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		CO3
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	**9**
Reading- comprehension-reading longer texts- reading different types of texts-		CO4

magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		
UNIT V	**EXTENDED WRITING**	**9**
Reading: Reading for comparisons and contrast and other deeper levels of meaning – Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development- Phrasal verbs- fixed and semi-fixed expressions.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	J	k	l	1	2	3	4
CO1	0	0	0	0	0	0	0	0	2	3	0	0	0	0	3	0
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	0	0	0
CO3	0	2	0	3	0	0	0	0	0	2	0	0	3	0	1	0
CO4	0	0	0	0	0	0	0	0	2	2	0	0	1	0	2	0
C05	0	2	1	1	2	0	2	0	0	3	0	0	1	0	1	0

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	1	0	4

Objectives

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		**CO1**
UNIT II	**CALCULUS OF ONE VARIABLE**	**12**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		**CO2**
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.		**CO3**
UNIT IV	**INTEGRAL CALCULUS**	**12**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		**CO4**
UNIT V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., —Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.

CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	1	2	3	0	0	3	2	3	3	2	2	1	1
CO2	3	3	3	2	2	1	0	0	0	0	1	2	2	2	1	1
CO3	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1	1
CO4	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1	1
C05	3	3	3	2	1	1	0	0	0	0	1	2	2	1	1	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.		CO1

UNIT II	LASER AND FIBER OPTICS	9
Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.		CO2

UNIT III	THERMAL PHYSICS	9
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		CO3

UNIT IV	QUANTUM PHYSICS	9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		**CO4**
UNIT V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2019.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	2
C05	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3	2

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I	WATER AND ITS TREATMENT	9

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis. **CO1**

UNIT II	SURFACE CHEMISTRY AND CATALYSIS	9

Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC.

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation. **CO2**

UNIT III	PHASE RULE AND ALLOYS	9

Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process.

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze. **CO3**

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **CO4**

Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		
UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media., New Delhi., (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.

CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	1	1	1	2
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	1	2	2	2
C05	3	2	3	3	3	3	3	2	2	2	2	2	3	3	2	2

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**

UNIT II	INTRODUCTION TO PYTHON	9
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		**CO2**

UNIT III	CONTROL FLOW, FUNCTIONS AND STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**

UNIT IV	LISTS, TUPLES, DICTIONARIES	9
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list		**CO4**

Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	2	0	4	4

Objectives

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)	**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.	

UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**

UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**

UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		**CO3**

UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids		**CO4**

– Prisms, pyramids cylinders and cones.		
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces

CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	1	2	1	1	0	0	3	3	2	3	1	1	0	0
CO2	3	1	2	2	1	1	0	0	3	3	2	3	1	1	0	0
CO3	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0	0
CO4	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0	0
CO5	3	1	2	3	1	1	0	0	3	3	2	3	1	1	0	0

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	0	0	4	2

Objectives

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.	**CO1**
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	**CO2**
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	**CO3**
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	**CO4**
10. Find the most frequent words in a text of file using command line arguments.	
11. Demonstrate Exceptions in Python.	**CO5**
12. Applications**:** Implementing GUI using turtle, pygame.	
	TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford

University Press, 2019

2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Implement Python programs with conditionals and loops.
CO4	Read and write data from/to files in Python and applications of python.
CO5	Develop Python programs step-wise by defining functions and calling them.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2	2

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

Objectives

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS– PHYSICS

(A minimum of 5 experiments to be performed from the given list)	
1. Determination of Young's modulus of the material of the given beam by Non-	**CO1**
uniform bending method.	**CO1**
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO2**
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	**CO2**
4. Determination of dispersive power of prism using Spectrometer.	**CO2**
5. (a) Determination of wavelength and particle size using a laser.	
(b) Determination of numerical aperture and acceptance angle of an optical fibre.	**CO2**
(c) Determination of width of the groove of compact disc using laser	**CO1**
6. Determination of Young's modulus of the material of the given beam by uniform bending method.	**CO2**
7. Determination of energy band gap of the semiconductor.	**CO2**
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	**CO1**
DEMONSTRATION EXPERIMENT	
1. Determination of thickness of a thin sheet / wire – Air wedge method	

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)	
1. Estimation of HCl using Na_2CO_3 as primary standard and determination	**CO5**

of alkalinity in water sample. 2. Determination of total, temporary & permanent hardness of water by EDTA method. 3. Determination of DO content of water sample by Winkler's method. 4. Determination of chloride content of water sample by argentometric method. 5. Estimation of copper content of the given solution by Iodometry. 6. Determination of strength of given hydrochloric acid using pH meter. 7. Determination of strength of acids in a mixture of acids using conductivity meter. 8. Estimation of iron content of the given solution using potentiometer. 9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer. 10. Conductometric titration of strong acid vs strong base. **DEMONSTRATION EXPERIMENTS** 1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method). 2. Estimation of sodium and potassium present in water using flame photometer.	**CO5** **CO5** **CO3** **CO3** **CO3** **CO4** **CO4** **CO4** **CO4** **CO3** **CO5**
	TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students should be

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.

CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	1	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	1	2	1
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1	2
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	2	2	1

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	INTRODUCTION TO PROFESSIONAL ENGLISH	9
Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals-newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.		**CO1**

UNIT II	READING AND STUDY SKILLS	9
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		**CO2**

UNIT III	TECHNICAL WRITING AND GRAMMAR	9
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing- Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		**CO3**

UNIT IV	REPORT WRITING	9
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical		**CO4**

essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	0	0	0	0	0	0	0	1	2	3	0	0	0	0	1	3
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	1	2	3
CO3	0	2	0	3	0	0	0	0	1	2	0	0	0	1	2	3
CO4	0	0	0	0	1	0	0	0	2	2	0	0	0	2	1	3
C05	0	2	1	1	2	0	2	0	0	3	0	0	3	3	3	3

MA1202	ENGINEERING MATHEMATICS - II	L	T	P	C
(Common for all branches of B.E. / B. Tech Programmes Except AI-DS & AI-ML)		3	1	0	4

Objectives

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I	ORDINARY DIFFERENTIAL EQUATIONS	12
Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients		CO1
UNIT II	**VECTOR CALCULUS**	**12**
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals		CO2
UNIT III	**COMPLEX VARIABLES**	**12**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = Z + C$, CZ, $1/Z$ - Bilinear transformation		CO3
UNIT IV	**COMPLEX INTEGRATION**	**12**
Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi circular contour(excluding poles on the real line)		CO4
UNIT V	**LAPLACE TRANSFORMS**	**12**
Existence conditions – Transforms of elementary functions –Basic properties –		CO5

Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals — Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients	

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., —Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCE BOOKS

1. G Bali N., Goyal M. and Watkins C., —Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. —Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, —Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., —Advanced Engineering Mathematics —Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply various techniques in solving differential equations
CO2	Gradient, divergence and curl of a vector point function and related identities
CO3	Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification
CO4	Analytic functions, conformal mapping and complex integration
CO5	Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	1	0	0	0	0	1	2	2	1	1	1
CO2	3	3	3	1	1	1	0	0	0	0	2	1	2	1	1	1
CO3	3	3	3	2	1	1	0	1	0	0	1	1	1	1	1	0
CO4	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1	0
C05	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1	0

PH1253	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
	(Common to EEE, ECE, EIE)	3	0	0	3

Objectives

- Understand the transport properties of conducting materials and their modelling using classical and quantum theories,
- Comprehend the origin of magnetic and superconducting properties in different materials and their engineering applications,
- Grasp the principles of dielectric materials and its applications.
- Understand the key factors for effective design of an optoelectronic device by its energy efficiency, and
- Analyze the structure-property of nano materials and their applications.

UNIT - I	CONDUCTING MATERIALS	9
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.		**CO1**

UNIT - II	PHYSICS OF SEMICONDUCTOR DEVICES	9
Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N- type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport -Einstein's relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions – Zener diode as voltage regulator- Ohmic contacts – tunnel diode - Schottky diode- MOS Capacitor		**CO2**

UNIT - III	MAGNETIC AND DIELECTRIC MATERIALS	9
Origin of magnetic moment – Bohr magneton – Microscopic and macroscopic classification of magnetic materials : comparison of diamagnetism , para magnetism and ferro magnetism – Domain theory – Hysteresis (based on domain theory) – soft and hard magnetic materials – Ferrites – applications. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown.		**CO3**

UNIT - IV	OPTICAL MATERIALS	9
Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – excitons - quantum confined Stark effect – Quantum dot laser, Quantum well laser		**CO4**
UNIT - V	**NANODEVICES**	**9**
Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – resonant tunneling – quantum interference effects –mesoscopic structures – Coulomb blockade effects- Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics, Spintronic Devices : Spin Valve - Spin FET, Carbon nanotubes: Types ,Preparation- CVD, Properties and applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”,Springer, 2008
2. Adaptation by Balasubramanian, R, Callister “Material Science and Engineering”, Wiley India Pvt. Ltd., 2nd Edition,2014.
3. Mani.P , “Physics for Electronics Engineering”, Dhanam Publishers , 2017.
4. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., “Physics for Electronics Engineering and Information Science”, McGraw Hill Education (India) Private Limited, 2018.

REFERENCE BOOKS

1. Traugott Fischer , “Materials Science for Engineering Students” ,Ist Edition,Elsevier , 2009
2. Budinski, K.G. & Budinski, M.K. “Engineering Materials Properties and Selection”, Prentice Hall,2009.
3. Rogers, B., Adams, J.& Pennathur, S.“Nanotechnology: Understanding Small Systems”. CRC Press,2014
4. Hanson, G.W. “Fundamentals of Nanoelectronics”. Pearson Education,2009

5. Kwok Ng, Simon Sze, and Yiming Li ," Physics of Semiconductor Devices", 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on classical and quantum free electron theories and formation of energy band structures.
CO2	Gain knowledge on semiconducting devices and its applications.
CO3	Acquire knowledge on magnetic and superconducting materials and their applications.
CO4	Understand the relationship of optoelectronic materials and their applications in various domains.
CO5	Acquire knowledge about the nano structures and its applications

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**B**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**K**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	3	3	2	1
CO3	3	3	1	1	2	2	1	1	1	1	1	2	3	3	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	2	3
C05	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3	1

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – 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 – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity.		**CO1**

UNIT II	ENVIRONMENTAL POLLUTION	9
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		**CO2**

UNIT III	NATURAL RESOURCES	9
Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		**CO3**
UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**9**
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		**CO4**
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).

2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	2	1	2	1	2	1	3	2	2	2	2
CO2	1	2	3	3	1	3	3	2	1	2	1	3	2	2	1	2
CO3	2	2	2	1	2	2	1	2	1	2	1	3	2	2	3	2
CO4	1	1	3	2	2	2	3	3	2	2	1	2	1	2	2	2
C05	2	2	3	2	1	2	2	1	2	1	2	3	3	3	1	2

GE1205	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
	(Common to BioTech, CHEMICAL, EEE, EIE)	3	0	0	3

Objectives

- The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System

UNIT – I	SCOPE OF CIVIL AND MECHANICAL ENGINEERING	6
Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering **Overview of Mechanical Engineering** - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.		**CO1**
UNIT - II	**SURVEYING AND CIVIL ENGINEERING MATERIALS**	**9**
Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. **Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel - timber - modern materials		**CO2**
UNIT - III	**BUILDING COMPONENTS AND STRUCTURES**	**12**
Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. **Civil Engineering Structures:** Brick masonry – stonemasonry – beams – columns – lintels – roofing flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.		**CO3**
UNIT - IV	**INTERNAL COMBUSTION ENGINES AND POWERPLANTS**	**12**
Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers,		**CO4**

Turbines, Reciprocating Pumps (single acting and double acting) and CentrifugalPumps		
UNIT - V	**REFRIGERATION AND AIR CONDITIONING SYSTEM**	**6**
Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Shanmugam G and Palanichamy MS ,"Basic Civil and Mechanical Engineering", Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCE BOOKS

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,"BasicCivil Engineering",AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,"Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,2000.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	To impart basic knowledge on Civil and Mechanical Engineering.
CO2	To familiarize the materials and measurements used in Civil Engineering.
CO3	To provide the exposure on the fundamental elements of civil engineering structures.
CO4	To enable the students to distinguish the components and working principle of power plant, IC engines
CO5	To provide the exposure on the fundamental elements of R & AC system.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	3	3	3	-	3	2	2	3	3	2	2	3
CO2	3	2	3	3	3	3	2	-	2	1	1	3	3	2	1	2
CO3	3	2	3	3	2	3	2	-	3	2	1	3	3	2	1	2
CO4	3	2	3	2	2	3	2	-	3	2	2	3	3	3	2	3
C05	3	2	3	2	2	3	2	-	2	2	1	3	2	3	2	3

EE1271	PRINCIPLES OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING	L	T	P	C
	(Common to EEE & EIE)	3	0	0	3

Objectives

- To understand the basic concepts of electric circuits and wiring practices.
- To study about the three phase system and magnetic circuits
- To understand the working principle of electronic devices.
- To study the working of current controlled and voltage controlled devices.
- To understand the basic concepts of communication systems.

UNIT I	BASIC ELECTRIC CIRCUITS AND DOMESTIC WIRING	9
Electrical circuit elements (R, L and C)-Dependent and independent sources - Ohm's Law, Kirchhoff's laws - Single phase AC circuits: Phasor – RMS and Average values-sinusoidal steady state response of simple RLC circuits - Types of wiring- Domestic wiring - Electrical Safety - Protective devices and Earthing		CO1
UNIT II	**THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS**	**9**
Evolution of Three phase circuits from single phase circuits – Star connection – Delta connection –Balanced and Unbalanced Loads- Power in three-phase circuits -Magnetic circuits- Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.		CO2
UNIT III	**BASICS OF ELECTRONICS**	**9**
P-N junction diode - VI Characteristics, static and dynamic resistance, Diffusion and drift current densities,transition & diffusion capacitance - Zener diode - VI Characteristics, Zener and avanlache Breakdown, Zener Voltage Regulator. Diode Rectifier & Filter circuits – LC Filters-PIN and Photo Diode, Photo Transistor.		CO3
UNIT IV	**CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES**	**9**
Current controlled devices: Construction, operation and characteristics of BJT, UJT, SCR. Voltage controlled devices: Construction,operation and characteristics of JFET and MOSFET.		CO4
UNIT V	**FUNDAMENTAL OF COMMUNICATION ENGINEERING**	**9**
Introduction – Elements of communication systems – Modulation and Demodulation : principle of amplitude and frequency modulation. Digital communication - Nyquist Sampling Theorem, Pulse Code Modulation, Delta Modulation, BPSK, QPSK(Qualitative Approach)- Communication systems: Radio Antenna, TV, Satellite and Optical fibre (Block diagram approach only)		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education,2014.
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 2015.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th edition,2013.

REFERENCE BOOKS

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7thedition, 2017.
3. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill,2010.
4. Muhammad H.Rashid, "Spice for Circuits and electronics",4th edition.,Cengage2019.
5. V.K. Mehta and Rohit Mehta, 'Principles of Power System', S.Chand Publishers, Reprint Edition 2019.
6. Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill 4th edition 2017

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	To be able to understand the concepts related with electrical circuits and wiring practices.
CO2	To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3	To be able to understand the working principle of electronic devices such as diode and zener diode.
CO4	To be able to understand the characteristics and working of current controlled and voltage controlled devices.
CO5	To be able to understand the basic concepts of communication systems.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	K	l	1	2	3	4
CO1	3	3	3	2	3	3	2	1	3	2	2	3	3	2	2	1
CO2	3	3	3	2	2	1	3	1	1	2	2	2	3	2	2	1
CO3	3	3	3	2	2	1	2	1	1	1	2	3	3	2	2	1
CO4	3	3	3	2	1	2	2	1	1	1	1	2	3	2	2	1
C05	3	2	1	2	1	1	2	1	1	1	1	2	3	2	2	1

GE 1207	ENGINEERING PRACTICE LABORATORY	L	P	T	C
(Common for all branches of B.E. / B. Tech Programmes)		0	0	4	2

Objectives

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I	**CIVIL ENGINEERING PRACTICE** **13** **Buildings:** (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects. **Plumbing Works:** (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings. (b) Study of pipe connections requirements for pumps and turbines. (c) Preparation of plumbing line sketches for water supply and sewage works. (d) **Hands-on-exercise:** Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components. (e) Demonstration of plumbing requirements of high-rise buildings. **Carpentry using Power Tools only:** (a) Study of the joints in roofs, doors, windows and furniture. (b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.	**CO1**
II	**MECHANICAL ENGINEERING PRACTICE** **18** **Welding:** (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding. (b) Gas welding practice **Basic Machining:** (a) Simple Turning and Taper turning (b) Drilling Practice **Sheet Metal Work:** (a) Forming & Bending: (b) Model making – Trays and funnels.	**CO2**

(c) Different type of joints. **Machine assembly practice:** (a) Study of centrifugal pump (b) Study of air conditioner **Demonstration on:** (a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt. (b) Foundry operations like mould preparation for gear and step cone pulley. (c) Fitting – Exercises – Preparation of square fitting and V – fitting models.	
GROUP B (ELECTRICAL & ELECTRONICS)	
III ELECTRICAL ENGINEERING PRACTICE 13	**CO3**
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit. 5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.	**CO4**
IV ELECTRONICS ENGINEERING PRACTICE 16 1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	**CO5**
TOTAL: 60 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.No.	**Description of Equipment**	**Quantity required**
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	**1 each**
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**

4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**K**	**l**	**1**	**2**	**3**	**4**
CO1	3	1	3	0	0	3	0	0	0	0	0	3	3	2	3	2
CO2	3	2	3	0	0	3	0	0	0	0	0	3	3	2	2	2
CO3	3	1	2	0	0	2	0	0	0	0	0	3	3	2	3	2
CO4	3	2	3	3	1	3	1	1	1	1	2	3	3	3	3	2
C05	3	2	3	3	1	2	1	1	1	1	2	3	3	3	3	2

EE1278	PRINCIPLES OF ELECTRICAL AND ELECTRONIC DEVICES LABORATORY	L	T	P	C
	(Common to EEE & EIE)	0	0	4	2

Objectives

- To provide practical knowledge of fundamental concepts of electrical and electronics engineering through relevant experiments.
- To impart hands on experience in measurement of electric and magnetic circuit parameters.
- To train the students in performing the verification of ohm's law and Kirchhoff's laws.
- To analyse various connections of balanced and unbalanced loads.
- To study the characteristics of electronic semiconductor devices.

LIST OF EXPERIMENTS

1. Measurement of equivalent Resistance in an electric circuit	**CO1**
2. Verification of ohm's law.	
3. Verification of Kirchhoff's laws.	**CO2**
4. Measurement of magnetic flux in magnetic circuits.	
5. Star and delta connections with balanced and unbalanced loads.	**CO3**
6. V-I characteristics of PN junction and Zener Diode.	
7. V-I characteristics of SCR.	**CO4**
8. V-I characteristics of BJT (CE, CB, CC Configuration).	
9. V-I characteristics of FET.	**CO5**
10. V-I characteristics of UJT and its application.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Dual,(0-30V) variability Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos- 1 MHz

4. Digital Multimeter -10 Nos
5. Bread board – 10 Nos
6. Digital Trainer Kit
7. Watt meter-2Nos.
8. Ammeter (0-10A)-10 Nos
9. Voltmeter (0-300V)-10Nos
10. Fluxmeter-2 Nos
11. Load Resistor Box-1Nos.

Consumables Sufficient Quantity

1. Resistor
2. BJT
3. UJT
4. Diodes
5. Zener Diode.
6. FET

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Manipulate simple electric and magnetic circuits.
CO2	Become familiar with the basic ohm's and kirchhoff's law realization.
CO3	Design and Analyse the basic circuit components and connect them to make a real electrical circuit.
CO4	Ability to Design and construct basic load connections of electrical networks
CO5	To study and analyse the characteristics of various electronic semiconductor devices.

MAPPING OF COs WITH POs AND PSOs																
Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**L**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2	1
CO2	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2	1
CO3	3	3	3	3	3	1	2	1	2	1	2	2	3	2	2	1
CO4	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2	1
C05	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2	1

SEMESTER-3

MA1301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (Common to CIVIL, EEE, EIE, MECH and BIO)	L	T	P	C
		3	1	0	4

Objectives

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To fDSamiliarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of difference equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT - I	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations (except $f(x^m z^k p, y^n z^k q) = 0$) – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types		**CO1**

UNIT - II	FOURIER SERIES	12
Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.		**CO2**

UNIT – III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12
Classification of PDE – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.		**CO3**

UNIT - IV	FOURIER TRANSFORMS	12
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.		**CO4**

UNIT - V	Z – TRANSFORMS AND DIFFERENCE EQUATIONS	12
Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) –Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform.		CO5
	Total Periods:	**60**

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

Reference Books:

1. Dass, H.K., and Er. Rajnish Verma, "Higher Engineering Mathematics", S.Chand Private Ltd.,2011.
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012
3. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Course Outcomes (CO)

CO1	Understand how to solve the partial differential equations and apply these concepts in the field of engineering.
CO2	Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.

CO4	Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.
CO5	Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals etc.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	I	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	2	0	2	1	2	0	3	1	1	1
CO2	3	3	2	2	1	2	1	0	1	0	2	0	3	2	1	2
CO3	3	3	2	2	0	1	0	0	1	0	2	0	3	1	1	1
CO4	3	2	1	2	1	0	1	1	0	0	3	0	2	2	2	2
C05	3	3	2	2	1	0	1	0	2	1	2	0	3	1	2	2

EE1301	Electromagnetic Theory	L	T	P	C
		2	1	0	3

Objectives

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of electrostatic fields, electrical potential, energy density and their applications.
- To impart knowledge on magneto static fields, magnetic flux density, vector potential and its applications.
- To study the important of different methods of EMF generation and Maxwell's equations.
- To understand the basic concepts electromagnetic waves and characterizing parameters.

UNIT – I	ELECTROSTATICS – I	6+6
Sources and effects of electromagnetic fields - Coordinate Systems - Vector fields - Gradient, Divergence, Curl - Theorems and applications - Coulomb's Law - Electric field intensity - Field due to discrete and continuous charges - Gauss's law and applications.		CO1

UNIT – II	**ELECTROSTATICS – II**	**6+6**
Electric potential - Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor - Electric field in free space, conductors, dielectrics - Dielectric polarization - Dielectric strength - Electric field in multiple dielectrics - Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.		**CO2**
UNIT – III	**MAGNETOSTATICS**	**6+6**
Magnetic field intensity (H) - Biot-Savart's Law - Ampere's Circuit Law - H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) - B in free space, conductor, magnetic materials - Magnetization, Magnetic field in multiple media - Boundary conditions, scalar and vector potential, Poisson's Equation - Lorentz force, Magnetic force, Torque, Inductance, Energy density, Applications.		**CO3**
UNIT – IV	**ELECTRODYNAMIC FIELDS**	**6+6**
Magnetic Circuits - Faraday's law - Transformer and motional EMF - Displacement current - Maxwell's equations (differential and integral form) - Relation between field theory and circuit theory - Applications.		**CO4**
UNIT – V	**ELECTROMAGNETIC WAVES**	**6+6**
Electromagnetic wave generation and equations - Wave parameters - velocity, intrinsic impedance, propagation constant - Waves in free space, lossy and lossless dielectrics, conductors - skin depth - Poynting vector - Plane wave reflection and refraction.		**CO5**
	Total Periods:	**60**

Text Books:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2020.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2017.

Reference Books:

1. V.V.Sarwate, 'Electromagnetic fields and waves', Second Edition, New Age International Publishers, 2018.

2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers, 2013.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2017.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint: 2015

Course Outcomes (CO)

CO1	Ability to understand the basic mathematical concepts related to electromagnetic vector fields.
CO2	Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
CO3	Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
CO4	Ability to understand the different methods of EMF generation and Maxwell's equations.
CO5	Ability to understand the basic concepts electromagnetic waves and characterizing parameters.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	2	2	2	1	1	2	1	2	3	3	2	1
CO2	3	3	3	2	2	2	2	1	1	2	1	2	3	3	2	1
CO3	3	3	3	2	2	2	1	1	1	2	1	2	3	3	2	2
CO4	3	3	2	2	3	2	2	1	2	1	1	2	3	3	2	2
C05	3	2	2	2	3	2	2	1	2	2	1	2	3	3	2	1

EE1302	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To educate the fundamental concepts and characteristics of measurement and errors.
- To impart the knowledge on the functional aspects of measuring instruments.
- To infer the importance of various bridge circuits used with measuring instruments.
- To acquire knowledge on various storage and display devices.
- To understand the concepts various transducers and the data acquisition systems.

UNIT – I	INTRODUCTION	9
Functional elements of an instrument - Static and dynamic characteristics - Errors in measurement -Techniques for reducing errors - Statistical evaluation of measurement data – Standards and calibration.		**CO1**

UNIT – II	ELECTRICAL AND ELECTRONIC INSTRUMENTS	9
Classification of Instruments – Principle and types of analog and digital voltmeters & ammeters – Principle and types of multi meters – Single and three phase watt meters and energy meters, Magnetic measurements – Determination of B-H curve and measurements of iron loss, Instrument transformers – Instruments for measurement of frequency and phase.		**CO2**

UNIT – III	COMPARATIVE METHODS OF MEASUREMENTS	9
D.C potentiometers – D.C bridges (Wheat stone, Kelvin and Kelvin Double bridge) – Measurement of high resistance- Megger & A.C bridges (Maxwell's, Anderson, Hay's, Owen's, Schering and Wien's bridges) – Transformer ratio bridges – Self-balancing bridges – Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic Interference – Grounding techniques.		**CO3**

UNIT – IV	STORAGE AND DISPLAY DEVICES	9
Types of analog recorders – Strip chart recorders and Magnetic tape Recorders – Digital plotters and printers – CRT display – Analog CRO – Measurement of Phase and Frequency (Lissajous Patterns) – Digital Storage Oscilloscopes – LED, LCD & Dot matrix display – Data Loggers.		**CO4**

UNIT – V	TRANSDUCERS AND DATA ACQUISITION SYSTEMS	9
Classification of transducers – Selection of transducers, Resistive transducers – Strain Gauges and Rosettes, Capacitive transducers – Measurement of Liquid level &		**CO5**

Measurement of displacement, Inductive Transducers – LVDT & RVDT, Piezo- electric Transducers – Hall effect Transducers – Opto- electronic Transducers – Digital encoding Transducers – Data acquisition system and its uses – Smart sensors, Thermal Imagers.	
Total Periods:	**45**

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co. (P) Limited, 2015.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, Reprint 2012.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., Reprint 2019.

REFERENCE BOOKS:

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2017.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, 'Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, Reprint 2010
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, Reprint 2013.

COURSE OUTCOMES (CO)

CO1	Acquire knowledge about measurement and basic functional elements of instrumentation.
CO2	Understand the concepts of fundamentals of electrical and electronic measuring instruments.
CO3	Understand the concept of measurement by comparison or balance of parameters.
CO4	Acquire knowledge on various storage and display devices to represent measured data.
CO5	Understand the concepts various transducers and the data acquisition systems.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	2	2	3	3	2	1	1	1	1	1	1	1	2	2	1	1

CO2	2	2	3	3	2	1	2	1	1	1	1	1	2	2	2	1
CO3	2	2	2	3	2	1	2	1	1	1	1	1	2	2	2	1
CO4	2	2	2	3	2	1	1	1	1	1	1	1	2	2	2	2
CO5	2	2	2	3	2	1	1	1	1	1	1	1	2	2	2	1

EE1371	**ELECTRIC CIRCUIT ANALYSIS**	**L**	**T**	**P**	**C**
	(Common to EEE and EIE)	2	1	0	3

Objectives

· To determine the response of electric circuits using basic analysis methods.
· To impart knowledge on solving circuit equations using network theorems.
·To Analyse the transient behaviour of electric circuits with different types of source.
· To understand the concepts of resonance and coupled circuits.
· To Compute and analyse the two-port network and its parameters.

UNIT – I	**ANALYSIS OF ELECTRIC CIRCUITS & NETWORK TOPOLOGY**	**9**
Mesh Analysis: Analysis with independent and dependent voltage sources, Supermesh Analysis; Node Analysis: Analysis with independent and dependent current sources, Supernodal Analysis; Introduction to graph theory - Network terminology; Duality and dual networks.		**CO1**

UNIT – II	**NETWORK THEOREMS FOR DC AND AC CIRCUITS**	**9**
Network reduction: voltage and current division, source transformation, star delta conversion; Applications of: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Mill man's theorem.		**CO2**

UNIT – III	**TRANSIENT RESPONSE ANALYSIS**	**9**
Transient response: Natural response & Forced response of RL, RC and RLC circuits using Laplace transform for DC input and AC sinusoidal input.		**CO3**

UNIT – IV	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance: Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor – Selectivity; Mutual coupled circuits: Self and mutual inductance – Coefficient of coupling – Dot Convention in coupled circuits; Ideal Transformer; Tuned circuits – single tuned circuits.		**CO4**

UNIT – V	TWO PORT NETWORK AND NETWORK FUNCTIONS	9
Two Port Networks: terminal pairs, relationship of two port variables, impedance(Z) parameters, admittance(Y) parameters, transmission parameters (ABCD) and hybrid parameters(H), interconnections of two port networks.		CO5
	Total Periods:	**45**

Text Books:

1. M Nahvi I J A Edminster “Electric Circuits”; Schaum's outline series , Tata Mcgraw Hill companies, 4th Edition, 2019.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Fifth Edition, McGraw Hill, 2020.
3. David A Bell ,” Electric circuits “, Oxford University Press, 2019.

Reference Books:

1. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 2017.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,Tata McGraw Hill publishers, New Delhi, 2019.
3. Sudhakar. A, Shyammohan. S.P “Circuits and Networks-Analysis and Synthesis”. Tata McGraw Hill publishers, 2018.
4. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2020.
5. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 2018.

Course Outcomes (CO)

CO1	Able to Determine the response of Electric circuits using basic analysis methods and network topology
CO2	Able to Compute the response of electric circuits using network theorem in real time applications.
CO3	Able to Apply Laplace transform techniques for solving problems and discuss the complete response of circuits.
CO4	Able to Design and analyse resonance and coupled circuits.
CO5	Able to Evaluate and analyse two port networks and its parameters.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1

CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1

EE1372	**ANALOG ELECTRONICS**	**L**	**T**	**P**	**C**
	(Common to EEE and EIE)	3	0	0	3

Objectives

- To be familiar with the biasing of BJT and its amplifier circuits.
- To analyse the operation of feedback amplifiers and oscillators.
- To study the characteristics of Op-Amp and its applications.
- To design and construct application circuits using IC741.
- To study the functional blocks and the applications of special ICs like 555, 565 and 566 and voltage regulator ICs.

UNIT – I	**BIASING METHODS AND AMPLIFIER CIRCUITS**	**9**
BJT -Need for biasing, DC Load Line and Bias point, Various biasing methods of BJT, BJT small signal model, Analysis of CE amplifier, Gain and Frequency response; Differential Amplifier - Common mode and Differential mode analysis - Multi-stage amplifier.		**CO1**

UNIT – II	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9**
Feedback Concepts, gain with feedback, effect of feedback on gain stability, distortion, bandwidth, input and output impedances. Topologies of feedback amplifiers - analysis of series-series, shunt-shunt, series-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation; Barkhausen criterion for oscillation, Types of oscillators –RC, LC and crystal oscillators.		**CO2**

UNIT – III	**OP-AMP CHARACTERISTICS AND ITS BASIC APPLICATIONS**	**9**
Basic introduction to IC fabrication. Op-Amp characteristics: DC characteristics, AC characteristics. Basic applications: Inverting, Non-inverting, Adder, Subtractor, Differential amplifier, Instrumentation amplifier, Differentiator, Integrator circuit and Comparators.		**CO3**

UNIT – IV	**APPLICATIONS OF OP-AMP**	**9**
V to I, I to V converter, Multi-vibrators, Triangular wave generators, Precision rectifier, Clippers and Clampers, Peak detector, Sample and hold Circuit; First-order and Second order active filters, A/D converters: Flash, Dual slope and Successive Approximation type; D/A converters: Weighted resistance type and R-2R ladder type.		**CO4**

UNIT – V	SPECIAL ICs	9
555-Timer circuit, Functional block diagram, characteristics & applications, Astable and Monostable multivibrator, 566-Voltage Controlled Oscillator circuit, 565-Phase Locked Loop and its applications, IC8038-Function generator, Linear Voltage regulators: Functional Block diagram : 78XX, 79XX, LM317, IC723-General purpose regulator - SMPS.		**CO5**
	Total Periods:	**45**

Text Books:

1. David A bell, "Electronic circuits", Oxford University Press, 2011.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', Fourth edition, New Age, 2018.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2015.

Reference Books:

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2008.
2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition, 2012.
5. Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
6. Floyd, Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.

Course Outcomes (CO): At the end of the course students will have the,

CO1	Ability to understand the biasing concepts of BJT and its amplifier circuits.
CO2	Ability to design circuits employing amplifier and oscillator circuits.
CO3	Ability to analyse, comprehend and design of analog electronic circuits involving Operational amplifier.
CO4	Ability to analyse and design applications using IC741 operational amplifier.
CO5	Ability to design analog integrated circuits using IC555 timer, PLL, VCO, voltage regulator and other special ICs.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	3	3	1	1	1	3	2	2	3	3	1
CO2	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3	1
CO3	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3	1
CO4	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3	1
C05	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3	1

EE1373	Digital Logic Circuits	L	T	P	C
	(Common to EEE, EIE)	2	1	0	3

Objectives

- To study number systems and the performance characteristics of digital logic families like DTL, TTL , ECL,CMOS.
- To study combinational circuits and implement it.
- To design synchronous sequential circuits.
- To introduce asynchronous sequential circuits and PLDs.
- To gain knowledge on VHDL coding style.

UNIT – I	NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES	9
Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code ;Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.		CO1

UNIT – II	COMBINATIONAL CIRCUITS	9
Combinational logic - logic gates ,universal gates ,representation of logic functions- SOP and POS forms, K-map representations - minimization using K maps, Quine-McCluskey method of minimization; Simplification and implementation of combinational logic: adders-subtractors, encoders and decoders, multiplexers and demultiplexers ,code converters.		CO2

UNIT – III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9
Sequential logic- SR, JK, D and T flip flops ; level triggering and edge triggering ; counters - asynchronous and synchronous type , Modulo counters ; Shift registers ; design of synchronous sequential circuits ; Moore and Melay models- Counters, state diagram, state reduction, state assignment.		CO3
UNIT – IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES**	**9**
Asynchronous sequential logic circuits; Transition stability, flow stability, race conditions, Hazards & errors in digital circuits; Analysis of asynchronous sequential logic circuits. Basics of memory structures; Introduction to Programmable Logic Devices: PROM , PLA ,PAL, CPLD-FPGA.		CO4
UNIT – V	**VHDL**	**9**
RTL Design, Combinational logic , Sequential circuit ; Operators ;Introduction to Packages ,Subprograms , Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & Demultiplexers).		CO5
	Total Periods:	**45**

Text Books:

1. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education,2013.
2. S.Salivahanan and S.Arivazhagan 'Digital Electronics' 1st Edition, Vikas Publishing House Pvt Ltd,2012.
3. Comer 'Digital Logic & State Machine Design', Oxford,2012.

Reference Books:

1. Mandal ,'Digital Electronics Principles & Application', McGraw Hill Edu, 2013.
2. William Keitz, 'Digital Electronics-A Practical Approach with VHDL', Pearson,2013.
3. Thomas L. Floyd, 'Digital Fundamentals', 11th edition, Pearson Education,2015.
4. James W. Bignel, 'Digital Electronics', Cengage learning, 5th Edition, 2007.
5. Jayaram Bhaskar AT&T(American Telephone & Telegraph Company ,Bell Laboratories Division "A VHDL Primer" ,3rd Edition ,Pearson Publisher,1999.

Course Outcomes (CO) : At the end of the course students will have the,

CO1	Ability to compare the performance characteristics of various digital logic families like DTL, TTL, ECL, CMOS.

CO2	Ability to design and implement digital circuits using combinational circuits.
CO3	Ability to design sequential circuits.
CO4	Ability to design asynchronous sequential circuits and PLDs.
CO5	Ability to simulate using software package for development of real time logic circuits.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3	4
CO1	3	3	3	3	3	2	2	1	1	1	1	2	2	3	3	1
CO2	3	3	3	3	3	2	2	1	1	1	1	2	2	3	3	1
CO3	3	3	3	3	3	2	2	1	1	1	1	2	2	3	3	1
CO4	3	3	3	3	3	2	2	1	1	1	1	2	2	3	3	1
C05	3	3	3	3	3	3	2	1	1	1	1	2	2	3	3	1

EE1381	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To gain practical experience on verification of theorems in an electric circuit.
- To simulate various electric circuits using MATLAB for verification of theorems.
- To study CRO and to measure sinusoidal voltage, frequency and power factor.
- To Analyse the RC transient circuit experimentally and verify the same using MATLAB.
- To Analyse the response characteristics of resonant circuits.

LIST OF EXPERIMENTS

1. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
2. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
3. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
4. Simulation and experimental verification of Maximum Power transfer theorem.
5. Simulation and experimental verification of Reciprocity theorem.
6. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.

7. Simulation and Experimental validation of R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Regulated Power Supply: 0 – 15 V D.C - 10 Nos / Distributed Power Source.
2. Function Generator (1 MHz) - 10 Nos.
3. Oscilloscope (20 MHz) - 10 Nos.
4. Digital Storage Oscilloscope (20 MHz) – 1 No.
5. 10 Nos. of PC with Circuit Simulation Software (min 10 Users) (e-Sim /Scilab/ Pspice / MATLAB /other Equivalent software Package) and Printer (1 No.)
6. AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.)
7. Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box - 6 Nos each.
8. Circuit Connection Boards - 10 Nos. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

Course Outcomes (CO)

CO1	Able to identify network theorems and their application to network reduction techniques.
CO2	Simulate electric circuits by applying network theorems using MATLAB.
CO3	Able to measure sinusoidal voltage, frequency and power factor using CRO.
CO4	Analyse the RC transient circuits experimentally and verify using MATLAB.
CO5	Analyse the response characteristics of various types of resonant circuits.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	2	1	1	1	1	3	1	1	1	1	3	2	2	1
CO2	3	2	2	1	1	1	1	3	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	3	1	1	1	2	3	2	2	1
CO4	2	1	2	2	1	1	1	3	1	1	1	2	3	2	2	1
C05	2	2	2	1	1	1	1	3	1	1	1	2	3	2	2	1

EE1391	ANALOG AND DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To be exposed to the operation and application of electronic devices and its circuits.
- To analyze operation using IC741 operational amplifier.
- To design and construct application circuits using IC741, IC555, etc.
- To learn, design, test the characteristics of circuit behaviour with digital ICs.
- To impart the analysis of sequential and combinational circuit.

LIST OF EXPERIMENTS

1. Frequency response of CE Amplifier.
2. Design of an Oscillator- RC and LC oscillator using BJT.
3. Applications of Op-Amp: inverting, non-inverting amplifier, Adder, Comparator and differential amplifier.
4. Design of Integrator, Differentiator, Clipper and Clamper.
5. IC 555 Timer applications – Astable and Monostable operation.
6. Design of Linear Voltage regulator.
7. Implementation of Boolean Functions, Adder/ Subtractor circuits.
8. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
9. Encoders and Decoders.
10. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using flip flop ICs and specific counter ICs.
11. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable ICs.
12. Implementation of multiplexer and demultiplexer.

Total Periods:	**60**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Dual (0-30V) variability Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos- 1 MHz
4. Digital Multimeter -10 Nos
5. IC Tester (Analog)- 2 Nos
6. Bread board – 10 Nos

7. Digital Trainer Kit

Consumables Sufficient Quantity

1. IC 741/ IC NE555
2. Digital IC types
3. LM317
4. Transistor – 2N3391, BC107, BC147
5. Diodes - IN4001, BY126
6. DIB, DCB
7. Capacitors
8. Resistors
9. Single Strand Wires
10. Potentiometer 10K
11. Step Down Transformer -230V to 12 V
12. Rectifier IC W10

Course Outcomes (CO)

CO1	Ability to understand the operation and application of electronic devices and their circuits.
CO2	Ability to analyse, comprehend and design an analog electronic circuits using IC741 operational amplifier.
CO3	Ability to analyse, comprehend and design an analog electronic circuits using IC555 timer.
CO4	Ability to learn, design, test and analyse digital ICs.
CO5	Ability to analyse the sequential and combinational circuit.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	3	3	1	3	1	3	1	2	3	3	1
CO2	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3	1
CO3	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3	1
CO4	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3	1
C05	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3	1

SEMESTER-4

MA1401	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	(Common to EEE, EIE and MECHANICAL)	3	1	0	4

Objectives

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the Interpolation operators and numerical techniques of interpolation in various intervals, numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT – I	TESTING OF HYPOTHESIS	12
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit.		**CO1**

UNIT – II	DESIGN OF EXPERIMENTS	12
One way and two-way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.		**CO2**

UNIT – III	SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	12
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method.		**CO3**

UNIT – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12
Interpolation operators (Forward, Backward, shifting operators and its Properties) –– Newton's forward and backward difference interpolation for equal intervals – Lagrange's and Newton's divided difference interpolations for unequal intervals -		**CO4**

Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.		
UNIT – V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Finite difference methods for solving second order two - point linear boundary value problems Single step methods: Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations.		**CO5**
Total Periods:		**60**

Text Books:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and scientists" 8th edition, Pearson Education, Asia, 2007.

Course Outcomes (CO)

CO1	Students will gain knowledge on Large Samples and Small Samples. These concepts are very useful in Biological, Electric power management, Social experiments and also in all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO2	ANOVA's statistical significance result is independent of constant bias and scaling of errors. It is used in testing the difference between several treatments in the Design of

	experiments. It checks the impact of one or more factors in any experiment in Engineering.
CO3	Students will learn on nonlinear (algebraic or transcendental) equations and linear equations. Students learn to solve the Eigen value problem of a matrix numerically when analytical methods tend to fail to give solution and apply all these in the fields like Vibrating systems, fluid dynamics.
CO4	Students will learn to construct approximate polynomials that can be used in data representation using interpolation techniques to find the intermediate values. In particular, interpolation methods are extensively applied in the models of the different phenomena where experimental data must be used in computer studies where expressions of those data are required. The learners are introduced to numerical differentiation and integration techniques. The techniques are useful when the function in the analytical form is complicated**.**
CO5	Students get an insight on ordinary differential equations which will be useful in solving engineering problems. Students learn about the different methods for solving first order and second order differential equations. It will be useful in attempting to solve any engineering problems. ODE is applied in specific mathematical fields like Electrical, Geometry, Analytical mechanics, Celestial mechanics and Weather modelling.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	2	3	3	3	2	3	2	-	2	-	2	2	2	2	1	2
CO2	2	3	3	3	3	2	2	-	2	-	2	2	2	1	1	2
CO3	2	3	2	2	1	-	-	-	-	-	-	2	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	1	2	1
C05	3	3	2	1	2	1	-	-	-	-	-	2	2	2	2	1

EE1401	ELECTRICAL MACHINES - I	L	T	P	C
		2	1	0	3

Objectives

- Magnetic circuit analysis and introduction to magnetic materials.
- Constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- Working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- Working principles of DC machines as Generator types, determination of their no-load/load characteristics, starting methods of speed control of motors.
- Working principles of DC machines as motor and its types along with their characteristics with various losses takes place in D.C. Motor and to study the different testing methods.

UNIT – I	MAGNETIC FIELDS AND MAGNETIC CIRCUITS	9
Magnetic circuits - Laws governing magnetic circuits - Flux linkage, Inductance and energy–Statically and Dynamically induced EMF-Torque-Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation. Introduction to permanent magnets-Transformer as a magnetically coupled circuit.		**CO1**

UNIT – II	TRANSFORMERS	9
Construction - principle of operation - equivalent circuit parameters - phasor diagrams, losses - testing - efficiency and voltage regulation-all day efficiency. Sumpner's test, per unit representation-inrush current. Three phase transformers-connections-Scott Connection - Phasing of transformer - parallel operation of three phase transformers. Auto transformer –tap changing transformers-tertiary winding.		**CO2**

UNIT – III	ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES	9
Energy in magnetic system - Field energy and co energy-force and torque equations - singly and multiply excited magnetic field systems. MMf of distributed windings– Winding Inductances-magnetic fields in rotating machines-rotating MMF waves– magnetic saturation and leakage fluxes.		**CO3**

UNIT – IV	DC GENERATORS	9
Construction and components of DC Machine- Principle of operation - Lap and wave windings-EMF equations–circuit model- armature reaction- methods of excitation-commutation-Interpoles compensating winding- characteristics of DC generators.		**CO4**

UNIT – V	DC MOTORS	9
Principle and operations - types of DC Motors - Speed torque characteristics of DC Motors-starting and speed control of DC motors - Plugging, dynamic and regenerative braking-testing and efficiency - Retardation test- Swinburne's test and Hopkinson's test – Permanent Magnet DC (PMDC)motors-Applications of DC Motor		CO5
	Total Periods:	**45**

Text Books:

1. Stephen J. Chapman, 'Electric Machinery Fundamentals '4th edition, McGraw Hill Education Pvt.Ltd, 2017.
2. P.C.Sen 'Principles of Electric Machines and Power Electronics' John Wiley& Sons, 3rd Edition 2013.
3. Nagrath, I.J. andKothari.D.P.,ElectricMachines',McGraw Hill Education, 5th edition 2017.

Reference Books:

1. Theodore Wildi, 'Electrical Machines, Drives and Power Systems', Pearson Education., (6th Edition), 2013.
2. B.R.Gupta, 'Fundamental of Electric Machines', Newage International Publishers, 3rd Edition, Reprint 2015.
3. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 4th Edition,2017.
4. Vincent Del Toro, 'Basic Electric Machines'PearsonIndiaEducation,2016.
5. Surinder Pal Bali, 'Electrical Technology Machines & Measurements,Vol.II, Pearson, 2013.
6. Fitzgerald.A.E., Charles Kingsely Jr, Stephen D.Umans,'Electric Machinery', 7th edition, McGraw Hill Books Company, 2017.

Course Outcomes (CO)

CO1	Able to understand the basics of magnetic circuits and the energy conversion in electromagnetic fields.
CO2	Able to understand the construction, operating principle and performance analysis of transformers.
CO3	Able to understand the basics of electromagnetic fields, induced EMF and Torque developed.
CO4	Able to understand the construction and winding structure of the DC machines.
CO5	Able to understand the operation, classification and performance analysis of DC machines.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1402	GENERATION, TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

Objectives

- To impart knowledge about the configuration of the electrical power system
- To study the line parameters and interference with neighbouring circuits
- To analyze and model different components of power system
- To learn different insulators and underground cables
- To compute sag and conductor length for different weather conditions.
- To study the distribution systems, types of substation and HVDC

UNIT - I	POWER GENERATION AND TRANSMISSION LINE PARAMETERS	9
Structure of electric power system, different types of power generation - Thermal, Hydro, Nuclear (Qualitative treatment only) - Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - self and mutual GMD; skin and proximity effects.		CO1

UNIT - II	MODELLING AND PERFORMANCE OF TRANSMISSION LINES	9
Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Formation of Corona - Critical Voltages - Effect on Line Performance.		CO2

UNIT - III	MECHANICAL DESIGN OF LINES	9
Mechanical design of overhead lines - Line Supports - Types of towers - Stress and Sag Calculation - Effects of Wind and Ice loading. Insulators: Types - voltage distribution in insulator string, improvement of string efficiency, testing of insulators.		**CO3**
UNIT - IV	**UNDER GROUND CABLES**	**9**
Underground cables - Types of cables - Construction of single core and 3 core Cables - Insulation Resistance - Potential Gradient - Capacitance of Single core and 3 core cables - Grading of cables - Power factor and heating of cables - DC cables.		**CO4**
UNIT - V	**DISTRIBUTION SYSTEMS**	**9**
Distribution Systems - General Aspects - Kelvin's Law - AC and DC distributions – Concentrated and Distributed loading - Techniques of Voltage Control and Power factor improvement - Distribution Loss- Types of Substations -GIS -HVDC.		**CO5**
	Total Periods:	**45**

Text Books:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, seventh edition 2018.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2008.

Reference Books:

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Sixth Edition, 2011.
2. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Arun Ingole, "power transmission and distribution" Pearson Education, first edition, 2018
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2011.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013

Course Outcomes (CO)	
CO1	Understand the structure of electric power system and to know the working of different types of power generation, and also to solve the expressions for transmission line parameters.
CO2	Obtain the equivalent circuit based on distance and operating voltage for determining voltage regulation and efficiency and also to know the methods of improvement of voltage profile along with real and reactive power flow in transmission lines with the help of power circle diagrams.
CO3	Develop the mechanical design of transmission lines with sag and tension calculation for different weather conditions and to know about tower spotting techniques along with substation.
CO4	Know the types of insulator and cables and to analyze the voltage distribution, methods of improvement string efficiency and grading of cables.
CO5	Explore about distribution systems, types of substations, HVDC

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	2	2	2	1	1	1	1	1	1	1	1	3	1	2	1
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	1	2	1
CO4	3	2	3	2	1	1	1	1	1	1	1	1	3	1	2	2
C05	3	2	3	2	1	1	1	1	2	2	1	1	3	1	3	2

EE1471	CONTROL SYSTEMS	L	T	P	C
	(Common to EEE and EIE)	2	1	0	3

Objectives

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems

UNIT – I	**SYSTEMS AND REPRESENTATION**	**9**
Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.		**CO1**
UNIT – II	**TIME RESPONSE**	**9**
Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.		**CO2**
UNIT – III	**FREQUENCY RESPONSE**	**9**
Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications		**CO3**
UNIT – IV	**STABILITY AND COMPENSATOR DESIGN**	**9**
Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag- lead compensator using bode plots.		**CO4**
UNIT – V	**STATE VARIABLE ANALYSIS**	**9**
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.		**CO5**
	Total Periods:	**45**

Text Books:

1. Nagarath I.J. and Gopal M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Farid Golnaraghi and Benjamin C. Kuo, “Automatic Control Systems”, McGraw-Hill Education, 2017.

Reference Books:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson,2015.
2. Richard C.Dorf and Robert H.Bishop, “Modern Control Systems”, Pearson Education, 2011.
3. Constantine H. Houpis and Stuart N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Press, Taylor & Francis Group, 2013.

4. Rames C.Panda and T.Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House,2017.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education,2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

Course Outcomes (CO)

CO1	Ability to develop various representations of system and to reduce the complex systems into simpler system in transfer function.
CO2	Ability to do time domain analysis of various models of linear system and understand the use of controllers in closed loop system
CO3	Ability to do frequency domain analysis of various models of linear system
CO4	Infer the stability of systems and ability to design appropriate compensator for the given specifications
CO5	Ability to represent the system in state variable forms

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	A	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO2	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO4	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
C05	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (LAB INTEGRATED)	L	T	P	C
	(Common to EEE & EIE)	3	0	2	4

Objectives

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT I	C PROGRAMMING BASICS	9 +6

Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays. **Lab Component:** • I**MPLEMENTATION OF BASIC C PROGRAMS** a. Find greatest of three numbers b. Create a simple Calculator • **IMPLEMENTATION OF ARRAY** a. Computing Mean, Median and Mode b. Matrix Addition		**CO1**
UNIT II	**FUNCTIONS, POINTERS AND STRUCTURES**	**9 + 6**
Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation. **Lab Component:** • **IMPLEMENTATION OF USER DEFINED DATA TYPES** a. Computation of Sine series. b. Swapping of two numbers and changing the value of a variable using pass by reference.		**CO2**
UNIT III	**LINEAR DATA STRUCTURES**	**9 + 6**
List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue. **Lab Component:** • **IMPLEMENTATION OF LINEAR DATA STRUCTURE** a. List implementation of List, Stack, Queue. b. Implement polynomial addition using list. c. Evaluate arithmetic expression.		**CO3**

UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9 + 6**
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort –Applications of graphs. **Lab Component** ● **IMPLEMENTATION OF TREE** a. Construct binary search tree. b. Traverse the binary tree recursively in pre-order, post-order and in-order. ● **GRAPH TRAVERSAL** a. Depth first search. b. Breadth first search.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASH TABLE**	**9 + 6**
Linear Search – Binary Search, Bubble Sort – Insertion sort – Merge sort – Quick sort- Hashing functions - Hash tables – Introduction to overflow handling. **Lab Component** ● **SORTING &SEARCHING** a. Insertion sort b. Merge sort c. Linear Search d. Binary Search		**CO5**
		PRACTICALS: 30 PERIODS **THEORY: 45 PERIODS** **TOTAL : 75 PERIODS**
TEXT BOOKS		
1. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.		
REFERENCE BOOKS		
1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Fourth Edition, Pearson Education, 2013.		

2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

CO1	Able to implement basics of C
CO2	Able to implement advanced features of C
CO3	Able to apply the different linear data structures to problem solutions.
CO4	Able to implement Tree and Graph data structure.
CO5	Able to analyse the various sorting, searching algorithms and hash table.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	2	2	0	0	0	2	2	2	3	3	2	3
CO2	3	3	3	2	2	2	0	0	0	2	2	2	3	3	2	3
CO3	3	3	3	2	2	2	0	0	0	2	2	2	3	3	2	3
CO4	3	3	3	2	2	2	0	0	0	2	2	2	3	3	2	3
C05	3	3	3	2	2	2	0	0	0	2	2	2	3	3	2	3

EE1481	ELECTRICAL MACHINES LABORATORY - I	L	T	P	C
		0	0	4	2

Objectives

- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load characteristics of DC series generator
4. Load characteristics of DC shunt and compound motor
5. Load characteristics of DC series motor
6. Swinburne’s test and speed control of DC shunt motor.
7. Hopkinson’s test

8. Load test on single phase transformer
9. Load test on three phase transformer
10. Open circuit and short circuit tests on single phase transformer
11. Sumpner's test
12. Separation of no-load losses in single phase transformer
13. Study of starters and 3-phase transformers connections.

Total Periods:	**60**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. DC Shunt Motor with Loading Arrangement – 3 Nos
2. DC Shunt Motor Coupled with Three phase Alternator – 1 No
3. Single Phase Transformer – 4 Nos
4. DC Series Motor with Loading Arrangement – 1 No
5. DC compound Motor with Loading Arrangement – 1 No
6. DC Shunt Motor Coupled With DC Compound Generator – 2 Nos
7. DC Shunt Motor Coupled With DC Shunt Motor – 1 No
8. Tachometer -Digital/Analog – 8 Nos
9. Single Phase Auto Transformer – 2 Nos
10. Three Phase Auto Transformer – 1 No
11. Single Phase Resistive Loading Bank – 2 Nos
12. Three Phase Resistive Loading Bank – 2 Nos

Course Outcomes (CO)

CO1	Understand the procedure to conduct direct test on DC machines and able to find its performance characteristics.
CO2	Understand the procedure to conduct indirect test on DC machines and able to find its performance characteristics.
CO3	Understand the procedure to conduct direct test on transformer and to find its performance characteristics.
CO4	Understand the procedure to conduct indirect test on transformer and able to find its performance characteristics.

CO5	Understand the procedure to conduct speed control of a DC motor and able to find its performance characteristics.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	A	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	2	2	1	1	1	1	1	3	1	1	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	3	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	3	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	3	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	3	1	1	1	2	3	2	2	1

EE1482	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

Objectives

• To provide knowledge on analysis and design of control system along with basics of instrumentation.

LIST OF EXPERIMENTS

CONTROL SYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modeling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Synchro-Transmitter- Receiver and Characteristics
7. Simulation of Control Systems by Mathematical development tools.

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges
9. Dynamics of Sensors/Transducers (a) Temperature (b) pressure (c) Displacement (d) Optical (e) Strain (f) Flow
10. Power and Energy Measurement
11. Signal Conditioning (a) Instrumentation Amplifier (b) Analog – Digital and Digital –Analog converters (ADC and DACs)
12. Process Simulation

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROL SYSTEMS:

1. PID controller simulation and learner kit – 1 No.
2. Digital storage Oscilloscope for capturing transience- 1 No.

2 Personal Computer with control system simulation packages - 10 Nos

3. DC motor –Generator test set-up for evaluation of motor parameters
4. CRO 30MHz – 1 No.
5. Function Generator 2MHz – 1No.
6. Position Control Systems Kit (with manual) – 1 No.

   Tacho Generator Coupling set
7. AC Synchro transmitter& receiver – 1No.
8. Sufficient number of Digital multi meters, speed and torque sensors

INSTRUMENTATION:

9. R, L, C Bridge kit (with manual)
10. a) Electric heater – 1No.
    Thermometer – 1No.
    Thermistor (silicon type)
    RTD nickel type – 1No.
    b) 30 psi Pressure chamber (complete set) – 1No.
    Current generator (0 – 20mA)
    Air foot pump – 1 No. (with necessary connecting tubes)
    c) LVDT20mm core length movability type – 1No.
    CRO 30MHz – 1No.
    d) Optical sensor – 1 No. Light source
    e) Strain Gauge Kit with Handy lever beam – 1No.
    100gm weights – 10 nos
    f) Flow measurement Trainer kit – 1 No.
    (1/2 HP Motor, Water tank, Digital Milliammeter, complete set)
11. Single phase Auto transformer – 1No.
    Watt-hour meter (energy meter) – 1No.
    Ammeter Voltmeter
    Rheostat
    Stop watch Connecting wires (3/20)
12. IC Transistor kit – 1No.
13. Instrumentation Amplifier kit-1 No.
14. Analog – Digital and Digital –Analog converters (ADC and DACs)- 1 No.

Course Outcomes (CO)	
CO1	Ability to understand control theory and apply them to electrical engineering problems
CO2	Ability to analyze the various types of converters
CO3	Ability to design compensators. Ability to understand the basic concepts of bridge networks.
CO4	Ability to the basics of signal conditioning circuits.
CO5	Ability to study the simulation packages.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	J	k	l	1	2	3	4
CO1	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO2	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO4	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
C05	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2

HS1310	PROFESSIONAL SKILLS LABORATORY	L	P	T	C
	(Common to CSE, EEE, CHEM, EIE,CIVIL, AI & DS)	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional.
- Make them Employable Graduates.
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.

UNIT II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language

UNIT III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -— questioning and clarifying –GD strategies- Structure and

dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc.

UNIT IV	**6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

UNIT V	**6**

Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management- developing a long- term career plan making career changes.

TOTAL : 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

One Server

30 Desktop Computers

One Hand Mike

One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,.OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	0	2	0	2	1	0	0	0	2	3	0	0	2	2	0	3
CO2	0	2	0	2	0	0	0	0	2	3	0	0	2	0	0	3
CO3	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	3
CO4	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0	3
CO5	0	2	1	1	2	0	2	0	2	3	0	2	2	2	0	3

Semester-5

EE1501	ELECTRICAL MACHINES - II	L	T	P	C
		2	1	0	3

Objectives

- Construction and performance analysis of salient and non–salient type synchronous generators.
- Principle of operation and performance analysis of synchronous motor.
- Construction, principle of operation and performance analysis of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and Performance analysis of single phase induction motors and special machines.

UNIT – I	SYNCHRONOUS GENERATOR	9
Constructional details: Types of rotors, stator - winding factors. EMF equation – Synchronous reactance–Armature reaction. Phasor diagrams of non-salient pole synchronous generator connected to infinite bus. Synchronization and parallel operation – Synchronizing torque - Change of excitation and mechanical input. Voltage regulation: EMF, MMF, ZPF and A.S.A methods. Steady state power - angle characteristics. Two reaction theory – slip test- short circuit transients –Capability Curves		CO1

UNIT – II	SYNCHRONOUS MOTOR	9
Principle of operation - Starting methods - Power input and power developed equations - Torque equation. Operation on infinite bus bars. V and Inverted V curves. Current loci for constant power input, constant excitation and constant power developed. Hunting – natural frequency of oscillations– damper windings. Synchronous condenser.		CO2

UNIT – III	**THREE PHASE INDUCTION MOTOR**	**9**
Constructional details: Types of rotors, stator - Principle of operation - Slip–cogging and crawling - Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque. Losses and efficiency. Load test - No load and blocked rotor tests - Circle diagram –Separation of losses; Double cage induction motors- Induction generators- Synchronous induction motor.		**CO3**
UNIT – IV	**STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR**	**9**
Need for starting - Types of starters: DOL, Rotor resistance, Autotransformer and Star-delta starters. Speed control: Voltage control, Frequency control and pole changing– Cascaded connection - V/f control – Slip power recovery scheme. Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.		**CO4**
UNIT – V	**SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES**	**9**
Constructional details of single phase induction motor - Double field revolving theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis. Starting methods of single-phase induction motors: Capacitor-start capacitor run Induction motor, Shaded pole induction motor; Linear induction motor- Repulsion motor- Hysteresis motor- AC series motor- Servomotor-Stepper motor; Introduction to magnetic levitation systems.		**CO5**
	Total Periods:	**45**

Text Books:

1. Nagrath, I.J. and Kothari.D.P., "Electric Machines", McGraw-Hill Education,5th Edition, 2017.
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, "Electric Machinery", 7th edition, McGraw Hill Books Company, 2020.

Reference Books:

1. Stephen J. Chapman, "Electric Machinery Fundamentals", 4th Edition, McGraw Hill Education Pvt. Ltd, 2017.
2. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education, 6th Edition, 2005.
3. B.L.Theraja and A.K.Theraja, "A Textbook of Electrical Technology" Vol II AC and DC Machines, 2020.
4. B.R. Gupta, "Fundamental of Electric Machines", New age International Publishers, 3rd Edition,Reprint 2015.

5. S.K. Bhattacharya, “Electrical Machines”, McGraw - Hill Education, New Delhi, 4th Edition, 2017.
6. P.C. Sen “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 3rd Edition 2013.
7. K. Murugesh Kumar, “Electric Machines”, Vikas publishing house Pvt Ltd,3rd Edition 2010.
8. Bimbhra P S, “Electrical Machinery”, Khanna Publishers, New Delhi, 2011.

Course Outcomes (CO)

CO1	Draw the constructional details and explain the performance of salient and non – salient type synchronous generators.
CO2	Draw and explain the Principle of operation and performance of synchronous motor.
CO3	Draw and describe the construction, principle of operation and performance of three phase induction machines.
CO4	Describe the starting and speed control of three-phase induction motors.
CO5	Explain the construction, principle of operation and performance of single phase induction motors and special machines.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	F	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1502	POWER SYSTEM ANALYSIS	L	T	P	C
		2	1	0	3

Objectives

- To impart knowledge on the need for “power system analysis” and model various power system components.
- To formulate the power flow equations and to conduct the power flow analysis by Numerical methods.

- To model and carry out short circuit studies of power system for symmetrical faults and to determine the fault levels of different buses.
- To learn about the symmetrical components and their application to carry out short circuit studies of power system for unsymmetrical faults and to determine the fault levels of different buses
- To model and perform stability analysis of the power system using graphical and analytical methods.

UNIT – I	**POWER SYSTEM OVERVIEW**	**9**
Need for system planning and operational studies - Power scenario in India - Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram, p.u. reactance diagram - Formation of bus admittance matrix - direct inspection method, singular transformation - Representation of off-nominal transformer - Formation of bus admittance matrix of large power network.		**CO1**
UNIT – II	**POWER FLOW ANALYSIS**	**9**
Significance of Power Flow Analysis in planning and operation- Formulation of Power Flow problem in rectangular and polar coordinates - Bus classification - Power flow solution using Gauss-Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton-Raphson method.		**CO2**
UNIT – III	**SYMMETRICAL FAULT ANALYSIS**	**9**
Importance of short circuit studies-Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix by building algorithm (without mutual coupling) - Symmetrical fault analysis using bus impedance matrix - Post fault bus voltages – Fault level - Current limiting reactors.		**CO3**
UNIT – IV	**UNSYMMETRICAL FAULT ANALYSIS**	**9**
Symmetrical components - Sequence impedances – Sequence circuits of synchronous machine, transformer and transmission line-Sequence networks - Analysis of unsymmetrical faults: single-line to-ground, line-to-line and double-line-to-ground using Thevenin's theorem and Z-Bus - computation of post fault currents in symmetrical component and phasor domains.		**CO4**
UNIT – V	**STABILITY ANALYSIS**	**9**
Importance of stability studies-Classification of power system stability: rotor angle stability and voltage stability –Single Machine Infinite Bus(SMIB) system: Development of swing equation - Equal area criterion - Critical clearing angle and time -solution of the swing equation – modified Euler method and Runge-Kutta fourth order method.		**CO5**

Total Periods:	**45**

Text Books:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', McGraw Hill Education (India) Private Limited, New Delhi, 2017.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Third Edition, 2019.
3. Hadi Saadat, 'Power System Analysis', 3rd edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

Reference Books:

1. Pai M A and Chatterjee, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Third Edition, 2017.
2. J.Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Sixth Edition, 2017.
3. Gupta B.R., 'Power System - Analysis and Design', Seventh Edition, S. Chand Publishing, 2005.
4. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2006.

Course Outcomes (CO)

CO1	To understand the modelling of the power system components and network modelling for the power system studies.
CO2	To understand the formulation of the power flow equation and its solutions using numerical methods.
CO3	To understand the basics of the symmetrical fault and its analysis using Thevenin's method and bus impedance matrix.
CO4	To understand the basics of the unsymmetrical faults, symmetrical components and its analysis using Thevenin's method and bus impedance matrix.
CO5	To understand the various stability problems in power systems and its solutions using equal area criterion and by using numerical methods.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	1	1	1	1	1	2	1	2	3	1	3	1
CO2	3	3	3	3	3	1	1	1	1	2	1	2	3	3	3	1
CO3	3	3	3	3	3	2	1	2	2	2	1	2	3	3	3	1

CO4	3	3	3	3	2	2	1	2	2	2	2	2	3	2	3	2
C05	3	3	3	3	3	2	1	1	2	2	2	2	3	3	3	2

EE1571	**POWER ELECTRONICS**	**L**	**T**	**P**	**C**
	(Common to EEE and EIE)	3	0	0	3

Objectives

- To impart knowledge on different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of uncontrolled and controlled rectifiers.
- To learn the Operation, switching techniques and basics topologies of DC-DC switching regulators.
- To Compute and analyse the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To understand the operation of AC to AC converter.

UNIT – I	**POWER SEMI-CONDUCTOR DEVICES**	**9**
Study of switching devices - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT; Static characteristics - SCR, MOSFET and IGBT; Triggering and commutation circuit for SCR; Introduction to Driver and snubber circuits.		**CO1**

UNIT – II	**UNCONTROLLED AND PHASE-CONTROLLED CONVERTERS**	**9**
Uncontrolled converters- half bridge and full bridge converters; Controlled converters - 2-pulse, 3-pulse and 6-pulse converters – performance parameters; Effect of source inductance; Firing Schemes for converter; Dual converters; Applications-light dimmer, Excitation system.		**CO2**

UNIT – III	**DC TO DC CONVERTERS**	**9**
Step-down and Step-up chopper; control strategy; Introduction to types of choppers - A, B, C, D and E; Switched mode regulators- Buck, Boost, Buck- Boost regulator; Introduction to Resonant Converters; Applications-Battery operated vehicles and Solar PV systems.		**CO3**

UNIT – IV	**INVERTERS**	**9**
Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode); Voltage & harmonic control; PWM techniques - Multiple PWM, Sinusoidal		**CO4**

PWM, modified sinusoidal PWM; Introduction to space vector modulation; Current source inverter; Applications-Induction heating, UPS.		
UNIT – V	**AC TO AC CONVERTERS**	**9**
Single phase and Three phase AC voltage controllers - Control strategy, Power Factor Control, Multistage sequence control; Single phase and three phase cyclo – converters; Introduction to Matrix converters; Applications –welding.		**CO5**
	Total Periods:	**45**

Text Books:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Fourth Edition, New Delhi, 2013.
2. P.S.Bimbra "Power Electronics" Vidyareddy Publishers, 2014.
3. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 1998.

Reference Books:

1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 1995.
2. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, Second Edition, 2017.
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2009.
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters,Application and Design, John Wiley and sons, Third Edition, 2007.
5. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, Second Edition, 2014.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, Second Edition, 2017.
7. JP Agarwal," Power Electronic Systems: Theory and Design" Pearson Education, 2000.

Course Outcomes (CO)

CO1	Ability to understand the operation of semiconductor devices and its dynamic characteristics.
CO2	Ability to analyse and choose the Uncontrolled and controlled converters for real time applications.
CO3	Ability to analyse the operation of DC- DC converter and its applications.
CO4	Able to Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5	Able to Understand the operation of AC voltage controllers and its applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2	1

EE1572	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
	(Common to EEE and EIE)	3	0	0	3

Objectives

- To study the architecture, pin diagram, memory organisation and interrupts of 8085 microprocessor and 8051 microcontroller.
- To study the addressing modes & instruction sets of 8085 and 8051.
- To develop skills in simple programming writing using assembly languages.
- To introduce commonly used peripherals/ interfacing ICs.
- To study and understand typical applications using 8085 and 8051.

UNIT – I	8085 PROCESSOR	9
Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Interrupts.		CO1

UNIT – II	PROGRAMMING OF 8085 PROCESSOR	9
Instruction format and addressing modes – Assembly language format – Data transfer, data Manipulation& control instructions – Programming: Loop structure with counting & Indexing –Look up table - Subroutine instructions – stack, Timing diagram of instructions.		CO2

UNIT – III	PERIPHERAL INTERFACING	9
Study on need, architecture, configuration and interfacing, with ICs: 8251, 8253/8254, 8255, 8259, 8279, A/D and D/A converters & its Interfacing with 8085.		CO3

UNIT - IV	8051 MICROCONTROLLER	9
Hardware Architecture, Pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timers-serial communication;		CO4

Interrupts, Instruction sets- Data Transfer, Manipulation, Control Algorithms & I/O instructions; Addressing modes; Timing Diagram; Comparison to Programming concepts with 8085.		
UNIT – V	**MICROCONTROLLER PROGRAMMING & APPLICATIONS**	**9**
Simple programming exercises; Key board and display interface; Control of servo motor, Stepper motor control, Application to automation systems.		**CO5**
	Total Periods:	**45**

Text Books:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application' with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
3. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 6th Indian reprint, 2013.

Reference Books:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2nd edition, 2013.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu, 2016.
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu, 2016.

Course Outcomes (CO)

CO1	Ability to explain the architecture, memory organisation and interrupt structures of 8085 Microprocessor.
CO2	Ability to acquire knowledge in Addressing modes, instruction sets, timing diagram and to write the assembly language program of 8085 Microprocessor.
CO3	Ability to understand the importance of Interfacing with microprocessors and microcontrollers.
CO4	Ability to explain the architecture of Microcontroller, addressing modes & instruction sets of 8051.
CO5	Ability to develop the Microprocessor and Microcontroller based applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	2	1	1	1	1	3	2	2	1
CO2	3	3	2	1	3	3	1	2	1	1	3	1	3	3	2	1
CO3	3	2	2	1	1	1	1	2	1	1	1	1	3	3	2	1
CO4	3	2	2	1	1	2	1	2	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	3	1	2	1	1	3	1	3	2	2	1

EE1581	ELECTRICAL MACHINES LABORATORY - II	L	T	P	C
		0	0	4	2

Objectives

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS

1. Predetermination of voltage regulation of three phase alternator by EMF, MMF and ZPF method, and ASA methods.
2. Determination of voltage regulation of three phase salient pole alternator by slip test.
3. Determination of negative and zero sequence impedance of three phase alternator.
4. Load test on three phase alternator.
5. Determination of V and inverted V curves of three phase synchronous motor.
6. Load test on three phase squirrel cage induction motor.
7. No-load and blocked rotor test on three phase squirrel cage induction motor.
8. Load test on single phase induction motor.
9. No-load and blocked rotor test on single phase induction motor.
10. Speed control of three phase slip ring induction motor using rotor resistance and variable frequency method.
11. Separation of no-load losses of three phase induction motor.

Total Periods:	60

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. Synchronous motor 3HP – 1 No.
2. DC Shunt motor Coupled with Three phase Alternator – 4 Nos.
3. DC Shunt motor Coupled with Three phase Slip Ring Induction motor – 1 No.
4. Three phase Induction motor with Loading arrangement – 2 Nos.
5. Single phase Induction motor with Loading arrangement – 2 Nos.
6. Tachometer – Digital/Analog – 8 Nos.
7. Single Phase Auto Transformer – 2 Nos.
8. Three Phase Auto Transformer – 2 Nos.
9. Single Phase Resistive Loading bank - 2 Nos.
10. Three Phase Resistive Loading bank - 2 Nos.
11. Capacitor Bank – 1 No.

Course Outcomes (CO)

CO1	Understand the procedure to conduct EMF, MMF and ZPF and ASA test on AC generator and able to find its performance characteristics.
CO2	Understand the procedure to conduct direct test on AC generator and able to find its performance characteristics.
CO3	Understand the procedure to conduct direct test on induction machines and able to find its performance characteristics.
CO4	Understand the procedure to conduct indirect test on induction machines and able to find its performance characteristics.
CO5	Understand the procedure to conduct no load test on synchronous motor and able to plot its excitation characteristics.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	3	1	1	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	3	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	3	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	3	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	3	1	1	1	2	3	2	2	1

EE1582	POWER ELECTRONICS AND DRIVES LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.
- To analyse the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.
- To study the behaviour of voltage waveforms of PWM inverter applying various modulation techniques
- To design and analyse the performance of SMPS
- To study the performance of AC voltage controller by simulation and Experimentation.

LIST OF EXPERIMENTS

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and TRIAC.
3. Characteristics of MOSFET and IGBT.
4. AC to DC half-controlled converter.
5. AC to DC fully controlled Converter.
6. Step down and Step up MOSFET based Choppers.
7. IGBT based single phase PWM inverter.
8. IGBT based three phase PWM inverter.
9. AC Voltage controller.
10. Switched Mode Power converter.
11. Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, AC voltage controllers).
12. Characteristics of GTO & IGCT.
13. Characteristics of PMBLDC motor.

Total Periods:	**60**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Device characteristics (for SCR, MOSFET, TRIAC, GTO, IGCT and IGBT kit with built-in / discrete power supply and meters) - 2each.
2. SinglephaseSCRbasedhalfcontrolledconverterandfullycontrolledconverteralo ng with built-in/separate/firing circuit/module and meter – 2each.
3. MOSFET based step up and step-down choppers (Built in/ Discrete) – 1each.
4. IGBT based single phase PWM inverter module/Discrete Component –2
5. IGBT based three phase PWM inverter module/Discrete Component –2
6. Switched mode power converter module/Discrete Component –2

7. SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load -2
8. Cyclo converter kit with firing module –1
9. Dual regulated DC power supply with common ground.
10. Cathode ray Oscilloscope–10
11. Isolation Transformer –5
12. Single phase Auto transformer–3
13. Components (Inductance, Capacitance) 3 sets of each.
14. Multimeter –5
15. LCR meter –3
16. Rheostats of various ranges – 2 sets of 10value.
17. Work tables – 10
18. DC and AC meters of required ranges –20
19. Component data sheets to be provided.

Course Outcomes (CO)

CO1	Able to determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT.
CO2	Able to find the transfer characteristics of full converter, semi converter, step up and step-down choppers by simulation and experimentation.
CO3	Able to analyse the voltage waveforms for PWM inverter using various modulation techniques.
CO4	Able to design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.
CO5	Able to understand the performance of AC voltage controllers by simulation and experimentation.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	2	1	1	1	1	2	3	2	2	1
CO2	3	3	3	3	3	2	2	1	1	1	1	2	3	2	2	1
CO3	3	3	3	3	3	2	1	1	1	1	1	2	3	2	2	1
CO4	3	3	3	3	3	2	1	1	1	1	1	2	3	2	2	1
C05	3	3	3	3	3	2	1	1	1	1	1	2	3	2	2	1

EE1591	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Read a key, interface display
7. Interface 8253 timer and perform mode-2 and mode-3 operation.
8. Demonstration of basic instructions with 8051 Micro controller
   (i) Conditional jumps & looping
   (ii) Calling subroutines.
9. Programming timer of 8051
10. Programming I/O Port of 8051 for
    (i) Interfacing of A/D & D/A
    (ii) Interfacing of DC & AC motors
11. Programming Practices with Simulators/Emulators/open source
12. Application hardware development using embedded processors.

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	Description of Equipment	Quantity required
1	8085 Microprocessor Trainer with Power Supply	15
2	8051 Micro Controller Trainer Kit with power Supply	15
3	8255 Interface boards	5
4	8251 Interface boards	5
5	8259 Interface boards	5
6	8279 Keyboard / Display Interface boards	5
7	8253/8254 timer/ counters	5
8	ADC and DAC cards	5
9	AC & DC motor with Controllers	5
10	Traffic Light Control Systems	5

Course Outcomes (CO)

CO1	Ability to perform basic programming using 8085 and 8051
CO2	Ability to perform interfacing of various peripheral ICs using 8085 & 8051
CO3	Ability to program basic interfacing applications.
CO4	Ability to use basic Simulators/Emulators/open source related to 8085 & 8051.
CO5	Ability to design and develop a simple application using any embedded processors.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	1	1	1	1	1	1	1	1	3	2	2	1	1
CO2	3	2	2	2	2	2	2	1	1	1	1	3	2	3	2	1
CO3	3	2	3	2	2	1	2	1	1	1	1	3	2	3	2	1
CO4	3	2	2	2	3	2	1	1	1	1	1	3	2	3	2	1
C05	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3

SEMESTER-6

EE1601	SOLID STATE DRIVES	L	T	P	C
		3	0	0	3

Objectives

- Steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- Analyze the operation and performance of induction motor drives.
- Analyze the operation and performance of synchronous motor drives.
- Design the current and speed controllers for a closed loop solid state DC motor drive.

UNIT – I	DRIVE CHARACTERISTICS	9
Electric drive , Equations governing motor load dynamics ,steady state stability ;multi quadrant Dynamics –acceleration, deceleration, starting & stopping ; typical load torque characteristics ;Selection of motor.		**CO1**

UNIT – II	CONVERTER / CHOPPER FED DC MOTOR DRIVE	9
Steady state analysis of the single and three phase converter fed separately excited DC motor drive,continuous conduction ; Time ratio and current limit control ; 4 quadrant operation of converter / chopper fed drive-Applications.		**CO2**

UNIT – III	INDUCTION MOTOR DRIVES	9
Stator voltage control; V/f control;Rotor Resistance control; qualitative treatment of slip power recovery drives;closed loop control;vector control ; Applications.		**CO3**

UNIT – IV	SYNCHRONOUS MOTOR DRIVES	9
V/f control and self-control of synchronous motor: Margin angle control and power factor control; Three phase voltage/current source fed synchronous motor; Applications.		**CO4**

UNIT – V	DESIGN OF CONTROLLERS FOR DRIVES	9
Transfer function for DC motor / load and converter ; closed loop control with Current and speed feedback;armature voltage control and field weakening mode ;Design of controllers ,current controller and speed controller; converter selection and characteristics.		**CO5**

Total Periods:	**45**

Text Books:

1. R.Krishnan, Electric Motor Drives- Modeling, Analysis, and Control, Prentice-Hall of Indian Private Limited, New Delhi, 2015.
2. Bimal K.Bose, "Modern Power Electronics and AC Drives, Pearson Education (Singapore) Ltd., New Delhi, 2015.
3. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, second edition 2010.

Reference Books:

1. Vedam Subramanyam, "Electric Drives Concepts and Applications", 2e, McGraw Hill, 2016.
2. Theodore Wildi, "Electrical Machines, Drives and power systems ,6th edition, Pearson Education ,2015.
3. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
4. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
5. N.K. De., P.K. SEN" Electric drives" PHI, 2012.

Course Outcomes (CO):

CO1	Analyze the speed control mechanisms of electrical machines to justify the selection of drives for their effective usage.
CO2	Evaluate the performance of converter and chopper fed DC motor drive.
CO3	Understand the power electronic converters used for induction motor speed control.
CO4	Understand the power electronic converters used for synchronous motor speed control.
CO5	Design controllers for electric drives.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	F	G	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	3	1	1	1	1	1	3	3	2	1
CO2	3	3	3	3	3	2	3	1	1	1	1	1	3	3	2	1
CO3	3	3	3	3	3	2	3	1	1	1	1	1	3	3	2	1
CO4	3	3	3	3	3	2	3	1	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	2	3	1	1	1	1	1	3	3	2	1

EE1602	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To create awareness about renewable and non-renewable Energy Sources, technologies and its impact on the environment
- To learn wind energy conversion system and its issues with grid integration.
- To learn the concepts of solar PV and solar thermal systems.
- To learn other alternate energy sources such as Biomass, geothermal energy and hydro energy variety of issues in harnessing
- To understand the concept of tidal energy, hydrogen energy, ocean thermal energy and its significance.

UNIT – I	RENEWABLE ENERGY SOURCES	9
Conventional energy sources- Fossil Fuels, types of fossil fuel, Environmental consequences of fossil fuel use; Non-Conventional energy sources- Renewable energy(RE) and its types, Significances of renewable energy sources, Sustainable design and development; Effects and Limitations of RE sources; Present Indian and international energy scenario of NRE and RE sources.		**CO1**

UNIT – II	WIND ENERGY	9
Wind formation; Power in the Wind; WPP (wind power plant)- Components of WPPs, Types of Wind Power Plants (WPPs),Working of WPPs; Siting of WPPs; Grid integration issues of WPPs.		**CO2**

UNIT – III	SOLAR - THERMAL SYSTEMS AND PV SYSTEMS	9
Solar Radiation; Radiation Measurement; Solar Thermal system and its types; Solar Photovoltaic systems (SPV) - Basic Principle of SPV conversion, Types of PV Systems- Types of Solar Cells; Photovoltaic cell concepts- Cell, module, array, I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.		**CO3**

UNIT – IV	BIOMASS,GEOTHERMAL AND HYDRO ENERGY SOURCES	9
Introduction; Bio mass resources and Energy from Bio mass- conversion processes, Biomass Cogeneration, Environmental Benefits; Geothermal Energy- Basics, Direct Use, Geothermal Electricity; Mini/micro hydro power- Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.		**CO4**

UNIT – V	OTHER ENERGY SOURCES	9
Tidal Energy- Energy from the tides, Barrage and Non Barrage Tidal power systems; Wave Energy- Energy from waves, wave power devices; Ocean Thermal Energy Conversion (OTEC); Hydrogen Production and Storage; Fuel cell - Principle of working, various types, construction and applications; Energy Storage System; Hybrid Energy Systems.		**CO5**
	Total Periods:	**45**

Text Books:

1. Joshua Earnest, Tore Wizeliu, "Wind Power Plants and Project Development", PHI Learning Pvt.Ltd, New Delhi, 2011.
2. Joshua Earnest,Sthuthi Rachel, "Wind power Technology", PHI Learning Pvt.Ltd, New Delhi, 2019.
3. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
4. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2015.

Reference Books:

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011.
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2018.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2018.
4. Bradley A. Striebig, AdebayoA.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2015.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education , 2015.

Course Outcomes (CO)

CO1	Ability to create awareness about non- renewable and renewable Energy Sources and technologies
CO2	Acquire knowledge on the concepts of wind energy conversion system, siting and grid related issues.
CO3	Ability to understand the solar PV and solar thermal systems
CO4	Ability to analyse other types of renewable energy resources like biomass, geothermal and Hydro energy.
CO5	Ability to Acquire knowledge on tidal energy, hydrogen energy, ocean thermal energy and fuel cell.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	F	G	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

EE1671	DIGITAL SIGNAL PROCESSING	L	T	P	C
	(Common to EEE and EIE)	2	1	0	3

Objectives

- Signals, systems, sampling techniques and their mathematical representation.
- Analysis of Discrete time systems like Z-transforms, Discrete Time Fourier transform and its applications.
- Discrete Fourier Transformation, Fast Fourier Transformation technique and their computation.
- Filters and their design procedure for digital implementation.
- Digital Signal Processor and its addressing modes.

UNIT – I	INTRODUCTION TO SIGNALS AND SYSTEM	9
Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance – Classification of signals: continuous and discrete, energy and power, mathematical representation of signals – Spectral density – sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.		CO1

UNIT – II	DISCRETE TIME SYSTEM ANALYSIS	9
Z-transform and its properties, inverse Z-transforms, difference equation – Solution by Z- transform, application to discrete systems – Stability analysis, frequency response – Convolution – Discrete Time Fourier transform, magnitude and phase representation.		CO2

UNIT – III	DISCRETE FOURIER TRANSFORM & COMPUTATION	9

Discrete Fourier Transform- properties, magnitude and phase representation – Computation of DFT: using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.		**CO3**
UNIT – IV	**DESIGN OF DIGITAL FILTERS**	**9**
FIR & IIR filter realization: Parallel & cascade forms – FIR design: Windowing Techniques, Need and choice of windows, Linear phase characteristics – Analog filter design: Butterworth and Chebyshev approximations – IIR Filters: Digital design using Impulse Invariant and Bilinear Transformation, Warping, pre warping.		**CO4**
UNIT – V	**DIGITAL SIGNAL PROCESSORS**	**9**
Introduction – Architecture – Features – Instruction Set – Addressing Formats – Functional modes – Introduction to Commercial Digital Signal Processors.		**CO5**
	Total Periods:	**45**

Text Books:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2012.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3. Lonnie C. Ludeman, 'Fundamentals of Digital Signal Processing', Wiley, 2013.

Reference Books:

1. Poorna Chandra S, Sasikala. B, 'Digital Signal Processing', Vijay Nicole/TMH, 2013.
2. Robert Schilling & Sandra L.Harris, 'Introduction to Digital Signal Processing using MATAB', Cengage Learning, 2014.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010.
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with MatLab', CRC Press, 2009.
5. Sen M.Kuo, Woon-Seng S Gan, 'Digital Signal Processors', Architecture, Implementations & Applications', Pearson, 2013.
6. Dimitris G. Manolakis, Vinay K. Ingle, 'Applied Digital Signal Processing', Cambridge, 2012.
7. Emmanuel C. Ifeachor, 'Digital Signal Processing – A Practical Approach', 2nd Edition, Prentice Hall, 2011.

Course Outcomes (CO)	
CO1	Acquire knowledge on Signals, systems, sampling techniques & their mathematical representation.
CO2	Understand and analyze the Discrete Time Systems like Z-transforms, Discrete Time Fourier transform and its applications.
CO3	Analyze the transformation techniques & their computation.
CO4	Understand the types of filters and their design procedure for digital implementation.
CO5	Gain knowledge about Digital Signal Processor and its addressing modes.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	A	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1

EE1672	EMBEDDED SYSTEMS (LAB INTEGRATED)	L	T	P	C
	(Common to EEE and EIE)	3	0	2	4

Objectives

- Building blocks of Embedded System.
- Introduction to Embedded processors.
- Bus communication in processors, Input/output interfacing.
- Basics of real time operating system.
- Real-time applications of an embedded system.

UNIT - I	INTRODUCTION TO EMBEDDED SYSTEMS	9
Introduction to Embedded Systems –Building blocks of Embedded System, Structural units in Embedded processor, selection of processor & memory devices- DMA –		CO1

Memory management methods- Timer and Counting devices, Watchdog Timer, Oscillator and Reset Circuits-Real Time Clock. Introduction to a brief study on a typical embedded processor.		
UNIT - II	**INTRODUCTION TO EMBEDDED PROCESSORS**	**9**
Introduction to PIC 16F877A microcontroller: architecture and pin diagram, Overview of instruction sets and addressing modes. Introduction to ARM processor: Architecture and pin diagram of CORTEX processor. Micro-c and Keil compilers for programming using embedded C coding.		**CO2**
UNIT – III	**EMBEDDED NETWORKING**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols- RS232 standard – RS422 – RS 485- Inter Integrated Circuits (I2C), Serial Peripheral Interface (SPI), CAN Bus, – USB- Wi-Fi- Bluetooth- Zigbee - need for Device Drivers.		**CO3**
UNIT - IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Pre-emptive and non-pre-emptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-Polling and interrupt handling mechanism-Overview and comparison of commercial RTOS:VX works- µC/OS-II.		**CO4**
UNIT - V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**9**
Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.		**CO5**
		THEORY : 45 periods **PRACTICAL** : 30 periods **TOTAL** : 75 Periods

List of Programming exercises:

1. Study of Embedded processors: PIC and ARM
2. Toggle pins and make an LED glow.
3. Buzzer alarm

4. 3 x 3 keypad matrix and display a key
5. Seven-segment Display
6. A/D conversion
7. D/A conversion
8. Generation of a PWM signal
9. Interface a DC motor and stepper motor
10. Interfacing a temperature sensor
11. ESP-8266 wifi MCU for IOT applications.

List of Equipment, software tools and compilers:

1. PIC 16F877a demonstration board with peripherals
2. ARM cortex board with peripherals
3. Desktops with advanced Pentium processors
4. Proteus software tool
5. Micro c -compiler
6. Keil-compiler

Text Books:

1. Peckol, "Embedded system Design", John Wiley & Sons,2010.
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013.
3. Shibu. K.V, "Introduction to Embedded Systems", Second Edition, McGraw Hill, 2017.
4. Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach Paperback – 1 March 2017.
5. PIC microcontroller and Embedded systems Using Assembly and C for PIC18,second edition,2021.

Reference Books:

1. Raj Kamal, 'Embedded Systems-Architecture, Programming, Design', Second Edition, Mc Graw Hill, 2013.
2. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, "Embedded Systems Architecture", Second Edition, Newnes, 2012.
4. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

Course Outcomes (CO)

CO1	Ability to understand the basic blocks of an embedded systems.
CO2	Ability to understand the embedded processors and its programming

CO3	Ability to acquire knowledge about the embedded network protocols.
CO4	Ability to understand basics of real time operating system.
CO5	Ability to suggest an embedded system for a given application.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	1	2	1	2	1	1	1	1	1	1	3	1	2	1	1
CO2	2	1	1	2	3	1	1	1	1	1	1	3	1	2	1	1
CO3	2	1	2	2	3	1	1	1	3	3	3	3	1	2	1	3
CO4	2	1	2	3	3	3	2	1	1	1	1	3	2	1	1	1
C05	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2

DS1302	OBJECT ORIENTED PROGRAMMING (LAB INTEGRATED)	L	P	T	C
	(Common to ADS, EEE, EIE)	3	0	2	4

Objectives

- To analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- To design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I	JAVA FUNDAMENTALS	9 +6
Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and String Buffer **Lab Component:**		**CO1**

1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 - 4ac$ is negative, display a message stating that there are no real solutions. 2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence		
UNIT II	**OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE**	**9 + 6**
Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes. **Lab Component:** 1. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number of Sides ( ) that shows the number of sides in the given geometrical figures 2. Write a Java program that counts the number of objects created by using static variable		**CO2**
UNIT III	**EXCEPTIONS, COLLECTIONS AND STREAMS**	**9 + 6**
Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. **Lab Component:** 1. Write a Java program to make frequency count of words in a given text 2. Write a Java program to implement a Queue using user defined Exception Handling		**CO3**

(also make use of throw, throws.).		
UNIT IV	**CONCURRENT PROGRAMMING AND GUI PROGRAMMING**	**9 + 6**
Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag. **Lab Component:** 1. Write a Java program that creates three threads. First thread displays "Good Morning" everyone second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds. 2. Write a java Program to create a window when we press i. M or m the window displays Good Morning ii. A or a the window displays Good After Noon iii. E or e the window displays Good Evening iv. N or n the window displays Good Night		**CO4**
UNIT V	**JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING**	**9 + 6**
Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams. **Lab Component:** 1.Develop a program for executing the remote command using TCP Socket 2.Create a GUI program in java with the following components.		**CO5**

i. A frame with Flow layout. ii. Add the following components on to the frame. a) Two Text Field b) A button with the label display iii. Allow the user to enter data into the JTextField iv. When the button is clicked paint the frame by displaying the data entered in the JTextField v. Allow the user to properly close the frame	

TOTAL : 45 + 30 PERIODS

TEXT BOOKS

1. Herbert schildt , "The complete reference", 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2. Cay S. Horstmann, "Core Java SE 9 for the Impatient", 2nd Edition, Addison-Wesley,2017 .
3. Paul Deitel, Harvey M. Deitel, "Java How to Program", 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. T. Budd, "An Introduction to Object Oriented Programming", 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , "Introduction to Java programming", 7th Edition, Pearson education, 2010.
3. C Xavier , "Java Programming – A Practical Approach", Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, "The Java programming language", 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

CO1	Understand the fundamental ideas behind the object-oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification

CO3	Develop and implement java programs with exception handling and various I/O Streams
CO4	A modern coverage of generic programming and concurrent programming that focuses on high-level synchronization constructs
CO5	To know the concept of event handling used in GUI and accessing database using JDBC

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	1	1	2	2	2	1	-	2	1	1	1	2	1	1	1
CO2	1	1	2	2	1	1	2	-	2	1	1	1	2	1	2	2
CO3	2	2	2	2	2	2	1	-	2	2	2	1	1	1	2	2
CO4	1	3	2	2	2	2	1	-	1	1	2	1	3	1	3	2
C05	2	3	3	2	3	2	1	-	2	1	2	2	1	1	2	1

EE1681	RENEWABLE ENERGY SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To train the students in Renewable Energy Sources and technologies
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and future role of Renewable energy sources.

LIST OF EXPERIMENTS

1. Simulation study on Solar- PV energy system.
2. Experiment on VI-Characteristics and Efficiency of 1kWp solar PV system.
3. Experiment on Shadowing effect & diode based solution in 1kWp Solar PV System.
4. Experiment on performance assessment of grid connected and Standalone 1kWp Solar power system.
5. Simulation study on Wind Energy Generator.
6. Experiment on performance assessment of micro-wind Energy Generator.

7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on performance Assessment of Hybrid (Solar-Wind) Power System.
9. Simulation study on Hydel Power.
10. Experiment on performance Assessment of 100W Fuel Cell.
11. Simulation study on Intelligent Controllers for Hybrid Systems.

Total Periods:	**60**

Requirements for a batch of 30 students

S.No.	Description of Equipment	Quantity required
1	Personal computers (Intel i3, 80GB, 2GBRAM)	15
2	CRO 30MHz	9
3	Digital Multimeter	10
4	PV panels – 1 kW, 100W	1
5	Battery storage system with charge and discharge control 40Ah	1
6	PV Emulator	1
7	Micro- wind Energy Generator module	1
8	Potentiometer	5
9	Step-down transformer 230V/12-0-12V	5
10	100W Fuel cell trainer module	1

Course Outcomes (CO)

CO1	Ability to understand and analyse renewable energy systems.
CO2	Ability to train the students in renewable energy sources and technologies.
CO3	Ability to provide adequate inputs on a variety of issues in harnessing renewable energy.
CO4	Ability to simulate the various renewable energy sources and to understand basics of Intelligent Controllers
CO5	Ability to recognize current and possible future role of renewable energy sources.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3

CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	3	3	3	3	3	3

EE1682	**MINI PROJECT**	**L**	**T**	**P**	**C**
		0	0	4	2

Objectives

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

The students in a group of 5 to 6 works on a topic approved by the Head of the Department and prepares a comprehensive mini project report after completing the work to thesatisfaction. The progress of the project is evaluated based on a minimum of two reviews. Thereview committee may be constituted by the Head of the Department. A mini project report isrequired at the end of the semester. The mini project work is evaluated based on oralpresentation and the mini project report jointly by external and internal examiners constitutedby the Head of the Department

TOTAL PERIODS	**60**

Course Outcomes (CO)

On Completion of the mini project work students will be in a position to take up theirfinal year project work and find solution by formulating proper methodology.

Semester-7

EE1701	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

Objectives

- To understand the various types of over voltages in power system and protection methods
- To impart knowledge on breakdown mechanisms of different dielectrics
- To learn about high voltage and high current generation techniques
- To teach the different measurements techniques of high voltages & currents
- To learn the Testing of power apparatus and insulation coordination

UNIT – I	OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS	9
Causes of over voltages and its effects on power system – Lightning, charge formation theories, mathematical modelling, characteristics – Switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- Bewley's Lattice diagram -Protection against over voltages		CO1

UNIT – II	DIELECTRIC BREAKDOWN IN GASES,LIQUIDS AND SOLIDS.	9
Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids– Breakdown mechanisms in solid and composite dielectrics.		CO2

UNIT – III	GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS	9
Generation of high D.C. voltages using voltage multiplier circuits - Greinacher Voltage Doubler - Cockroft Walton Voltage Multiplier - Electrostatic generator principle - Van de Graff generator -Generation of high AC voltages: cascaded transformers, Resonant transformer and Tesla coil- Generation of switching surges – Generation of Impulse currents - Triggering and control of impulse generators		CO3

UNIT – IV	MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS	9
High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers –Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.		CO4

UNIT – V	HIGH VOLTAGE TESTING & INSULATION COORDINATION	9
High voltage testing of electrical power apparatus as per International and Indian standards – testing of Insulators, circuit breakers, bushing, isolators and transformers-testing of cables-Insulation Coordination		CO5
	Total Periods:	**45**

Text Books:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2020.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Fourth Edition, 2020.

Reference Books:

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering – Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

Course Outcomes (CO)

CO1	Able to understand the sources and effects of switching surges, lightning and temporary over voltages, corona and its effects in power systems, various protection mechanisms against overvoltage.
CO2	Able to understand the nature of various breakdown mechanisms in gas, liquid and solid dielectrics.
CO3	Able to understand and analyze the various methods of generating high voltage AC, DC and impulse voltages and currents.
CO4	Able to understand and analyze the various methods of measuring high voltage AC, DC and impulse voltages and currents.
CO5	Able to understand and analyze the various methods of testing insulators, circuit breakers, bushings, Isolators and transformers, insulation coordination.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	1	3	2	2	2	1	1	1	2	3	2	2	1
CO2	3	2	1	1	1	2	1	3	1	1	1	3	3	1	1	1
CO3	3	3	1	2	1	2	1	3	1	1	1	3	3	1	1	1
CO4	3	3	1	2	1	2	1	3	1	1	1	3	3	1	1	1
CO5	3	2	1	1	1	2	2	3	1	1	1	3	3	1	1	1

EE1702	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- Significance of power system operation and control.
- Real power– frequency interaction and design of power– frequency controller.
- Reactive power– voltage interaction and the compensators for maintaining the voltage profile.
- Generation scheduling and economic operation of power system.
- SCADA and its application for real time operation and control of power systems.

UNIT – I	INTRODUCTION	9
Power scenario in Indian grid – National and Regional load dispatching centres – Requirements of good power system – Necessity of voltage and frequency regulation – System load variation, load curves – Load forecasting – Computational methods in load forecasting – Load shedding and Islanding, Basics of electrical energy tariff.		**CO1**

UNIT – II	REAL POWER – FREQUENCY CONTROL	9
Basics of speed governing mechanisms and modelling – Speed regulation of two generators in parallel Load Frequency Control (LFC) of single area system – Static and dynamic analysis – LFC of two area system –Tie line modelling – Block diagram representation of two area system – Static and dynamic analysis – Tie line with frequency bias control – State variable model – Integration of economic dispatch control with LFC.		**CO2**

UNIT – III	REACTIVE POWER – VOLTAGE CONTROL	9
Generation and absorption of reactive power – Basics of reactive power control – Automatic Voltage Regulator (AVR) – Brushless AC excitation system – Block diagram representation of AVR loop static and dynamic analysis – Stability compensation – Voltage drop in transmission line – Methods of reactive power injection – Tap changing transformer, SVC and STATCOM for voltage control, Introduction to Dynamic Voltage Restorer.		**CO3**
UNIT – IV	**ECONOMIC OPERATION OF POWER SYSTEM**	**9**
Statement of economic dispatch problem – Input and output characteristics of thermal plant incremental cost curve – Optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) – Lambda–iteration method – Base point and participation factors method. Statement of Unit Commitment (UC) problem – Constraints on UC problem – Solution of UC problem using priority list – Special aspects of short term and long term hydrothermal scheduling problems.		**CO4**
UNIT – V	**COMPUTER AIDED CONTROL OF POWER SYSTEM**	**9**
Need of computer control of power system – Concept of energy control centres and functions – PMU system monitoring, Data acquisition and controls – System hardware configurations – SCADA and EMS functions – State estimation – Measurements and errors – Weighted least square estimation – Various operating states – State transition diagram.		**CO5**
	Total Periods:	**45**

TEXT BOOKS:

1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 36th reprint, 2014.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, Reprint 2018.

Reference Books:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw – Hill Education, Second Edition, Reprint 2018.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 23rd reprint, 2015.

3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 12th reprint, 2015.

Course Outcomes (CO)

CO1	To acquire knowledge about loads, analysis of Indian Power grid and its parameters, forecasting of demand and other issues.
CO2	To understand the dynamics of frequency and power generation in power systems.
CO3	To understand the dependency of voltage control on reactive power control.
CO4	To acquire knowledge of scheduling and operation of the generation in power plants in an economical way.
CO5	To understand the contemporary issues in modern computer controlled power systems.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	3	3	1	1	1	1	1	1	1	1	1	3	3	1	1
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	3	1	1
CO4	3	3	2	1	2	1	3	1	1	1	1	1	3	2	1	1
C05	3	1	3	1	3	1	1	1	1	1	1	3	1	3	1	1

EE1703	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

Objectives

- To teach the principles and need for protection schemes by different fault current calculations.
- To teach the basic principles, construction and characteristics of different Electromagnetic relays.
- To learn to protect different power equipments like transformer, generator etc.,
- To teach different aspects of static relays and numerical protection schemes.
- To learn the principles, construction and problems associated with different types of circuit breaker.

UNIT - I	PROTECTION SCHEMES	6
Principles and need for protective schemes - nature and causes of faults - types of faults - fault current calculation - Zones of protection and essential qualities of protection; Methods of neutral grounding.		CO1
UNIT - II	**ELECTROMAGNETIC RELAYS**	**9**
Operating principles of relays - Torque equation - R –X diagram - Electromagnetic Relays - Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays		**CO2**
UNIT - III	**APPARATUS PROTECTION**	**9**
Application of Current transformers and Potential transformers in protection schemes - Sources of error. Protection of transformer, generator, motor, bus bars and transmission line.		**CO3**
UNIT - IV	**STATIC RELAYS AND NUMERICAL PROTECTION**	**9**
Static relays - Phase, Amplitude Comparators - Synthesis of various relays using Static comparators - Block diagram of Numerical relays - Over current protection, transformer differential protection, distance protection of transmission lines.		**CO4**
UNIT - V	**CIRCUIT BREAKERS**	**12**
Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking - re-striking voltage and recovery voltage - rate of rise of recovery voltage - current chopping - interruption of capacitive current - resistance switching - Types of circuit breakers - air, oil, SF6 and vacuum circuit breakers - comparison of different circuit breakers - Rating and selection of Circuit breakers.		**CO5**
	Total Periods:	**45**

Text Books:

1. Sunil S.Rao, “Switchgear Protection and Power Systems”, Khanna publishers, New Delhi, 14th Edition 2019.
2. Y.G.Paithankar and S.R.Bhide, “Fundamentals of power system protection”, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi – 2010 .

Reference Books:

1. BadriRam ,B.H.Vishwakarma, Power System Protection and Switchgear, New Age International Pvt Ltd Publishers, Second Edition 2011.
2. B.Rabindranath and N.Chander, Power System Protection and Switchgear, New Age International (P) Ltd., First Edition 2011.

3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, A Text Book on Power System Engineering, Dhanpat Rai & Co., 2013.
4. C.L.Wadhwa, Electrical Power Systems, 6th Edition, New Age International (P) Ltd., 2018.
5. Ravindra P Singh, " Switchgear and Power System Protection " PHI Learning Private Ltd., New Delhi 2009.

Course Outcomes (CO)

CO1	Ability to understand the principles and need of protection schemes by different fault current calculation and also know the importance of grounding in power system.
CO2	Ability to understand the basic principles, construction and characteristics of different Electromagnetic relays.
CO3	Ability to gain knowledge on CT and PT in protection schemes and learn to protect different power equipment like transformer, generator etc.,
CO4	Ability to understand the concept of Static relay and numerical protection schemes.
CO5	Ability to gain knowledge on theory of arc interruption and various type of circuit breakers.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	2	2	2	1	1	1	1	1	1	1	1	3	1	2	1
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	1	2	1
CO4	3	2	3	2	1	1	1	1	1	1	1	1	3	1	2	2
C05	3	2	3	2	1	1	1	1	2	2	1	1	3	1	3	2

EE1704	ELECTRIC VEHICLE MECHANICS AND CONTROL (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

Objectives

- To provide knowledge of the operation and dynamics of electrical vehicles
- To impart knowledge on vehicle control for standard drive cycles of electrical vehicles (EVs)
- To estimate the energy requirement of EVs and Hybrid Electric Vehicles (HEVs)

- To provide knowledge about different energy sources and energy management in HEVs.
- To provide knowledge of supervisory control of EVs

UNIT - I	INTRODUCTION TO CONVENTIONAL AND ELECTRIC VEHICLES	9
Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics. **Electric Vehicle:** EV system-History of evolution of Electric Vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) - Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.		**CO1**

UNIT - II	MECHANICS OF ELECTRIC VEHICLES	9
Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.		**CO2**

UNIT - III	CONTROL OF DC AND AC MOTOR DRIVES	9
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.		**CO3**

UNIT - IV	ENERGY STORAGE AND MANAGEMENT SYSTEMS	9
Battery: Principle of operation, types, models, Estimation of SOC & SOH, Traction Batteries and their capacity for standard drive cycles. **Alternate sources:** Fuel cells, Ultra capacitors, Fly wheels. Energy management systems-Classification of different management strategies		**CO4**

UNIT - V	HYBRID VEHICLE CONTROL STRATEGY	9
HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.		**CO5**

PRACTICALS: 30 PERIODS
THEORY: 45 PERIODS
TOTAL : 75 PERIODS

LIST OF EXPERIMENTS:

1. Lithium Ion Battery Handling
2. Battery Management System
3. BLDC Hub Motor Control for EV

4. BLDC Mid-Drive Motor Control for EV
5. Throttle control mechanisms and Analog to Digital Conversion
6. Vehicle Chassis design for Electric 2-Wheelers
7. Vehicle Diagnosis and Benchmarking
8. CAN bus protocol suite
9. Electric Vehicle Wiring Harness and Connectors
10. Electric Vehicle Architecture

LIST OF EQUIPMENTS

1. Lithium-Ion Battery Pack with BMS, and Charger (LFP Cell Array) for 48V System-5 Nos
2. Logic Analyzer and Software Package for Analyzing CAN Bus-2 Nos
3. BLDC Hub Mounted Motor-3 Nos
4. Controller and Test Jig with RPM Sensor-3 Nos
5. Throttle and Display Panel (Requires DC Power Input)-3 Nos
6. BLDC Mid-Drive Motor with Gearbox
7. Analog Throttles (Hand and Foot Operated)- 2 Nos
8. ADC Circuit with Display Output-2 Nos
9. Vehicle Chassis (2W Scooter)-2 Nos
10. Vehicle Diagnosis System with Software Package
11. Driver Console based on Microcontroller Wires, connectors and cable specimen- As required

Text Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. Iqbal Husain, “Electric and Hybrid vehicles: Design fundamentals”, CRC PRESS, Boca Raton London, New York Washington, D.C,2005.
3. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017.
4. Christopher D Rahn, Chao-Yang Wang, "Battery Systems Engineering", Wiley, 2013.

Reference Books:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.

2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
6. Gregory L.Plett, “Battery Management systems”, ARTECH House,London,2016.

Course Outcomes (CO)

CO1	Learned the significance of Electric Vehicle compared to conventional vehicles.
CO2	understood the concept of mechanics of Electric Vehicles.
CO3	Acquired the knowledge in Control of DC And AC Motor Drives.
CO4	Concept of different strategies related to battery technology and energy storage systems are analysed.
CO5	Acquired knowledge in control strategy for Hybrid Vehicle & Battery management systems for EV

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	1	3	2	2	3	3	2	1	3	3	3	3	3
CO2	3	2	3	3	3	2	2	3	3	2	1	2	3	3	3	3
CO3	3	3	3	3	2	2	2	3	2	2	2	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3
C05	3	2	2	2	3	3	3	3	3	3	2	3	3	3	3	3

EE1781	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To provide better understanding of power system analysis through digital simulation.

LIST OF EXPERIMENTS

1. Computation of Transmission Line Parameters

2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Power Flow Analysis using Gauss-Seidel Method
4. Power Flow Analysis using Newton Raphson Method
5. Symmetric and unsymmetrical fault analysis
6. Transient stability analysis of SMIB System
7. Economic Dispatch in Power Systems
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. State estimation: Weighted least square estimation
10. Electromagnetic Transient Analysis in power system by using EMTP

Total Periods:	**60**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Personal computers (Intel i3, 80GB, 2GBRAM) – 30 nos
Printer laser- 1 No.
Dot matrix- 1 No.
Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor) – 1 No.
Software: MATLAB simulation software with 5 user license and EMTP software.

Course Outcomes (CO)

CO1	To develop simple Matlab programs for the following basic requirements: a) Formation of bus admittance and impedance matrices and line parameters with solutions.
CO2	To understand the concepts of power flow solution of small systems using simple method, Gauss-Seidel P.F. method, Unit Commitment and Economic Dispatch.
CO3	To arrive the solutions through the standard algorithms and researches available and to confirm the same by implementing in the modern software packages available
CO4	To have experience in the usage of standard packages for the following analysis / simulation / control functions. a) Steady-state analysis of large system using NRPF method. b) Quasi steady-state (Fault) analysis for balanced and unbalanced faults.
CO5	To know the basics of transient stability and Load Frequency dynamics and to check the same in the simulation of multi-machine power system for effective control of power system.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO2	3	3	2	2	2	1	1	2	1	1	1	1	3	3	2	1
CO3	3	3	3	3	2	1	2	1	2	1	1	1	3	3	2	1
CO4	3	2	3	3	3	1	2	2	1	1	1	1	3	3	2	1
C05	3	2	3	3	3	1	3	1	1	1	2	2	3	3	2	1

EE1782	PROJECT PHASE I	L	T	P	C
		0	0	4	2

Objectives

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. 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. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report by examiners constituted by the Head of the Department.

TOTAL PERIODS 60

Course Outcomes (CO)

On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology

Semester-8(all electives)

EE1881	PROJECT PHASE II	L	T	P	C
		0	0	20	10

Objectives

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. 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. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS | **300**

Course Outcomes (CO)

On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Professional Electives-1(V Semester)

EI1501	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Objectives

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT - I	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	9
Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems –Kidney and blood flow - Biomechanics of bone - Biomechanics of		CO1

soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors		
UNIT - II	**NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES**	**9**
Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.		**CO2**
UNIT - III	**ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS**	**9**
Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.		**CO3**
UNIT - IV	**IMAGING MODALITIES AND ANALYSIS**	**9**
Radio graphic and fluoroscopic techniques – Computer tomography – MRI – ltrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.		**CO4**
UNIT - V	**LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES**	**9**
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system – Nano Robots - Robotic surgery –Orthopedic prostheses fixation.		**CO5**
Total Periods:		**45**

Text Books:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2005
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012

Reference Books:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 5th edition 2020.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

Course Outcomes (CO)

CO1	Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
CO2	Ability to provide latest ideas on devices of non-electrical devices.
CO3	Ability to gain knowledge on various sensing and measurement devices of electrical origin.
CO4	Ability to bring out the important and modern methods of imaging techniques and their importance.
CO5	Ability to explain the medical assistance/techniques, robotic and therapeutic equipments

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	2	3	3	2	1	2	1	2	3	2	2	3	1
CO2	3	3	3	3	3	3	2	2	2	1	2	3	2	2	3	1
CO3	3	3	3	3	3	3	2	2	2	1	2	3	2	2	3	1
CO4	3	3	3	3	3	3	2	2	2	1	2	3	2	2	3	1
C05	3	3	3	2	3	3	2	1	2	1	2	3	2	2	3	1

EE1512	ADVANCED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge on the following topics:

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT – I	STATE VARIABLE ANALYSIS	9
Introduction: concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation- solution of state equations; Concepts of controllability and observability.		CO1

UNIT – II	STATE VARIABLE DESIGN	9
Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design; Design of state observers- Separation principle; Design of servo systems; State feedback with integral control.		CO2

UNIT – III	SAMPLED DATA ANALYSIS	9
Introduction- spectrum analysis of sampling process - signal reconstruction - difference equations; The Z transform function- the inverse Z transform function, response of Linear discrete system, the Z transform analysis of sampled data control systems, response between sampling instants, the Z and S domain relationship; Stability analysis and compensation techniques.		CO3

UNIT – IV	NON LINEAR SYSTEMS	9
Introduction - common physical non linearity; The phase plane method: concepts, singular points, stability of nonlinear systems, construction of phase trajectories system analysis by phase plane method; The describing function method, stability analysis by describing function method, Jump resonance.		CO4

UNIT – V	OPTIMAL CONTROL	9
Introduction: Classical control and optimization, formulation of optimal control problem - Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control - Application & examples.		CO5

Total Periods:	**45**

Text Books:

1. M. Gopal, "Digital Control and State Variable Methods", 4th edition, Mc Graw Hill India, 2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson,2012.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers,2016.

Reference Books:

1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2017.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2018.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2018.

Course Outcomes (CO)

CO1	Able to understand the modelling of state equation and its solution.
CO2	Able to understand the state model, observer and feedback system.
CO3	Able to understand the sampled data analysis, various transforms, stability and compensation techniques.
CO4	Able to understand the nonlinear systems and various methods of analysis.
CO5	Able to understand and design optimal controller.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1513	PRINCIPLES OF ROBOTICS	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge on the following topics:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on vari ous path planning techniques
- To introduce the dynamics and control of manipulators

UNIT – I	BASIC CONCEPTS	9
Brief history–Types of Robot – Robot Technology–Robot classifications and specifications–Design and control issues– Various manipulators – Sensors – work cell – Programming languages.		CO1

UNIT – II	DIRECT AND INVERSE KINEMATICS	9
Mathematical representation of Robots – Position and orientation – Homogeneous transformation– Various joints– Representation using the Denavit Hattenberg parameters –Degrees of freedom–Direct kinematics–Inverse kinematics– SCARA robots– Solvability – Solution methods–Closed form solution.		CO2

UNIT – III	MANIPULATOR DIFFERENTIAL MOTION AND STATICS	9
Linear and angular velocities–Manipulator Jacobian–Prismatic and rotary joints–Inverse –Wrist and arm singularity – Static analysis – Force and moment Balance.		CO3

UNIT – IV	PATH PLANNING	9
Definition–Joint space technique–Use of p–degree polynomial–Cubic polynomial–Cartesian space technique – Parametric descriptions – Straight line and circular paths – Position and orientation planning.		CO4

UNIT – V	DYNAMICS AND CONTROL	9
Lagrangian mechanics – 2DOF Manipulator–Lagrange Euler formulation–Dynamic model –Manipulator control problem – Linear control schemes –PID control scheme–Force control of robotic manipulator.		CO5

Total Periods:	45

Text Books:

1. R. K. Mittal and I. J. Nagrath, 'Robotics and Control', Tata McGraw Hill, New Delhi, 4th Reprint, 2017.
2. John J. Craig, 'Introduction to Robotics Mechanics and Control', Third edition, Pearson Education, 2009.
3. M. P. Groover, M. Weiss, R.N. Nagel and N. G. Odrej, 'Industrial Robotics', McGraw – Hill Singapore, 1996.

Reference Books:

1. Ashitava Ghoshal, 'Robotics–Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K. Appu Kuttan, 'Robotics', I K International, 2007.
3. Edwin Wise, 'Applied Robotics', Cengage Learning, 2003.
4. R. D. Klafter, T. A. Chimielewski and M. Negin, 'Robotic Engineering–An Integrated Approach', Prentice Hall of India, New Delhi, 1994.
5. B. K. Ghosh, 'Control in Robotics and Automation: Sensor Based Integration', Allied Publishers, Chennai, 1998.
6. S. Ghoshal, 'Embedded Systems & Robotics' – Projects using the 8051 Microcontroller', Cengage Learning, 2009.

Course Outcomes (CO)

CO1	Able to understand the basic concept of robotics.
CO2	Able to analyze Instrumentation systems and their applications to various
CO3	Able to know about the differential motion add statics in robotics
CO4	Able to know about the various path planning techniques.
CO5	Able to know about the dynamics and control in robotics industries.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	3	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

ME1703	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

Objectives

- To provide an overview about the layout, construction and working of the components inside a thermal power plant.
- To impart knowledge on the layout, construction and working of the components inside a thermal power plant.
- To study the construction and working of the components inside nuclear power plants.
- To learn about the layout, construction and working of the components inside Renewable energy power plants.
- To learn about the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

UNIT - I	COAL BASED THERMAL POWER PLANTS	9
Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers,FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants, Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.		**CO1**

UNIT - II	DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS	9
Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.		**CO2**

UNIT - III	NUCLEAR POWER PLANTS	9
Basics of Nuclear Engineering, 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, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.		**CO3**

UNIT - IV	POWER FROM RENEWABLE ENERGY	9
Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.		**CO4**

UNIT - V	ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS	9
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.		CO5
	Total Periods:	**45**

Text Books:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

Reference Books:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

Course Outcomes (CO)

CO1	Explain the layout, construction and working of the components inside a thermal power plant.
CO2	Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants
CO3	Explain the layout, construction and working of the components inside nuclear power plants.
CO4	Explain the layout, construction and working of the components inside Renewable energy power plants.
CO5	Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	1	3	3	3	3	3	1	1	3	3	2	3	1
CO2	3	2	1	1	1	1	1	1	2	1	1	2	3	2	2	1
CO3	3	2	3	2	2	3	3	3	2	3	1	3	3	2	3	1

CO4	3	3	3	3	3	3	3	3	2	3	1	3	2	3	3	1
C05	3	3	3	3	3	2	3	3	1	3	3	2	3	3	3	3

CS1516	**VISUAL PROGRAMMING**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming, event driven programming, variability's, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT – I	**FUNDAMENTALS OF WINDOWS AND MFC**	**9**
Messages-Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.		**CO1**

UNIT – II	**RESOURCES AND CONTROLS**	**9**
Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.		**CO2**

UNIT – III	**DOCUMENT / VIEW ARCHITECTURE**	**9**
The in existence function revisited – Document object – View object – Frame window object- Dynamic object creation. SDI document template - Command routing.		**CO3**

Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in app wizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializability classes.		
UNIT – IV	**FUNDAMENTALS OF VISUAL BASIC**	**9**
Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming. Variabilitys: Declaration – Types – Converting variability types – User defined data types - Lifetime of a variability. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.		**CO4**
UNIT – V	**DATABASE PROGRAMMING WITH VB**	**9**
Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Tability def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements–Cursor types and locking mechanism– Manipulating the record set object – Simple record editing and updating.		**CO5**
	Total Periods:	**45**

Text Books:

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted,2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications,2002.

Reference Books:

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, McGraw Hill, reprinted,2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', McGraw Hill, Reprinted,2002.

3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Tech media Pub,1999.

Course Outcomes (CO)

CO1	Ability to understand study about the concepts of windows programming models.
CO2	Ability to understand the concepts of Menu basics, menu magic and classic controls.
CO3	Ability to understand the concept of Document/View Architecture with single & multiple document interface.
CO4	Ability to understand the integrated development programming event driven document interface.
CO5	Ability to understand the database and the database management system programming.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

CS1520	FUNDAMENTALS OF OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads.
- To analyze various memory management and file management schemes.
- To understand disk management and I/O management systems.

UNIT – I	INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES	9
Introduction to OS –Operating-System View Multiprogramming & time sharing, Multiprocessor Systems. Real Time Systems, Operating System Structures – Services - System Calls, Process, Scheduling, Booting process of an Operating System.		CO1

UNIT – II	**PROCESS & THREADS**	**9**
Process & Threads: The Process, Process creation, State & Transitions, Process Termination, Manipulation of the process address Space. Signals, Thread & process, Multithreaded programming Models Overview.		**CO2**
UNIT – III	**PROCESS SYNCHRONISATION AND DEADLOCKS**	**9**
Process Synchronization: The critical-section & Race Condition, Mutex, Semaphores, Classic problems of synchronization –Bounded Buffer Problem - Reader's & Writer Problem, Dinning Philosopher Problem, Deadlock: Deadlock characterization, Methods for handling deadlocks -Deadlock prevention - Deadlock avoidance - Deadlock detection - Recovery from deadlock.		**CO3**
UNIT – IV	**MEMORY MANAGEMENT AND FILE MANAGEMENT**	**9**
Memory Management: Paging systems, Structure of the Page Table, Swapping, Demand Paging, Hybrid system with Swapping & Demand Paging, Thrashing: File Management: File Concept – Access Methods – Directory Structure – Protection - Structure of a regular file, IO & Memory Mapped File.		**CO4**
UNIT – V	**DISK MANAGEMENT & I/O MANAGEMENT**	**9**
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks, I/O Management: I/O Hardware: I/O devices & controllers, Driver Interface, Disk Drivers, Terminal Drivers, Interrupts, Exceptions, Direct Memory Access.		**CO5**
	Total Periods:	**45**

Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, ―Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.

Reference Books:

1. RamazElmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. Achyut S.Godbole, Atul Kahate, ―Operating Systems‖, McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, ―Modern Operating Systems‖, Second Edition, Pearson Education, 2004.
4. Gary Nutt, ―Operating Systems‖, Third Edition, Pearson Education, 2004.

5. Harvey M. Deitel, —Operating Systems‖, Third Edition, Pearson Education, 2004.

Course Outcomes (CO)

CO1	Ability to understand the basic concepts and functions of operating systems.
CO2	Ability to understand the basic concepts of process, thread.
CO3	Ability to understand the basic concepts of process synchronization and deadlock.
CO4	To compare and contrast various memory management schemes.
CO5	Ability to understand the functionality of disk and I/O management systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

GE1001	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

Objectives

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components .
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

UNIT - I	INTRODUCTION	9
Introduction to IPRs: Basic concepts and need for Intellectual Property, Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – The way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations – Important examples of IPR.		CO1

UNIT - II	**REGISTRATION OF IPRs**	**9**
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad		**CO2**
UNIT - III	**AGREEMENTS AND LEGISLATIONS**	**9**
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.		**CO3**
UNIT - IV	**DIGITAL PRODUCTS AND LAW**	**9**
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.		**CO4**
UNIT - V	**ENFORCEMENT OF IPRs**	**9**
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.		**CO5**
	Total Periods:	**45**

Text Books:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, Lexis Nexis, 2017.

Reference Books:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition,2017.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education,2011.
3. Derek Bosworth and Elizabeth Webster, "The Management of Intellectual Property", Edward Elgar Publishing Ltd., 2013.

Course Outcomes (CO)

CO1	Ability to get an adequate knowledge on patent and copyright for their innovative research works
CO2	Ability to get idea about the registration process of IPR
CO3	Ability to study various agreements and Acts regarding IPR

CO4	Ability to inculcate the knowledge on innovations, developments and IP laws
CO5	Ability to aware the knowledge on enforcement and current issues

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3	2
CO2	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3	2
CO3	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3	3
CO4	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3	2
CO5	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3	2

CE1025	DISASTER MANAGEMENT	L	T	P	C
	(Common to EEE,ECE,IT)	3	0	0	3

Objectives

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country.
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT - I	INTRODUCTION TO DISASTERS	9
Definition - Disaster, Hazard, Vulnerability, Resilience, Risks ; Disasters- Types of disasters, Earthquake, Landslide, Flood, Drought, Volcanoes, Forest fire, Manmade disaster; Causes, Impacts including social, economic, political, environmental, health, psychosocial; Differential impacts - in terms of caste, class, gender, age, location, disability; Global trends in disasters - urban disasters, pandemics, complex emergencies, Climate change; Do's and Don'ts during various types of Disasters.		CO1

UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness; Structural, non-structural measures; Community based DRR; Roles and responsibilities		CO2

of community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre & other stake holders; Institutional Processes and Framework at State and Central Level; State Disaster Management Authority(SDMA); Early Warning System, Advisories from appropriate agencies.		
UNIT - III	**INTER– RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting Vulnerabilities; Differential impacts; Impact of Development projects such as dams, embankments, changes in Land-use ; Climate Change Adaptation– IPCC Scenario and Scenarios in the context of India; Relevance of indigenous knowledge, appropriate technology and local resources.		**CO3**
UNIT - IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9**
Hazard and Vulnerability profile of India; Components of Disaster Relief- Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements Mitigation, Response and Preparedness, Disaster Management Act and Policy , Other related policies, plans, programmes and legislation ; Role of GIS and Information Technology components in preparedness, Risk assessment, Response and recovery phases of disaster ;Disaster damage assessment.		**CO4**
UNIT - V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide hazard zonation - Case Studies; Earthquake vulnerability assessment of buildings and Infrastructure- Case Studies; Drought assessment - Case Studies; Coastal Flooding - Storm surge assessment; Floods - Fluvial and Pluvial Flooding Case Studies; Forest Fire - Case Studies; Man Made disasters - Case Studies; Space based inputs for disaster mitigation and management and field works related to disaster management.		**CO5**
	Total Periods:	**45**

Text Books:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN– 10: 9380386427 ISBN– 13: 978– 9380386423.
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN– 10: 1259007367, ISBN– 13: 978– 1259007361.
3. Gupta Anil K, Sreeja S. Nair,” Environmental Knowledge for Disaster Risk Management” NIDM, New Delhi, 2011.
4. Kapur Anu, ”Vulnerability India: A Geographical Study of Disasters” IIAS and Sage Publishers, New Delhi, 2010.

Reference Books:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

Course Outcomes (CO):

CO1	Differentiate the types of disasters, causes and their impact on environment and society.
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
CO4	Understand the disaster risk management process in India.
CO5	Acquire knowledge on disaster management applications and case studies.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	2	1	1	2	2	1	1	1	2	2	2	2	2	2
CO2	1	2	1	1	1	2	2	1	1	1	2	2	2	2	2	2
CO3	1	1	1	1	2	2	2	1	1	1	2	2	2	2	2	2
CO4	1	1	1	1	2	1	1	1	1	1	2	2	2	2	2	2
C05	2	1	1	1	2	2	2	1	1	1	2	2	2	2	2	2

PROFESSIONAL ELECTIVE-II (VI SEMESTER)

EE1621	DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Magnetic circuit parameters and thermal rating of various types of electrical machines.
- Armature and field systems for D.C.Machines.
- Core, yoke, windings and cooling systems of transformers.
- Design of stator and rotor of induction machines and synchronous machines.
- The importance of computer aided design method.

UNIT – I	DESIGN OF FIELD SYSTEM AND ARMATURE	9
Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.		CO1

UNIT – II	DESIGN OF TRANSFORMERS	9
Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers; Computer program: Complete Design of single phase core transformer.		CO2

UNIT – III	DESIGN OF DC MACHINES	9
Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions.		CO3

UNIT – IV	DESIGN OF INDUCTION MOTORS	9
Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram - Computer program: Design of slip-ring rotor.		CO4

UNIT – V	DESIGN OF SYNCHRONOUS MACHINES	9
Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding –		CO5

Design of turbo alternators -Computer program: Design of Stator main dimensions- Brushless DC Machines.	
Total Periods:	**45**

Text Books:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, 6th Edition, 2006 (Reprint 2019).
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 3rd Edition , 2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition,2009.

Reference Books:

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., 2011.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1982.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2018.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications, 2019.

Course Outcomes (CO)

CO1	Able to understand the design of field system and armature.
CO2	Able to design the single and three phase transformer.
CO3	Able to design armature and field of DC machines.
CO4	Able to design stator and rotor of induction motor.
CO5	Able to design and analyze synchronous machines.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	2	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	2	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	2	1	1	1	1	1	1	1	2	3	2	2	1
C05	3	2	2	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1622	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics

- Construction, principle of operation, control and performance of stepping motors.
- Construction, principle of operation, control and performance of switched reluctance motors.
- Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- Construction, principle of operation and performance of permanent magnet synchronous motors.
- Construction, principle of operation and performance of other special Machines.

UNIT – I	STEPPER MOTORS	9
Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle – Applications		CO1

UNIT – II	SWITCHED RELUCTANCE MOTORS (SRM)	9
Constructional features –Principle of operation– Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive– Sensor less operation of SRM – Applications.		CO2

UNIT – III	PERMANENT MAGNET BRUSHLESS D.C. MOTORS	9
Fundamentals of Permanent Magnets– Types– Principle of operation– Magnetic circuit analysis– EMF and Torque equations– Power Converter Circuits and their controllers – Characteristics and control– Applications		CO3

UNIT – IV	PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)	9
Constructional features –Principle of operation – EMF and Torque equations – Sine wave motor with practical windings – Phasor diagram – Power controllers – Performance characteristics –Digital controllers – Applications.		CO4

UNIT – V	OTHER SPECIAL MACHINES	9
Constructional features – Principle of operation and Characteristics of Hysteresis motor– Synchronous Reluctance Motor– Linear Induction motor– Repulsion motor– Applications.		CO5

Total Periods:	**45**

Text Books:

1. K. Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2009.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1985.
3. E.G. Janardanan, 'Special Electrical Machines', PHI learning Private Limited, Delhi, 2014.

Reference Books:

1. R. Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2017.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T. J. E. Miller, 'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R. Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

Course Outcomes (CO)

CO1	Ability to nalyse and design controllers for special Electrical Machines and knowledge on construction and operation of stepper motor.
CO2	Ability to acquire the knowledge on construction and operation of switched reluctance motors.
CO3	Ability to acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
CO4	Ability to acquire the knowledge on construction and operation of permanent magnet synchronous motors.
CO5	Ability to select a special Machine for a particular application

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	3	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1623	MODERN POWER CONVERTERS	L	T	P	C
		3	0	0	3

Objectives

- Switched mode power supplies
- AC – DC Converter
- DC – AC converter
- AC – AC converter
- Soft switched converters

UNIT – I	SWITCHED POWER SUPPLIES (SMPS)	9
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.		**CO1**

UNIT – II	AC – DC CONVERTER	9
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		**CO2**

UNIT – III	DC – AC CONVERTER	9
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.		**CO3**

UNIT – IV	AC – AC CONVERTERS WITH AND WITHOUT DC LINK	9
Matrix converters. Basic topology of matrix converter; 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.		**CO4**

UNIT – V	SOFT SWITCHING POWER CONVERTERS	9
Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison of hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter, Resonant DC power supplies.		**CO5**
	Total Periods:	**45**

Text Books:

1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 4th edition 2017.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2017.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmier kowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2003.

Reference Books:

1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons Inc., 2006.
2. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and ZheChen, Morgan & Claypool Publishers series, United States of America,2006.
3. Krein Philip T, Elements of Power Electronics, Oxford University press, 2017.
4. Jai P Agarwal ,Power Electronics: Converters, Applications, and Design, 3rd edition, Prentice Hall,2000
5. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons, 2009.

Course Outcomes (CO)

CO1	Able to understand the design of SMPS.
CO2	Able to understand and analyze the AC- DC converters.
CO3	Able to understand and analyze the DC- AC converters.
CO4	Able to understand and analyze the basic AC- AC and matrix converters.
CO5	Able to understand the soft switching of power converters.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	1	1	1	1	1	2	1	2	3	1	3	1
CO2	3	3	3	3	3	1	1	1	1	2	1	2	3	3	3	1
CO3	3	3	3	3	3	2	1	2	2	2	1	2	3	3	3	1
CO4	3	3	3	3	2	2	1	2	2	2	2	2	3	2	3	2
C05	3	3	3	3	3	2	1	1	2	2	2	2	3	3	3	2

EE1624	EHVAC TRANSMISSION	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- EHVAC Transmission lines

- Electrostatic field of AC lines
- Corona in E.H.V. lines

UNIT – I	**INTRODUCTION**	**9**
EHVAC Transmission line trends and preliminary aspect – standard transmission voltages – Estimation at line and ground parameters–Bundle conductors: Properties – Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.		**CO1**
UNIT – II	**ELECTROSTATIC FIELDS**	**9**
Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines – Effect of high electrostatic field on biological organisms and human beings – Surface voltage gradients and Maximum gradients of actual transmission lines – Voltage gradients on sub conductor.		**CO2**
UNIT – III	**POWER CONTROL**	**9**
Electrostatic induction in un energized lines – Measurement of field and voltage gradients for three phase single and double circuit lines – Un energized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage – Charging currents at power frequency–Voltage control – Shunt and Series compensation – Static VAR compensation		**CO3**
UNIT – IV	**CORONA EFFECTS AND RADIO INTERFERENCE**	**9**
Corona in EHV lines – Corona loss formulae–Charge voltage diagram– Attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona – properties of radio noise – Frequency spectrum of RI fields – Measurements of RI and RIV.		**CO4**
UNIT – V	**STEADY STATE AND TRANSIENT LIMITS**	**9**
Design of EHV lines based on steady state and transient limits – EHV cables and their characteristics–Introduction six phase transmission – UHV		**CO5**
	Total Periods:	**45**

Text Books:

1. Rokosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering' – Wiley Eastern Ltd., New Delhi 1990.
2. S. Rao, 'HVAC and HVDC Transmission, Engineering and Practice' Khanna Publisher, Delhi, 1990.

Reference Books:

1. Subir Ray, 'An Introduction to High Voltage Engineering', Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, 'Extra High Voltage AC Transmission Engineering'– New Academic Science Ltd; 4 edition 2011.
3. Edison,' EHV Transmission line'– Electric Institution, GEC, 1968.

Course Outcomes (CO)

CO1	Ability to understand the principles and types of EHVAC system.
CO2	Ability to analyze the electrostatic field of AC lines
CO3	Ability to study about the compensation.
CO4	Ability to study about the corona in E.H.V. lines
CO5	Ability to understand the EHV cables and analyze the steady state and transient limits.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
C05	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1

EE1625	POWER SYSTEM STABILITY	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- The fundamentals of power systems stability and its classification.
- Small signal stability modelling and analysis of power systems.
- Transient stability modelling of power system and to analyse using numerical methods.
- Voltage stability in power system and the various methods to control the voltage profile.
- Methods to enhance small-signal & transient stability.

UNIT – I	INTRODUCTION TO STABILITY	9
Fundamental concepts - Stability and energy of a system - Power System Stability: Definition, Causes, Nature and Effects of disturbances, Classification of stability, Modelling of electrical components - Basic assumptions made in stability studies- Modelling of Synchronous machine for stability studies (classical model) - Rotor dynamics and the swing equation.		**CO1**
UNIT – II	**SMALL - SIGNAL STABILITY**	**9**
Basic concepts and definitions – State space representation, Physical Interpretation of small–signal stability, Eigen properties of the state matrix: Eigen values and eigenvectors, modal matrices, eigen value and stability, mode shape and participation factor. Small– signal stability analysis of a Single-Machine Infinite Bus (SMIB) Configuration with numerical example.		**CO2**
UNIT – III	**TRANSIENT STABILITY**	**9**
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 (TSA) with partitioned – explicit approaches- Application of TSA to SMIB system.		**CO3**
UNIT – IV	**VOLTAGE STABILITY**	**9**
Factors affecting voltage stability- Classification of Voltage stability-Transmission system characteristics- Generator characteristics- Load characteristics- Characteristics of reactive power compensating Devices- Voltage collapse.		**CO4**
UNIT – V	**ENHANCEMENT OF SMALL-SIGNAL STABILITY AND TRANSIENT STABILITY**	**9**
Power System Stabilizer –. Principle behind transient stability enhancement methods: 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.		**CO5**
	Total Periods:	**45**

Text Books:

1. Power system stability and control ,P. Kundur ; edited by Neal J. Balu, Mark G. Lauby, McGraw-Hill, 2008.
2. R.Ramnujam," Power System Dynamics Analysis and Simulation, PHI Learning Private Limited, New Delhi, 2010.
3. T.V. Cutsem and C.Vournas, "Voltage Stability of Electric Power Systems", Kluwer publishers,2013.

Reference Books:

1. Peter W., Saucer, Pai M.A., "Power System Dynamics and Stability,Pearson Education (Singapore), 9th Edition, 2007.
2. EW. Kimbark., "Power System Stability", John Wiley & Sons Limited, New Jersey, 2013.
3. SB. Crary., "Power System Stability", John Wiley & Sons Limited, New Jersey,2002.
4. K.N. Shubhanga, "Power System Analysis" Pearson,2017.
5. Power systems dynamics: Stability and control / K.R. Padiyar, BS Publications,2008
6. Power system control and Stability P.M. Anderson, A.A. Foud, Iowa State University Press,2007.

Course Outcomes (CO)

CO1	Able to understand the stability problems in power system and dynamic modelling of the synchronous machine.
CO2	Able to understand the small-signal modelling and the stability analysis.
CO3	Able to understand the transient stability modelling and its solution using classical and numerical methods.
CO4	Able to understand the voltage stability problems in power systems and its control.
CO5	Able to understand the design of power system stabilizer and the various methods of enhancing the power system stability.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1626	LINE COMMUTATED AND ACTIVE RECTIFIERS	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Able to understand the diode with passive filtering.
- Able to understand the Thyristor rectifiers with passive filtering
- Able to understand the multi pulse converter
- Able to understand the single–phase ac–dc single–switch boost converter
- Able to understand the Isolated single–phase ac–dc flyback converter

UNIT – I	DIODE RECTIFIERS WITH PASSIVE FILTERING	9
Half wave diode rectifier with RL and RC loads; 1–phase full wave diode rectifier with L, C and LC filter; 3–phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction; input current wave shape; effect of source inductance; commutation overlap.		**CO1**

UNIT – II	THYRISTOR RECTIFIERS WITH PASSIVE FILTERING	9
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3–phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction; input current wave shape.		**CO2**

UNIT – III	MULTI–PULSE CONVERTER	9
Review of transformer phase shifting, generation of 6–phase ac voltage from 3–phase ac, 6– pulse converter and 12–pulse converters with inductive loads- steady state analysis, commutation overlap, notches during commutation.		**CO3**

UNIT – IV	SINGLE–PHASE AC–DC SINGLE–SWITCH BOOST CONVERTER	9
Review of dc–dc boost converter; power circuit of single–switch ac–dc converter- steady state analysis, unity power factor operation, closed–loop control structure; Review of 1–phase inverter and 3–phase inverter; power circuits of 1–phase and 3–phase ac–dc boost converter- steady state analysis, operation at leading, lagging and unity power factors; Rectification and regenerating modes; Phasor diagrams; closed–loop control structure.		**CO4**

UNIT – V	ISOLATED SINGLE–PHASE AC–DC FLYBACK CONVERTER	9
DC–DC flyback converter, output voltage as a function of duty ratio and transformer turns ratio; Power circuit of ac–dc fly back converter- steady state analysis, unity power factor operation, closed loop control structure.		**CO5**

Total Periods:	**45**

Text Books:

1. G. De, 'Principles of Thyristorised Converters', Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, 'Principles of Power Electronics', Addison–Wesley, 2010.
3. L. Umanand, 'Power Electronics: Essentials and Applications', Wiley India, 2009.

Reference Books:

1. N. Mohan and T. M. Undeland, 'Power Electronics: Converters, Applications and Design', John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, 'Fundamentals of Power Electronics', Springer Science &Business Media, 2005.

Course Outcomes (CO)

CO1	Analyse controlled rectifier circuits.
CO2	Understand the operation of line–commutated rectifiers – 6 pulse and multi–pulse configurations.
CO3	Understand the operation of PWM rectifiers – operation in rectification and
CO4	regeneration modes and lagging, leading and unity power factor mode
CO5	Know the concepts about the flyback converter

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	3	2	3	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	3	2	3	2	1	1	1	1	1	1	1	1	3	3	2	1
CO4	3	2	3	2	1	1	1	1	1	1	1	1	3	3	2	1
C05	3	1	3	1	1	1	1	1	1	1	1	1	2	3	1	1

EE1627	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize with different architectures and training algorithms of neural networks.
- To expose the various neural modelling and control techniques.
- To gain knowledge on fuzzy set theory and fuzzy rules.
- To expose the concepts of Genetic Algorithm and other optimization techniques.
- To provide adequate knowledge about designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box.

UNIT - I	ARTIFICIAL NEURAL NETWORK	9
Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perception, Limitation – Multi layer perception – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – Real-time Recurrent Learning (RTRL) algorithms – Reinforcement learning.		**CO1**

UNIT - II	MODELLING OF ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY	9
Modelling of non-linear systems using Artificial Neural Networks **(**ANN) – Generation of training data – Optimal architecture–Model validation – Control of non-linear systems using ANN – Direct and indirect Neuro control schemes, Counter propagation network, Hopfield network, Boltzman Machine – Adaptive Resonance Theory		**CO2**

UNIT - III	FUZZY LOGIC AND APPLICATIONS	9
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 - Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox.		**CO3**

UNIT - IV	GENETIC ALGORITHM AND OTHER EVOLUTIONARY ALGORITHMS	9
Evolutionary programs – Genetic Algorithms, genetic programming and evolutionary programming - Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators - Optimization problems using GA-discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary		**CO4**

programming, Particle Swarm Optimization and Ant Colony Optimization (ACO) algorithm.		
UNIT - V	**HYBRID CONTROL SCHEMES**	**9**
Fuzzification and rule base using ANN–Neuro Fuzzy Systems-Adaptive Neuro Fuzzy Inference System (ANFIS) – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm –Introduction to Support Vector Machine-Evolutionary Programming Case study with Particle Swarm Optimization - Familiarization of NN, FLC and ANFIS Tool Box.		**CO5**
	Total Periods:	**45**

TEXT BOOKS:

1. Laurene V. Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms And Applications”, Pearson Education, 2004.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India, 2011.
3. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2014.
4. David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, Pearson Education, 2002.
5. W.T.Miller, R.S.Sutton and P.J.Webrose, “Neural Networks for Control” MIT Press”, 1996.
6. T. Ross, “Fuzzy Logic with Engineering Applications”, Tata McGraw Hill, New Delhi, 2002.
7. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)”, MIT Press,2014.
8. Corinna Cortes and V. Vapnik, " Support - Vector Networks, Machine Learning ”1995.

REFERENCE BOOK:

1. S N Sivanandam and S N Deepa, “Principles of Soft Computing Techniques”, Wiley and Sons, 2007.

Course Outcomes (CO)

CO1	Articulate the main concepts, key technologies, strengths and limitations of Artificial Neural Network.
CO2	Learn the key and enabling technologies that help in modelling of ANN and associated memory.
CO3	Develop the ability to understand and use the architecture of fuzzy logic service and delivery models.

CO4	Explain the optimisation using genetic algorithm and PSO.
CO5	Be able to install and use current control technologies and Choose the appropriate technologies and approaches for implementation and use of soft computing techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO2	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO3	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO4	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
C05	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1

GE1002	HUMAN RIGHTS	L	T	P	C
		3	0	0	3

Objectives

- To sensitize the Engineering students to various aspects of Human Rights.
- To educate on the evolution of human rights movement.
- To create awareness and understanding on the international deliberations towards human rights.
- To educate on constitutional rights and provisions related to human rights in India.
- To Create awareness on support organisations in Human Rights in India.

UNIT - I	INTRODUCTION	9
Human Rights- Meaning, origin and development; Notion and classification of Rights - Natural, Moral and Legal Rights, Civil and Political rights, economic, social and cultural rights, collective/ Solidarity rights.		CO1

UNIT - II	EVOLUTION OF HUMAN RIGHTS MOVEMENT	9
Evolution of the concept of Human rights- Magana Carta, Geneva Convection of 1864, Universal Declaration of Human rights 1948;Theories of Human rights.		CO2

UNIT - III	INTERNATIONAL PERSPECTIVES	9
Theories and perspective of UN Laws; UN Agencies to monitor and compliance.		CO3

UNIT - IV	**HUMAN RIGHTS IN INDIA**	**9**
Human Rights in India; Constitutional Provisions/ Guarantees.		**CO4**
UNIT – V	**HUMAN RIGHTS SUPPORT ORGANISATION**	**9**
Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disable persons, including aged and HIV infected people; Implementation of Human Rights - National and State Human Rights Commission; Judiciary; Role of NGO's, Media, Educational Institutions, Social Movements.		**CO5**
Total Periods:		**45**

Reference Books:

1. Kapoor S.K., “Human Rights under International law and Indian laws", Central law agency, Allahabad, 2014.
2. Chandra U., “Human Rights", Allahabad law agency, Allahabad, 2014.
3. Upendra Baxi, The future of Human Rights, Oxford University Press, New Delhi.

Course Outcomes (CO)

CO1	Able to understand the definition and types of human rights
CO2	Able to understand the evolution and theories of human rights
CO3	Able to understand the theories and perspectives of human rights
CO4	Able to know about human rights in India
CO5	Able to know about human rights of people of various classes and implementation of human rights

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2
CO2	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2
CO3	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2
CO4	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2
C05	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2

PROFESSIONAL ELECTIVE – III

EE1731	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- The concept of system identification and adaptive control.
- Black-box approach based system identification.
- Batch and recursive identification.
- Computer Controlled Systems.
- Design concept for adaptive control schemes.

UNIT - I	**NON-PARAMETRIC METHODS**	**9**
Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis -Spectral analysis - Input signal design for identification.		**CO1**
UNIT - II	**PARAMETRIC METHODS**	**9**
Least squares estimation - Analysis of the least squares estimate - Best linear unbiased estimate - Model parameterizations - Prediction error methods.		**CO2**
UNIT - III	**RECURSIVE IDENTIFICATION METHODS**	**9**
The recursive least square method - Model validation - Model structure determination, Introduction to closed loop system identification of the Cell - series and parallel connections, maximum power point tracking, Applications.		**CO3**
UNIT - IV	**ADAPTIVE CONTROL SCHEMES**	**9**
Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling.		**CO4**
UNIT - V	**MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR)**	**9**
STR – Pole placement design – Indirect STR and direct STR, MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR.		**CO5**
	Total Periods:	**45**

Text Books:

1. T. Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1988.
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Addison-Wesley, 2016.

Reference Books:

1. L. Ljung, System Identification - Theory for the User, 2nd Edition, Pearson education, 1999.
2. K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Dover Publications, 2005.
3. H. K. Khalil, Nonlinear Systems, Pearson education, 3rd Edition, 2002.
4. William S.Levine, "Control Systems Advanced Methods, the Control Handbook,2nd Edition, CRC Press, 2010.
5. S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1988.

Course Outcomes (CO)

CO1	Ability to understand various system identification techniques and features of adaptive control like STR and MRAC.
CO2	Ability to understand the concept of system identification and adaptive control.
CO3	Ability to understand about Black-box approach based system identification.
CO4	Ability to get knowledge about batch and recursive identification, Ability to design concept for adaptive control schemes.
CO5	Ability to study about computer controlled systems.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

EE1732	ADVANCED ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- To understand the DC drive control.
- To study and analyze the Induction motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the SRM and BLDC motor drive control.
- To analyze and design the digital control for drives.

UNIT - I	CONTROL OF DC DRIVES	9
Losses in electrical drive system, Energy efficient operation of drives, block diagram/transfer function of self, separately excited DC motors - closed loop control-speed control- current control - constant torque/power operation - P, PI and PID controllers - response comparison.		**CO1**

UNIT - II	CONTROL OF INDUCTION MOTOR DRIVE	9
VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drive- power factor considerations– modified Kramer drive-principle of vector control – Implementation, block diagram, Design of closed loop operation of V/f control of Induction motor drive systems		**CO2**

UNIT – III	CONTROL OF SYNCHRONOUS MOTOR DRIVES	9
Open loop VSI fed drive and its characteristics–Self-control–Torque control –Torque angle control –Power factor control, Brushless excitation systems - Field oriented control –Design of closed loop operation of Self-control of Synchronous motor drive systems.		**CO3**

UNIT - IV	CONTROL OF SRM AND BLDC MOTOR DRIVES	9
SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme - Sinusoidal and trapezoidal type of Brushless DC motors – Block diagram of current controlled Brushless DC motor drive.		**CO4**

UNIT - V	DIGITAL CONTROL OF DC DRIVE	9
Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant torque and constant horse power operations, Speed detection and current sensing circuits and feedback elements.		CO5
	Total Periods:	**45**

Text Books:

1. Dubey, G.K, "Power semiconductor controlled devices", Prentice Hall International New jersey, 1988.
2. R.Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Pearson Education, India, 2015.
3. Murphy, J.M.D, Turnbull F.G, "Thyristor control of AC motors", Pergamon press, Oxford, 1978.

Reference Books:

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press, 2005.
2. Buxbaum A, Schierau K , and Staughen A "Design of control systems for DC drives", Springer-Verlag, Berlin, 1990.
3. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, India, 2015.
4. R.Krishnan, "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications", CRC press, 2001.
5. Werner Leonhard, "Control of Electrical Drives", 3rd Edition, Springer, 2001.
6. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC press, 2009.

Course Outcomes (CO)

CO1	Ability to use standard methods to control for various DC electrical motor.
CO2	Ability to analyze different advanced control schemes of induction machines.
CO3	Ability to understand the various characteristics of synchronous motor drives for proper control.
CO4	Ability to analyze different control techniques for SRM and BLDC motors.
CO5	Ability to justify new digital control for implementing the control of DC drive.

Course Outcomes (CO)

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

EE1733	POWER SYSTEMS TRANSIENTS	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Generation of switching transients and their control using circuit – theoretical concept.
- Mechanism of lighting strokes and the production of lighting surges.
- Propagation, reflection and refraction of travelling waves.
- Voltage transients caused by faults, circuit breaker action and load rejection on integrated power system.

UNIT - I	INTRODUCTION AND SURVEY	9
Review and importance of the study of transients - causes for transients; RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients; Different types of power system transients - effect of transients on power systems; role of the study of transients in system planning.		CO1

UNIT – II	SWITCHING TRANSIENTS	9
Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit; Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients – Ferro resonance.		CO2

UNIT – III	**LIGHTNING TRANSIENTS**	**9**
Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes model for lightning stroke: Factors contributing to good line design, protection using ground wires, Tower Footing Resistance - Interaction between lightning and power system.		**CO3**
UNIT – IV	**TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS**	**9**
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.		**CO4**
UNIT – V	**TRANSIENTS IN INTEGRATED POWER SYSTEM**	**9**
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines – overvoltage induced by faults - Switching surges on integrated system Qualitative application of EMTP for transient computation.		**CO5**
	Total Periods:	**45**

Text Books:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley - Interscience, New York, 2ndEdition,1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and SonsInc.,Second Edition,2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition,2010.

Reference Books:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, 6th Edition, 2020.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', New Academic science Limited, March 2011.
3. Y.Hase, Handbook of Power System Engineering," Wiley India,2012.

4. J.L.Kirtley, “Electric Power Principles, Sources, Conversion, Distribution and use,” Wiley,2012.
5. Akihiro ametani,” Power System Transient theory and applications”, CRC press, 2013.

Course Outcomes (CO)

CO1	Ability to understand and analyse switching and lightning transients.
CO2	Ability to acquire knowledge on generation of switching transients and their control.
CO3	Ability to analyse the mechanism of lighting strokes.
CO4	Ability to understand the importance of propagation, reflection and refraction of travelling waves.
CO5	Ability to understand the concept of circuit breaker action, load rejection on integrated power system.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

EE1734	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the various characteristics of Intelligent agents.
- To learn about the different experts systems in AI.
- To learn about the supervised learning with classifications.
- To understand the methods of unsupervised learning.
- To know about the various applications of AI.

UNIT I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AI)	9
History and evolution of artificial intelligence, strong AI and weak AI, definitions of Artificial Intelligence, emergence of AI – Technological advances, Machine Learning (ML)		CO1

- Deep Learning, Functions of AI, Characteristics of AI, Applications of AI - Industry 4.0, education sector, Business and Finance Sector, society.		
UNIT II	**AI – EXPERT SYSTEMS**	**9**
Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Defuzzification - Introduction to Neuro-Fuzzy system- Adaptive Fuzzy system(Qualitative analysis).		**CO2**
UNIT III	**SUPERVISED LEARNING**	**9**
Linear Models for Classification - Discriminant Functions - Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression - Decision Trees - Classification Trees - Regression Trees - Pruning. Neural Networks - Feed-forward Network Functions – Error – Back propagation - Regularization - Mixture Density and Bayesian Neural Networks - Kernel Methods - Dual Representations - Radial Basis Function Networks. Ensemble methods - Bagging- Boosting (Qualitative analysis).		**CO3**
UNIT IV	**UNSUPERVISED LEARNING**	**9**
Clustering - K-means - EM - Mixtures of Gaussians - The EM Algorithm in General - Model selection for latent variable models - high-dimensional spaces - The Curse of Dimensionality - Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA - Independent components analysis – RNN – LSTM(Qualitative analysis).		**CO4**
UNIT V	**REAL TIME APPLICATIONS**	**9**
Smart city – Vehicle Parking and Traffic Management System - Bio-medical image processing – Inventory control - Demand Prediction for Inventory Management.		**CO5**
		TOTAL PERIODS: 45

TEXT BOOKS & REFERENCES:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2020.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 4th edition, 2016.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 3rd Edition,2018
4. Ethem Alpaydin," Introduction to Machine Learning", MIT Press, Third Edition 2014
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2012
6. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
7. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.
8. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006
9. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009.

Course Outcomes (CO) Upon Completion of the course, the students will be able,	
CO1	To understand the basics of AI, various subsets and applications.
CO2	To understand the concept of AI expert systems and the structure of the fuzzy Based expert system.
CO3	To understand the structure of the various supervised learning networks.
CO4	To understand the structure of the various unsupervised and deep learning networks.
CO5	To understand and implement the concept of the AI / ML algorithms for real time applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	K	l	1	2	3	4
CO1	2	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1
CO2	2	2	2	3	3	1	1	2	1	2	1	2	2	1	1	1
CO3	2	2	2	3	3	1	1	2	1	2	1	2	2	1	1	1
CO4	2	2	2	3	3	1	1	2	1	2	1	2	2	1	1	1
C05	3	3	3	3	3	2	2	3	2	3	3	2	3	2	2	2

CS1304	COMPUTER ARCHITECTURE	L	T	P	C
	Common to CSE,IT and EEE(Elective)	3	0	0	3

Objectives

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies, cache memories and virtual memories.

UNIT - I	BASIC STRUCTURE OF A COMPUTER SYSTEM	9
Eight ideas-Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations –decision making – MIPS Addressing		CO1

UNIT - II	DATA REPRESENTATION AND ARITHMETIC FOR COMPUTERS	9
Signed number representation, Addition and Subtraction – Multiplication – Division – Fixed- and Floating-Point Representation – Floating Point Operations.		CO2
UNIT - III	**DATA PATH AND CONTROL UNIT**	**9**
A Basic MIPS implementation – Building a Data path – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards –Exceptions.		CO3
UNIT - IV	**PARALLELISIM**	**9**
Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.		CO4
UNIT - V	**MEMORY AND PERIPHERAL DEVICES**	**9**
Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.		CO5
	Total Periods:	**45**

Text Books:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

Reference Books:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
3. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
4. Jim Ledin, "Modern Computer architecture and Organization", Packt Publishing,2020.
5. Douglas Comer, "Essentials of Computer Architecture", Taylor and Francis Group 2020

Course Outcomes (CO)	
Students will be able to	
CO1	Understand the basics structure of computers, operations and instructions.
CO2	Design arithmetic and logic unit.
CO3	Understand pipelined execution and design control unit.
CO4	Understand parallel processing architectures.
CO5	Understand the various memory systems and I/O communication.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

EC1731	CMOS VLSI DESIGN	L	T	P	C
		3	0	0	3

Objectives

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT - I	INTRODUCTION TO MOS TRANSISTOR	9
MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.		CO1

UNIT - II	COMBINATIONAL MOS LOGIC CIRCUITS	9

Circuit Families: Static CMOS, Ratioed Circuits, Cascade Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.		**CO2**
UNIT - III	**SEQUENTIAL CIRCUIT DESIGN**	**9**
Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Mono stability Sequential Circuits, Astability Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.		**CO3**
UNIT - IV	**DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUB SYSTEM**	**9**
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed trade-offs, Case Study: Design as a trade-off. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.		**CO4**
UNIT - V	**IMPLEMENTATION STRATEGIES AND TESTING**	**9**
FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability,Boundary Scan.		**CO5**
	Total Periods:	**45**

Text Books:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson , 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits: A Design perspective”, Second Edition , Pearson , 2016.

Reference Books:

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley,1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits: Analysis& Design”,4th edition McGraw HillEducation,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education,2007
4. R. Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

Course Outcomes (CO)

CO1	Realize the concepts of digital building blocks using MOS transistor.
CO2	Design combinational MOS circuits and power strategies.
CO3	Design and construct Sequential Circuits and Timing systems.
CO4	Design arithmetic building blocks and memory subsystems.
CO5	Apply and implement FPGA design flow and testing.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3
C05	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3	3

MG1002	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3

Objectives

- To classify and formulate real-life problem for modelling, solving and applying for decision making.
- To study the formulation and various methods of solutions for linear programming, transportation, assignment , CPM and PERT problems
- To solve problems using dynamic programming method

UNIT - I	LINEAR MODELS	9
Introduction to operations research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method-Primal Dual problems - Dual theory and Sensitivity analysis		CO1

UNIT – II	**TRANSPORTATION MODELS**	**9**
Transportation and assignment problems-Applications (Emphasis should be more on problems than theory)		**CO2**
UNIT – III	**NETWORK MODELS**	**9**
Shortest path problem: Dijkstra's algorithms, Floyd's algorithm, systematic method – CPM / PERT–Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations-example-Sequencing problems.		**CO3**
UNIT – IV	**DECISION MODELS AND INVENTORY MODELS**	**9**
Replacement problems-Capital equipment-Discounting costs-Group replacement. Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models-Single period inventory models with shortage cost.		**CO4**
UNIT – V	**QUEUING MODELS**	**9**
Characteristics of Queuing Models – Single and multi server models Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.		**CO5**
	Total Periods:	**45**

Text Books:

1. H. A. Taha, operational research-An introduction, Macmillan, 1976
2. F. S. Hiller and G. J. Liebermann, Introduction to operational research (7th edition)
3. B. E. Gillet, Introduction to operational research-A computer oriented algorithmic approach, McGraw Hill, 1989
4. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975

Reference Books:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.

5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.
6. J. C. Pant, ‘Introduction to Optimisation: Operations Research’, Jain Brothers, Delhi, 2008.
7. Pannerselvam, ‘Operations Research’, Prentice Hall of India 2010.

Course Outcomes (CO)

CO1	To analyze the problems in engineering, management or business environment, focusing on important details
CO2	To formulate real problems in terms of input-output parameters relationships and identify the solution procedure
CO3	To understand the concept of network and project planning
CO4	To understand the inventory management in manufacturing context
CO5	To understand the application of queuing theory in real world

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	1	1	1	0	0	0	0	1	2	1	1	1	1
CO2	3	3	2	1	1	1	0	0	0	0	1	2	3	3	3	3
CO3	3	3	2	0	1	1	0	0	0	0	1	2	3	3	3	3
CO4	3	3	2	0	1	1	0	0	0	0	1	2	3	3	3	3
C05	3	3	2	1	1	1	0	0	0	0	1	2	3	3	3	3

PROFESSIONAL ELECTIVE – IV (VIII SEMESTER)

EE1841	ELECTRIC ENERGY UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge on the following Topics

- To study the utilization and conservation of electrical power and energy efficient equipment.
- To understand the principle, design of illumination systems and energy efficiency lamps.
- To study the methods of industrial heating and welding.
- To understand the electric traction systems and their performance.

UNIT - I	ILLUMINATION	9
Importance of lighting – properties of good lighting scheme, laws of illumination, photometry, types of lamps, lighting calculations; basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting; LED lighting and energy efficient lamps.		CO1

UNIT - II	REFRIGERATION AND AIR CONDITIONING	9
Refrigeration-Domestic refrigerator and water coolers ; Air-Conditioning, Various types of air-conditioning systems and their applications; smart air conditioning units ; Energy Efficient motors- Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.		CO2

UNIT - III	HEATING AND WELDING	9
Role of electric heating for industrial applications – resistance heating, induction heating, dielectric heating, electric arc furnaces; Brief introduction to electric welding – welding generator, welding transformer and the characteristics.		CO3

UNIT - IV	TRACTION	9
Merits of electric traction – requirements of electric traction system, supply systems, mechanics of train movement, traction motors and control, braking - Recent trends in electric traction.		CO4

UNIT - V	DOMESTIC UTILIZATION OF ELECTRICAL ENERGY	9
Domestic utilization of electrical energy - House wiring, Induction based appliances, Online and OFF line UPS, Batteries; Power quality aspects - nonlinear and domestic		CO5

loads; Earthing - Domestic, Industrial and Substation; BEE standards on energy efficiency	
Total Periods:	**45**

Text Books:

1. Wadhwa, C.L. “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt. Ltd, Reprint edition 2015.
2. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3. Energy Efficiency in Electric Utilities, BEE Guide Book, Revised 2015.

Reference Books:

1. Partab.H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, New Delhi, Revised edition 2017.
2. Openshaw Taylor.E, “Utilization of Electrical Energy in SI Units”, Orient Longman Pvt. Ltd, Reprint 2012.
3. Gupta.J.B, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, Reprint 2015.

COURSE OUTCOMES (CO)

CO1	Acquire knowledge about the basics of illumination systems based on electrical energy
CO2	Knowledge on basics of refrigeration and air conditioning systems and the burden they create on electrical systems
CO3	Understand the process of heating and welding and different types of apparatus used
CO4	Acquire a comprehensive overview of traction systems and their significance
CO5	Understand the application of electrical energy in domestic appliances and energy conservation with BEE standards.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	3	3	1	1	1	1	1	1	1	1	3	1	3	1
CO2	3	3	3	1	1	1	1	1	1	1	1	2	3	3	1	1
CO3	3	2	3	3	1	1	1	1	1	1	2	1	3	3	1	1

CO4	3	3	3	2	2	1	3	1	1	1	1	1	3	3	1	1
C05	3	3	3	1	3	1	1	1	1	1	2	1	1	2	1	1

EE1842	**FLEXIBLE AC TRANSMISSION SYSTEMS**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To understand:

- The problems in AC transmission systems and establish the Flexible AC transmission systems
- The operation and control of SVC and its applications to enhance the stability and damping.
- The different modes of operation TCSC and to model it for power flow and stability studies.
- The basic operation and control of voltage source converter based FACTS controllers.
- The advanced FACTS controllers

UNIT - I	**INTRODUCTION**	**9**
Reactive power control in electrical power transmission lines–load & system compensation; Uncompensated transmission line–shunt and series compensation; Basic concepts of Static Var Compensator (SVC); Thyristor Controlled Series Capacitor (TCSC).		**CO1**

UNIT - II	**STATIC VAR COMPENSATOR AND APPLICATIONS**	**9**
Voltage control by SVC–Advantages of slope in dynamic characteristics, Influence of SVC on system voltage, Design of SVC voltage regulator, Modelling of SVC for power flow and fast transient stability, Applications- Enhancement of transient stability , Steady state power transfer , Enhancement of power system damping.		**CO2**

UNIT - III	**THYRISTOR CONTROLLER SERIES CAPACITOR AND APPLICATIONS**	**9**
Operation of the TCSC–Different modes of operation, Modelling of TCSC, Variable reactance model, Modelling for Power Flow and stability studies- Applications; Improvement of the system stability limit, Enhancement of system damping.		**CO3**

UNIT - IV	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS	9
Static Synchronous Compensator (STATCOM)–Principle of operation, V-I Characteristics, Applications; Steady state power transfer, enhancement of transient stability, prevention of voltage instability; SSSC-operation of SSSC and the control of power flow, modeling of SSSC in load flow and transient stability studies.		CO4

UNIT - V	ADVANCED FACTS CONTROLLERS	9
Interline DVR(IDVR); Unified Power flow controller (UPFC); Interline power flow controller (IPFC); Unified Power quality conditioner (UPQC).		CO5

Total Periods:	**45**

Text Books:

1. R.Mohan Mathur, Rajiv K.Varma,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2011.
2. NarainG. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

Reference Books:

1. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2016.
2. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

COURSE OUTCOMES (CO)

CO1	Analyse the reactive power flow in transmission networks and understand the importance of voltage stability
CO2	Analyse and understand the operation of shunt compensated devices namely SVC
CO3	Analyse and Understand the operation of series compensated devices namely TCSC
CO4	Acquire knowledge about the effectiveness of active compensation.
CO5	Acquire knowledge about new age compensators and their interaction with the system.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	3	3	1	1	1	1	1	1	1	1	1	3	2	1	1

CO3	3	2	2	3	1	1	1	1	1	1	1	1	3	3	1	1
CO4	2	3	2	1	2	1	3	1	1	1	1	1	2	2	1	1
C05	3	1	3	1	3	1	1	1	1	1	1	3	1	3	1	1

EE1843	**POWER QUALITY**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Various sources, causes and effects of power quality issues, and their measures and mitigation.
- Concepts of voltage sag and swell.
- Concept of Harmonics and their effects
- Analyze and design the passive filters and to acquire knowledge on compensation techniques.
- Power quality monitoring & custom power devices

UNIT – I	**INTRODUCTION TO POWER QUALITY**	**9**
Terms and definitions & Sources – Overloading, under voltage, over voltage – Concepts of transients – Short duration variations such as interruption – Long duration variation such as sustained interruption – Sags and swells – Voltage sag – Voltage swell – Voltage imbalance – Voltage fluctuations – Power frequency variations – International standards of power quality – Computer Business Equipment Manufacturers Associations (CBEMA) curve		**CO1**

UNIT – II	**VOLTAGE SAG AND SWELL**	**9**
Estimating voltage sag performance – Thevenin's equivalent source – Analysis and calculation of various faulted condition – Estimation of the sag severity – Mitigation of voltage sag, Static transfer switches and fast transfer switches. – Capacitor switching – Lightning – Ferro resonance – Mitigation of voltage swell		**CO2**

UNIT – III	**HARMONICS**	**9**
Harmonic sources from commercial and industrial loads – Locating harmonic sources – Power system response characteristics – Harmonics Vs transients. Effect of harmonics – Harmonic distortion – Voltage and current distortions – Harmonic indices – Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards.		**CO3**

UNIT – IV	**PASSIVE POWER COMPENSATORS**	**9**
Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters– Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. Fundamentals of load compensation – voltage regulation & power factor correction		**CO4**
UNIT – V	**POWER QUALITY MONITORING & CUSTOM POWER DEVICES**	**9**
Monitoring considerations – Monitoring and diagnostic techniques for various power quality problems – Quality measurement equipment – Harmonic / spectrum analyzer – Flicker meters Disturbance analyzer – Applications of expert systems for power quality monitoring. Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR –Unified power quality conditioner		**CO5**
	Total Periods:	**45**

Text Books:

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H. Wayne Beaty, 'Electrical Power Systems Quality', McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York : Wiley), 2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al–Haddad,' Power Quality Problems & Mitigation Techniques' Wiley, 2015.

Reference Books:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press), 2000.
3. G. J. Wakileh, 'Power Systems Harmonics – Fundamentals, Analysis and Filter Design,' Springer 2007.
4. E. Aeha and M. Madrigal, 'Power System Harmonics, Computer Modelling and Analysis', Wiley India, 2012.
5. R. S. Vedam, M. S. Sarma, 'Power Quality – VAR Compensation in Power Systems,' CRC Press 2013.
6. C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2002.

Course Outcomes (CO)

CO1	Ability to understand various sources, causes and effects of power quality issues, electrical systems and their measures and mitigation.
CO2	Ability to study the concepts of voltage sag and swell.
CO3	Ability to study the concept of Harmonics and their effects
CO4	Ability to analyze and design the passive filters and to acquire knowledge on compensation techniques.
CO5	Ability to understand the power quality monitoring & custom power devices

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	1	1	1	1	1	1	2	1	1	3	2	2	1
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2	1
CO3	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1
CO4	3	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1
C05	3	2	1	1	1	1	1	1	1	1	1	2	3	2	2	1

EE1844	SMPS AND UPS	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge about the following topics:

- Modern power electronic converters and its applications in electric power utility.
- Resonant converters and UPS

UNIT - I	DC-DC CONVERTERS	9
Principles of step down and step up converters; Analysis and state space modeling of Buck, Boost, Buck - Boost and Cuk converter.		CO1

UNIT - II	SWITCHED MODE POWER CONVERETRS	9
Analysis and state space modelling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters - control circuits and PWM techniques.		CO2

UNIT - III	RESONANT CONVERTERS	9
Introduction - classification - basic concepts - Resonant switch - Load Resonant converters - ZVS, Clamped voltage topologies - DC link inverters with Zero Voltage Switching - Series and parallel Resonant inverters - Voltage control.		CO3

UNIT - IV	**DC-AC CONVERTERS**	**9**
Single phase and three phase inverters, control using various (sine PWM, SVPWM and Phase - Shift Modulation PWM) techniques, various harmonic elimination techniques; Multilevel inverters - Concepts - Types - Diode clamped- Flying capacitor- Cascaded types - Applications.		**CO4**
UNIT - V	**POWER CONDITIONERS, UPS AND FILTERS**	**9**
Introduction - Power line disturbances - Power conditioners; UPS - offline UPS, Online UPS, Applications; Filters - Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters; Design of inductor and transformer for PE applications - Selection of capacitors.		**CO5**
	Total Periods:	**45**

TEXT BOOKS:

1. Simon Ang, Alejandro Oliva, "Power-Switching Converters", Third Edition, CRC Press, 2014.
2. KjeldThorborg, "Power Electronics - In theory and Practice", Overseas Press, First Indian Edition 2015.
3. M.H. Rashid – Power Electronics circuits, devices and applications- 4th edition, Pearson publishers, Reprint 2017.

Reference Books:

1. Philip T Krein, " Elements of Power Electronics", Oxford University Press 2015
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons- 2016.

COURSE OUTCOMES (CO)

CO1	Acquire Knowledge about DC-DC Converters
CO2	Acquire knowledge about Switched mode power converters
CO3	Analyse the operation of Resonant Converters
CO4	Knowledge about inverter applications
CO5	Understand the operation of different UPS topologies.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	3	3	1	2	1	1	1	1	1	1	1	3	2	1	1
CO3	3	2	2	2	2	1	1	1	1	1	1	2	2	3	1	1
CO4	3	3	2	1	2	1	2	1	1	1	1	1	3	2	1	1
C05	2	1	3	1	2	1	1	1	1	1	1	3	2	3	1	1

EE1845	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators.
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT - I	INTRODUCTION	9
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.		CO1

UNIT - II	SENSORS AND ACTUATORS-I	9
Electrostatic sensors – Parallel plate capacitors – Applications – Inter digitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.		CO2

UNIT - III	SENSORS AND ACTUATORS-II	9
Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric		CO3

sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.		
UNIT - IV	**MICROMACHINING**	**9**
Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.		**CO4**
UNIT - V	**POLYMER AND OPTICAL MEMS**	**9**
Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.		**CO5**
	Total Periods:	**45**

Text Books:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

Reference Books:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

Course Outcomes (CO)

CO1	Ability to understand the operation of micro devices, micro systems and their applications along with knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
CO2	Ability to introduce various sensors and actuators
CO3	Ability to introduce piezo electric sensors, actuators and its applications

CO4	Ability to design the micro devices, micro systems using the MEMS fabrication process. To educate on the rudiments of Micro fabrication techniques.
CO5	Ability to introduce different materials used for MEMS

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	1	3	2	2	3	3	2	1	3	3	3	3	3
CO2	3	2	3	3	3	2	2	3	3	2	1	2	3	3	3	3
CO3	3	3	3	3	2	2	2	3	2	2	2	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3
C05	3	2	2	2	3	3	3	3	3	3	2	3	3	3	3	3

GE1003	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

Objectives

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT – I	HUMAN VALUES	9
Morals, values and Ethics; Integrity; Work ethics; 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.		CO1

UNIT – II	ENGINEERING ETHICS	9
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.		**CO2**
UNIT – III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**
Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law.		**CO3**
UNIT – IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**
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.		**CO4**
UNIT – V	**GLOBAL ISSUES**	**9**
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.		**CO5**
	Total Periods:	**45**

Text Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2012.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

5. 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.
6. World Community Service Centre, “Value Education”, Vethathiri publications, Erode, 2011.

Course Outcomes (CO)

CO1	Able to define the dimensions or senses of engineering ethics and describe the various theories of moral development.
CO2	Able to describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.
CO3	Able to understand significance of safety and risk assessment when developing engineering products.
CO4	Able to understand the social responsibilities and intellectual property rights of engineers.
CO5	Able to understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	B	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3	3
CO2	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3	3
CO3	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3	3
CO4	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3	3
CO5	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3	3

MG1001	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Objectives

- To enable the students to study the evolution of Management.
- To study the functions and principles of management.
- To learn the application of the principles in an organization.

- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

UNIT – I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**9**
Definition of Management – Science or Art – Manager Vs Entrepreneur – Types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.		**CO1**
UNIT – II	**PLANNING**	**9**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		**CO2**
UNIT – III	**ORGANISING**	**9**
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.		**CO3**
UNIT – IV	**DIRECTING**	**9**
Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		**CO4**
UNIT – V	**CONTROLLING**	**9**
System and process of controlling – Budgetary and non–budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.		**CO5**
	Total Periods:	**45**

Text Books:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.

2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

Reference Books:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 6th Edition 2017.

Course Outcomes (CO)

CO1	Ability to understand the various terms and definitions related to management and organization.
CO2	Ability to acquire the skill of planning and various strategies of management in an organization.
CO3	Ability to understand the types of organization and also get an insight into HR planning, recruitment, selection and career planning and management.
CO4	Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.
CO5	Ability to understand the concept of budget and budgetary control and acquire the skill of controlling technique.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1	3
CO2	1	2	2	2	3	3	3	3	3	3	3	3	1	1	1	3
CO3	2	2	2	2	3	2	2	3	3	3	3	3	1	1	1	3
CO4	1	1	2	2	3	3	3	3	3	3	3	3	1	1	1	3
C05	3	3	3	3	3	3	3	3	3	3	3	3	1	2	1	3

PROFESSIONAL ELECTIVE -5

EE1851	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Basic concepts behind energy management and energy audit process.
- Fundamentals of energy management on different electrical equipments and cogeneration.
- Knowledge on lighting systems.
- Concepts of metering for energy management.
- Concepts behind economic analysis and Load management.

UNIT – I	INTRODUCTION	9
Basics of Energy - Need for energy management - Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.		CO1

UNIT - II	ENERGY MANAGEMENT FOR MOTORS AND COGENERATION	9
Energy management for electric motors - Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration - Forms of cogeneration - Feasibility of cogeneration - Electrical interconnection.		CO2

UNIT - III	LIGHTING SYSTEMS	9
Energy management in lighting systems - Task and the working space - Light sources - Ballasts - Lighting controls - Optimizing lighting energy - Power factor and effect of harmonics, lighting and energy standards.		CO3

UNIT – IV	METERING FOR ENERGY MANAGEMENT	9
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, metering techniques and practical examples.		CO4

UNIT – V	ECONOMIC ANALYSIS AND MODELS	9
Economic analysis - Economic models - Time value of money - Utility rate structures - Cost of electricity - Loss evaluation, load management - Demand control techniques - Utility monitoring and control system - HVAC and energy management - Economic justification.		CO5

Total Periods:	**45**

Text Books:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 8th Edition, River Publishers, 2020.
2. Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1st Edition, 1990.

Reference Books:

1. Reay D.A, Industrial Energy Conservation, Revised 1st Edition, Pergamon Press, 1979.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.
5. National Productivity Council Guide Books.

Course Outcomes (CO)

CO1	Ability to understand the basics of Energy management and Energy audit process.
CO2	Ability to understand the basics of energy management for motors and energy management by cogeneration
CO3	Ability to acquire knowledge on Energy management in lighting systems.
CO4	Ability to understand the importance of Energy management on various electrical equipment and metering.
CO5	Ability to impact concepts behind economic analysis and various control techniques.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	3	1	2	1	1	1	1	3	2	3	1	2	3
CO2	3	3	1	3	1	2	1	1	1	1	3	2	3	1	3	3
CO3	3	3	2	3	1	2	1	1	1	1	3	2	3	2	3	3
CO4	3	3	2	3	1	2	1	1	1	1	3	2	3	2	3	3
C05	3	3	3	3	1	2	1	1	1	1	3	2	3	2	3	3

EE1852	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Planning of DC power transmission and comparison with AC power transmission system.
- HVDC converters.
- HVDC system control.
- Harmonics and design of filters.
- Power flow in HVDC system under steady state condition.

UNIT - I	INTRODUCTION	9
DC Power transmission technology - Comparison of AC and DC transmission - Application of DC transmission - Description of DC transmission system - Planning for HVDC transmission - Modern trends in HVDC technology - DC breakers - Operating problems - HVDC transmission based on VSC - Types and applications of MTDC systems.		CO1

UNIT – II	ANALYSIS OF HVDC CONVERTERS	9
Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number - Choice of converter configuration - Converter bridge characteristics - Analysis of a 12 pulse converters - Analysis of VSC topologies and firing schemes.		CO2

UNIT - III	CONVERTER AND HVDC SYSTEM CONTROL	9
Principles of DC link control - Converter control characteristics - System control hierarchy - Firing angle control - Current and extinction angle control - Starting and stopping of DC link - Power control - Higher level controllers - Control of VSC based HVDC link.		CO3

UNIT - IV	REACTIVE POWER AND HARMONICS CONTROL	9
Reactive power requirements in steady state - Sources of reactive power - SVC and STATCOM - Generation of harmonics - Design of AC and DC filters - Active filters.		CO4

UNIT - V	POWER FLOW ANALYSIS IN AC/DC SYSTEMS	9
Per unit system for DC quantities - DC system model - Inclusion of constraints - Power flow analysis - Case study.		CO5

Total Periods:	45

Text Books:

1. Padiyar,K.R., "HVDC Power Transmission System", New Age International (P)Ltd. New Delhi, Second Edition, 2015.
2. Arrillaga,J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 2nd Edition, 1998.

Reference Books:

1. Kundur P.," Power System Stability and Control", McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG," High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Edward Wilson Kimbark," Direct Current Transmission", Vol.1, Wiley inter science, New York, London, Sydney, 1971.

Course Outcomes (CO)

CO1	Ability to get knowledge about modern trends and planning of DC power transmission and AC power transmission system.
CO2	Ability to analyze and understand the concepts of HVDC converters.
CO3	Ability to acquire knowledge on DC link control and its characteristics.
CO4	Ability to understand the concepts of reactive power management and harmonics control.
CO5	Ability to understand the importance of power flow in HVDC system under steady state.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	E	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	1	1	1	1	1	3	3	3	3	1
CO2	3	3	3	3	3	2	1	1	1	1	1	3	3	3	3	1
CO3	3	3	3	3	3	2	1	1	1	1	1	3	3	3	3	1
CO4	3	3	3	3	3	2	1	1	1	1	1	3	3	3	3	1
C05	3	3	3	3	3	2	1	1	1	1	1	3	3	3	3	1

EE1853	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Architecture and programming model of PIC microcontroller.
- Interrupts and timers in PIC microcontroller.
- Various communication buses for data transfer and I/O interfacing.
- Architecture and programming model of ARM processor.
- ARM Organisations and embedded ARM applications.

UNIT - I	INTRODUCTION TO PIC MICROCONTROLLER	9
Introduction to PIC Microcontroller; PIC 16C6x and PIC16C7x Architecture, Pipelining - Program Memory considerations, Register File Structure, Instruction Set , Addressing modes, Simple Operations.		**CO1**

UNIT - II	INTERRUPTS AND TIMER	9
PIC micro controller Interrupts; External Interrupts, Interrupt Programming; Loop time subroutine Timers, Timer Programming; Front panel I/O, Soft Keys, State machines and key switches, Display of Constant and Variable strings.		**CO2**

UNIT - III	PERIPHERALS AND INTERFACING	9
I^2C Bus for Peripherals Chip Access: Bus operation;Bus subroutines; Serial EEPROM; Analog to Digital Converter; Digital to Analog converter; UART- Baud rate selection; Data handling circuit- Initialization; LCD and keyboard Interfacing ; Sensor Interfacing.		**CO3**

UNIT - IV	INTRODUCTION TO ARM PROCESSOR	9
Architecture, ARM programmer's model, ARM Development tools, Memory Hierarchy ,ARM Assembly Language Programming, Simple Examples, Architectural Support for Operating systems.		**CO4**

UNIT - V	ARM ORGANIZATION	9
3-Stage Pipeline ARM Organization; 5-Stage Pipeline ARM Organization; ARM Instruction Execution; ARM Implementation; ARM Instruction Set; ARM coprocessor interface; Architectural support for High Level Languages; Embedded ARM Applications.		**CO5**

	Total Periods:	**45**

Text Books:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2nd edition, 2015.

Reference Books:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.

Course Outcomes (CO)

CO1	Ability to understand the concepts of Architecture of PIC microcontroller
CO2	Ability to acquire knowledge on Interrupts and timers.
CO3	Ability to understand the importance of Peripheral devices for data communication and to understand the basics of sensor interfacing
CO4	Ability to acquire knowledge in Architecture of ARM processors
CO5	Ability to acquire knowledge on ARM Organization in embedded ARM application.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	3	3	2	1	1	1	2	1	3	2	3	3	1
CO2	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3	1
CO3	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3	1
CO4	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3	1
C05	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3	1

EE1854	SMART GRID	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Smart Grid technologies, different smart meters and advanced metering infrastructure.
- The power quality management issues in Smart Grid.
- The high performance computing for Smart Grid applications

UNIT - I	**INTRODUCTION**	**9**
Evolution of Electric Grid- Concept, Definitions and Need for Smart Grid; Smart grid drivers- functions, opportunities, challenges and benefits; Difference between conventional Grid & Smart Grid, National and International Initiatives in Smart Grid.		**CO1**
UNIT - II	**SMART GRID TECHNOLOGIES**	**9**
Technology Drivers; Smart energy resources; Smart substations; Substation Automation; Feeder Automation; Transmission systems- EMS, FACTS and HVDC, Wide area monitoring, Protection and control; Distribution systems- DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles(PHEV).		**CO2**
UNIT - III	**SMART METERS AND ADVANCED METERING INFRASTRUCTURE**	**9**
Introduction to Smart Meters; Advanced Metering infrastructure(AMI) drivers and benefits; AMI protocols, standards and initiatives; AMI needs in the smart grid; Phasor Measurement Unit(PMU); Intelligent Electronic Devices(IED) & their application for monitoring & protection.		**CO3**
UNIT - IV	**POWER QUALITY MANAGEMENT IN SMART GRID**	**9**
Power Quality & EMC in Smart Grid; Power Quality issues of Grid connected Renewable Energy Sources; Power Quality Conditioners for Smart Grid; Web based Power Quality monitoring; Power Quality Audit.		**CO4**
UNIT - V	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS**	**9**
Local Area Network (LAN); House Area Network (HAN); Wide Area Network (WAN); Broad band over Power line (BPL); IP based Protocols; Basics of Web Service and CLOUD Computing to make Smart Grids smarter; Cyber Security for Smart Grid.		**CO5**
	Total Periods:	**45**

Text Books:

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions",CRCPress2012.
2. Janaka Ekanayake, NickJenkins, KithsiriLiyanage, JianzhongWu, Akihiko Yokoyama, "Smart Grid: TechnologyandApplications",Wiley, 2012.

Reference Books:

1. VehbiC. Gungor,Dilan Sahin, Taskin Kocak, Salih Ergut, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol.7,No.4, November, 2011.
2. Xi Fang, SatyajayantMisra, Guoliang Xue, and DejunYang"SmartGrid –The New and Improved Power Grid: A Survey" ,IEEE Transaction on Smart Grids,vol.14,2012.
3. James Momohe "Smart Grid: Fundamentals of Design and Analysis,", Wiley-IEEE Press, 2012.

Course Outcomes (CO)

CO1	Ability to understanding on the concepts of Smart Grid and its present developments.
CO2	Ability to gain knowledge about different Smart Grid technologies.
CO3	Ability to acquire knowledge about different smart meters and advanced metering infrastructure.
CO4	Ability to acquire knowledge on power quality management and issues in Smart Grids.
CO5	Ability to develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	2	3	2	1	1	1	1	1	3	2	2	2	1
CO2	3	2	2	2	3	2	1	1	1	1	1	3	2	2	2	1
CO3	3	2	2	2	3	2	1	1	1	3	1	3	2	2	2	1
CO4	3	2	2	2	3	2	1	1	1	3	1	3	2	2	2	1
C05	3	2	2	2	3	2	1	1	1	3	1	3	2	2	2	1

EE1855	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Objectives

- To know various standardization procedures
- To learn the testing procedures for EV & HEV components

- To know the functional safety and EMC
- To realize the effect of EMC in EVs
- To study the effect of EMI in motor drives and in DC-DC converter system

UNIT - I	**EV STANDARDIZATION**	**9**
Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.		**CO1**
UNIT - II	**TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES**	**9**
Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer.		**CO2**
UNIT - III	**FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC**	**9**
Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management - Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality - Standards - Functional safety of autonomous vehicles.		**CO3**
UNIT - IV	**EMC IN ELECTRIC VEHICLES**	**9**
Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements		**CO4**
UNIT - V	**EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM**	**9**
Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive		**CO5**

System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path	
Total Periods:	**45**

Text Books:

1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
3. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.

Reference Books:

1. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.
2. Automotive EMC, Mark Steffika, Springer 2013, 1st Edition.
   Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2015, 1st Edition.

Course Outcomes (CO)

CO1	To describe the status and other details of standardization of EVs
CO2	To illustrate the testing protocols for EVs and HEV components
CO3	To analyze the safety cycle and need for functions safety for EVs
CO4	To analyze the problems related with EMC for EV components.
CO5	To evaluate the EMI in motor drive and DC-DC converter system.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	1	1	0	0	0	2	0	0	0	0	0	3	2	2	1
CO2	3	1	1	0	0	0	1	0	0	0	0	0	3	2	2	1
CO3	3	1	1	0	0	0	2	0	0	0	0	0	3	2	2	1
CO4	3	1	1	0	0	0	1	0	0	0	0	0	3	2	2	1
C05	3	1	1	0	0	0	2	0	0	0	0	0	3	2	3	1

EE1856	INTELLIGENT CONTROL OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Objectives

- To design and drive the mathematical model of a BLDC motor and its characteristics
- To learn the different control schemes for BLDC motor
- To study the basics of fuzzy logic
- To study the FPGA & VHDL basics
- To implement fuzzy logic control of BLDC motor in real time

UNIT - I	MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF THE BLDC MOTOR	9
Structure and Drive Modes - Basic Structure, General Design Method, Drive Modes. Mathematical Model, Differential Equations, Transfer Functions, State-Space Equations. Characteristics Analysis, Starting Characteristics, Steady-State Operation, Dynamic Characteristics, Load Matching Commutation Transients		CO1

UNIT - II	SPEED CONTROL FOR ELECTRIC DRIVES	9
Introduction -PID Control Principle, Anti windup Controller, Intelligent Controller. Vector Control. Control applied to BLDC motor.		CO2

UNIT - III	FUZZY LOGIC	9
Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems, overview of fuzzy expert system-fuzzy decision making.		CO3

UNIT - IV	FPGA AND VHDL BASICS	9
Introduction – FPGA Architecture-Advantages-Review of FPGA family processors-Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data		CO4

type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.		
UNIT - V	**REAL TIME IMPLEMENTATION**	**9**
Inverter design, identifying rotor position via hall effect sensors, open loop and fuzzy logic control of 48 V BLDC motor using FPGA.		**CO5**
	Total Periods:	**45**

Text Books:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
2. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition 2015.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 2021, 1st Edition.
4. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley 2012, 1st Edition.

Reference Books:

1. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1st Edition, 2002.
2. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, Wiley 2017, 2nd Edition
3. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi, Robert Shorten, Sonja Stüdli Fabian Wirth, CRC Press, 1st Edition. 2018.

Course Outcomes (CO)

CO1	To design the mathematical model of a BLDC motor and to discuss about its characteristics
CO2	To demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor
CO3	To illustrate the basics of fuzzy logic system
CO4	To describe the basics of VHDL & FPGA applied to control of EVs
CO5	To design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	0	0	0	3	0	2	0	3	3	3	3	3
CO2	3	3	2	2	0	0	0	4	0	2	0	3	3	3	3	3
CO3	3	3	3	3	0	0	0	0	0	2	0	3	3	3	3	3
CO4	3	3	3	3	0	0	0	0	0	2	0	3	3	3	3	3
C05	3	3	3	3	3	0	0	3	0	2	0	3	3	3	3	3

DS1816	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

Objectives

- To outline an overview of exploratory data analysis and phases involved in data analytics
- To acquire an in-depth knowledge in EDA techniques
- To experiment the data visualization
- To describe the methods of time series analysis
- To explain the basics of tree and hierarchical representation of big data

UNIT I	EXPLORATORY DATA ANALYSIS	9
EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA		CO1

UNIT II	EDA TECHNIQUES	9
Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques -Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.		CO2

UNIT III	VISUALIZING DATA	9
The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping-Location, Data, two sided data ranges, smooth interpolation of values over time		CO3

UNIT IV	TIME SERIES ANALYSIS	9

Overview of time series analysis-showing data as an area, drawing tabs, handling mouse input, Connections And Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues		**CO4**
UNIT V	**TREES, HIERARCHIES, AND RECURSION**	**9**
Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt publishing , March 2020.
2. Ben Fry, “Visualizing Data”, O’reilly publications, 2007.

REFERENCE BOOKS

1. Danyel Fisher & Miriah Meyer, “Making Data Visual: A Practical Guide To Using Visualization For Insight”, O’reilly publications, 2018.
2. Claus O. Wilke, ”Fundamentals of Data Visualization”, O’reilly publications, 2019.
3. EMC Education Services, “Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.
4. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition, 2014.
5. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the overview of exploratory data analysis and phases involved in data analytics
CO2	Explore in-depth knowledge in EDA techniques
CO3	Apply the visualization techniques in data
CO4	Describe the methods of time series analysis
CO5	Represent the data in tree and hierarchical formats

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2	2
CO2	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2	2
CO3	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2	2
CO4	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2	2
C05	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2	2

GE1004	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

Objectives

- To learn about basis of nanomaterial science, preparation method, types and application.

UNIT - I	INTRODUCTION	9
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).		CO1

UNIT - II	GENERAL METHODS OF PREPARATION	9
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.		CO2

UNIT - III	NANOMATERIALS	9
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.		CO3

UNIT - IV	CHARACTERIZATION TECHNIQUES	9
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.		**CO4**
UNIT - V	**APPLICATIONS**	**9**
Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.		**CO5**
	Total Periods:	**45**

Text Books:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

Reference Books:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Outcomes (CO)

CO1	Ability to understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Ability to acquire knowledge in general methods of preparation of nano materials.
CO3	Ability to understand the Nano forms of Carbon and methods of synthesis
CO4	Ability to acquire knowledge in characteristic nanomaterial on various technique.
CO5	Ability to gain knowledge on various application of nano materials.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3	4
CO1	3	2	2	3	1	2	1	1	2	1	1	3	2	2	3	2
CO2	3	2	3	3	1	2	1	1	2	1	1	3	3	2	3	2
CO3	3	3	3	3	1	2	1	1	2	1	1	3	3	2	3	1
CO4	3	3	3	3	1	2	1	1	2	1	2	3	3	2	3	1
C05	3	2	3	3	1	2	1	1	2	1	2	3	3	2	3	3

OPEN ELECTIVE-1(IV SEMESTER)

OEE101	INTRODUCTION TO PLC PROGRAMMING	L	T	P	C
		3	0	0	3

Objectives

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.
- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.

UNIT - I	INTRODUCTION TO PLC	9
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O, PLC Types.		CO1

UNIT - II	PLC INSTRUCTIONS	9
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays- Interlock examples- Timers, Counters, Examples.		CO2

UNIT - III	PLC PROGRAMMING	9

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions		**CO3**
UNIT - IV	**COMMUNICATION OF PLC AND SCADA**	**9**
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures		**CO4**
UNIT - V	**CASE STUDIES**	**9**
Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems		**CO5**
	Total Periods:	**45**

Text Books:

1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

Reference Books:

1. MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson publication

List of Open Source Software/ Learning website:

1. https://nptel.ac.in/courses/108105063 263
2. https://www.electrical4u.com/industrial-automation/
3. https://www.etf.ues.rs.ba/~slubura/Procesni%20racunari/Programmable%20Logic%20Contr ollers%20Programming%20Methods.pdf
4. https://www.electrical4u.com/industrial-automation/

Course Outcomes (CO)

CO1	Know the basic requirement of a PLC input/output devices and architecture

CO2	Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming
CO3	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function BIock
CO4	Able to develop a PLC logic for a specific application on real world problem
CO5	Ability to Understand the Concepts of Communication used for PLC/SCADA.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	1	0	0	0	0	1	0	1	0	0	0	0	0	2
CO2	3	3	2	0	0	0	0	1	0	1	2	0	0	0	2	2
CO3	3	3	3	3	1	0	0	1	0	1	0	0	3	3	0	2
CO4	3	3	0	3	3	0	0	1	0	1	0	0	3	3	0	3
C05	3	3	3	2	1	0	0	1	0	1	0	0	3	3	3	3

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
	(COMMON TO EEE, EIE, MECH, BIOTECH)	3	0	0	3

Objectives

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges.
- To have knowledge on the various virtualization techniques that serve in computation. and storage services on the cloud.
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT I	INTRODUCTION	9
Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing.		CO1

UNIT II	VIRTUALIZATION	9
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization.		CO2

UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**9**
NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage.		**CO3**
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**9**
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.		**CO4**
UNIT V	**CASE STUDIES**	**9**
Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

COURSE OUTCOMES(CO)

CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing

CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO2	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO3	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
CO4	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1
C05	3	3	3	3	2	0	0	0	0	2	2	2	1	2	2	1

OCS104	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
	(Common to EEE, EIE, MECH)	3	0	0	3

Objectives

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of Transaction Processing and concurrency
- To have an basic knowledge about the Storage implementation and query processing
- To understand database security concepts and database programming

UNIT - I	INTRODUCTION	10
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL		CO1

UNIT - II	**DATABASE DESIGN**	**10**
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form		**CO2**
UNIT – III	**TRANSACTION CONCEPTS AND CONCURRENCY CONTROL**	**7**
Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery		**CO3**
UNIT – IV	**IMPLEMENTATION TECHNIQUES**	**9**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation.		**CO4**
UNIT – V	**ADVANCED TOPICS AND DATABASE PROGRAMMING**	**9**
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools,		**CO5**
	Total Periods:	**45**

Text Books:

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill.

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications.

Course Outcomes (CO)	
CO1	To understand relational data model, evolve conceptual model of a given problem and SQL
CO2	To understand Relational model and normalization to perform database design effectively
CO3	Apply and relate the concept of transaction, concurrency control and recovery in database
CO4	To understand the implementation technique and query processing
CO5	To understand the concepts of database security and database programming

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	1	1	1	1	1	3	3	1	1	3	2	2	1
CO2	3	3	3	1	1	1	1	1	3	3	1	1	3	3	2	1
CO3	3	3	3	1	1	1	1	2	3	3	1	1	3	3	2	1
CO4	3	3	3	1	1	2	1	2	3	3	1	1	3	3	2	1
C05	3	3	3	1	1	1	1	2	3	3	1	1	3	2	2	1

OEC101	INTRODUCTION TO SIGNALS AND SYSTEMS	L	T	P	C
	(COMMON TO EEE & EIE)	3	0	0	3

Objectives

- To understand the basic properties of signal and systems
- To know the methods of characterization of LTI systems in the time domain
- To analyze continuous-time signals and system in the Fourier and Laplace domain
- To analyze discrete-time signals and system in the Fourier and Z transform domain

UNIT - I	CLASSIFICATION OF SIGNALS AND SYSTEM	12
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals – Continuous-time (CT) and Discrete-time (DT) signals, Periodic and Aperiodic signals, Deterministic and Random signals, Energy and Power signals - Classification of systems- CT systems and DT systems- – Linear and Nonlinear, Time-variant and Time-invariant, Causal and Non- causal, Stable and Unstable.		CO1

UNIT - II	ANALYSIS OF CONTINUOUS TIME SIGNALS	12
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.		**CO2**
UNIT - III	**LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS**	**12**
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series and parallel.		**CO3**
UNIT-IV	**ANALYSIS OF DISCRETE TIME SIGNALS**	**12**
Baseband signal Sampling – Fourier Transform of discrete-time signals (DTFT) – Properties of DTFT - Z Transform and Properties.		**CO4**
UNIT - V	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS**	**12**
Impulse response – Difference equations-Convolution sum- Discrete-time Fourier Transform and Z Transform analysis of Recursive and Non-Recursive systems-DT systems connected in series and parallel.		**CO5**
	Total Periods:	**60**

Text Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.

Reference Books:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford,2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson,2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson,2007.

Course Outcomes (CO)

CO1	To be able to determine if a given system is linear/causal/stable
CO2	Capable of determining the frequency components present in a deterministic signal
CO3	Capable of characterizing LTI systems in the time domain and frequency domain
CO4	Understand the process of sampling and able to analyze the discrete-time signals in the frequency domain.
CO5	To be able to compute the output of an LTI system in the time and frequency domains.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3	4
CO1	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1	3
CO2	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1	3
CO3	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1	3
CO4	3	2	3	3	2	2	0	0	0	0	1	2	2	2	1	3
C05	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1	3

OME101	AUTOMOTIVE SYSTEMS	L	T	P	C
	(COMMON TO EEE & BIOTECH)	3	0	0	3

Objectives

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT - I	AUTOMOTIVE ENGINE AUXILIARY SYSTEMS	9
Automotive engines- External combustion engines –Internal combustion engines - classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.		CO1

UNIT - II	VEHICLE FRAMES AND STEERING SYSTEM	9
Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system – conventional – sophisticated vehicle- and types of steering gear box-Power Steering-Steering geometry-condition for true rolling motion-Ackermann's- Devi's steering system - types of stub axle – Types of rear axles.		CO2

UNIT - III	TRANSMISSION SYSTEMS	9
Clutch-types and construction, gear boxes- manual and automatic, gear shift		CO3

mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres.		
UNIT – IV	**SUSPENSION AND BRAKES SYSTEMS**	**9**
Suspension Systems- conventional Suspension Systems -independent Suspension Systems –leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes - Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient.		**CO4**
UNIT – V	**ALTERNATIVE ENERGY SOURCES**	**9**
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers -Engine emission control by three way catalytic converter system. Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.		**CO5**
	Total Periods:	**45**

Text Books:

1. Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2007.
2. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997

Reference Books:

1. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998. 2.Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
2. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart –Will Cox Company Inc, USA ,1978.
3. Newton ,Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,198.

Course Outcomes (CO)	
CO1	To identify the different components in automobile Engineering
CO2	To understand the different types of vehicle frames and steering mechanism
CO3	Have clear understanding on different auxiliary and transmission systems usual.
CO4	To understand the vehicle suspension and different types of brakes systems.
CO5	To understand the alternative energy used for vehicle

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	a	b	f	a	b	i	a	b	l	a	b	3	a
CO1	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2	1
CO4	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
C05	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1

OEI101	SENSORS AND TRANSDUCERS	L	T	P	C
	(COMMON TO EEE,MECH,CIVIL & BIOTECH)	3	0	0	3

Objectives

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.
- To learn about optical pressure and temperature sensors
- To learn about single channel and multi-channel data acquisition systems

UNIT - I	INTRODUCTION	9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.		CO1

UNIT - II	MOTION, PROXIMITY AND RANGING SENSORS	9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth,		CO2

Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		
UNIT - III	**FORCE, MAGNETIC AND HEADING SENSORS**	**9**
Strain Gage, Load Cell, Magnetic Sensors–types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		**CO3**
UNIT – IV	**OPTICAL, PRESSURE AND TEMPERATURE SENSORS**	**9**
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 – SmartSensors-Film sensor, MEMS & Nano Sensors, LASER sensors.		**CO4**
UNIT – V	**SIGNAL CONDITIONING AND DAQ SYSTEMS**	**9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multichannel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.		**CO5**
	Total Periods:	**45**

Text Books:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill,2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi,2013.

Reference Books:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi,2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications,1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

Course Outcomes (CO)

CO1	Expertise in various calibration techniques and signal types for sensors.
CO2	Apply the various sensors in the Automotive and Mechatronics applications
CO3	Study the basic principles of various smart sensors.
CO4	Implement the DAQ systems with different sensors for real time applications

CO5	Expertise in signal conditioning systems and can implement in automotive and manufacturing areas.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2	1
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO4	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
C05	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1

OEI104	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Objectives

- Understand general concepts of Internet of Things(IoT) (Understand)
- Recognize various devices, sensors and applications (Knowledge)
- Analyze and Apply design concept to IoT solutions (Apply)
- Evaluate design issues in IoT applications (Evaluate)
- Create IoT solutions using sensors, actuators and Devices (Create)

UNIT I	INTRODUCTION TO IoT	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology		CO1

UNIT II	IoT ARCHITECTURE	9
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.		CO2

UNIT III	IoT PROTOCOLS	9
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP– Security		CO3
UNIT IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO**	**9**
Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		CO4
UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.		CO5
		TOTAL: 45 PERIODS

REFERENCE BOOKS

1. ArshdeepBahga, Vijay Madisetti, —Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
4. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols‖, Wiley, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze various protocols for IoT
CO2	Develop web services to access/control IoT devices.
CO3	Design a portable IoT using Rasperry Pi

CO4	Deploy an IoT application and connect to the cloud.
CO5	Analyze applications of IoT in real time scenario

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	2	-	2	3	3	2	3	-	2	2	1	1	1
CO2	3	2	3	2	-	2	3	3	2	3	-	2	2	1	1	1
CO3	3	2	3	2	-	2	3	3	2	3	-	2	2	1	1	1
CO4	3	2	3	2	-	2	3	3	2	3	-	2	2	1	1	1
CO5	3	2	3	2	-	2	3	3	2	3	-	2	2	1	1	1

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
	(Common to BIOTECH, EEE, EIE, MECH)	3	0	0	3

Objectives

- To impart knowledge on the principle and design of particulate/ gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT - I	AIR QULALITY MONITORING	9
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution –Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Composition of Particulate and Gaseous Pollutants.		**CO1**

UNIT - II	EFFECT OF ATMOSPHERIC DISPERSION	9
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.		**CO2**

UNIT - III	PARTICULATE CONTAMINANTS	9
Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.		**CO3**

UNIT - IV	GASEOUS CONTAMINANTS	9
Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing.		CO4
UNIT - V	**INDOOR AIR QUALITY MONITORING**	**9**
Sources, types and control of indoor air pollutants, sick building syndrome types – Sources and Effects of Noise Pollution– Standards–Control and Preventive measures.		CO5
	Total Periods:	**45**

Text Books:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

Reference Books:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.

Course Outcomes (CO) : The students completing the course will have

CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	I	j	k	l	1	2	3	4
CO1	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2	1
CO2	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2	1
CO3	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2	1
CO4	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2	1
C05	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2	1

OPEN ELECTIVE-2 (VII SEMESTER)

OEE102	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Objectives

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT - I	INTRODUCTION TO DRONE TECHNOLOGY	9
Drone Concept -Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses-Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability		CO1

UNIT - II	DRONE DESIGN, FABRICATION AND PROGRAMMING	9
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.		CO2

UNIT - III	**DRONE FLYING AND OPERATION**	**9**
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications		**CO3**
UNIT - IV	**DRONE COMMERCIAL APPLICATIONS**	**9**
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing		**CO4**
UNIT - V	**FUTURE DRONES AND SAFETY**	**9**
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardizationDrone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms		**CO5**
	Total Periods:	**45**

Text Books:

1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016.

Reference Books:

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

Course Outcomes (CO)

CO1	Know about a various type of drone technology, drone fabrication and programming
CO2	Execute the suitable operating procedures for functioning a drone
CO3	Select appropriate sensors and actuators for Drones
CO4	Develop a drone mechanism for specific applications
CO5	Create the programs for various drones

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	2	3	1	3	2	0	0	0	0	0	1	2	1	3	1
CO2	1	2	3	1	3	2	0	0	0	0	0	1	2	1	3	1
CO3	1	2	3	1	3	2	0	0	0	0	0	1	2	1	3	1
CO4	1	2	3	1	3	2	0	0	0	0	0	1	2	1	3	1
C05	1	2	3	1	3	2	0	0	0	0	0	1	2	1	3	1

OEE103	INDUSTRIAL IOT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

Objectives

- IoT Nodes & Sensors
- IoT Gateways
- IoT Cloud Systems
- IoT Cloud Dashboards
- Challenges in Iot system Design – Hardware & Software

UNIT - I	UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM	9
IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics		CO1

UNIT - II	ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM	9
UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow		CO2

UNIT - III	IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS	9

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; **Sensors-** Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors,Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.	**CO3**

UNIT - IV	**CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM**	**9**
Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services		**CO4**

UNIT - V	**CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE**	**9**
Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.		**CO5**

Total Periods:	**45**

Text Books:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

Reference Books:

1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan

Course Outcomes (CO)

CO1	Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications
CO2	Use processors & peripherals to design & build IoT hardware
CO3	Assess, select and customize technologies for IoT applications
CO4	Connect numerous IOT applications with the physical world of humans and real life problem solving
CO5	Design and implement IOT applications that manage big data

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	2	1	2	0	0	0	0	0	2	3	2	2	2
CO2	3	2	2	2	1	2	0	0	0	0	0	2	3	3	2	2
CO3	3	2	2	2	2	2	0	0	0	0	0	2	3	3	2	2
CO4	3	2	3	2	3	2	0	0	0	0	0	2	3	3	2	2
C05	3	3	3	3	3	3	0	0	0	0	0	1	3	2	3	3

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
	(COMMON TO EEE & EIE)	3	0	0	3

Objectives

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT - I	INTRODUCTION TO DATA ANALYSIS	9
Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		CO1

UNIT - II	R PROGRAMMING BASICS	9

Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		**CO2**
UNIT - III	**DATA VISUALIZATION USING R**	**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. **Working with R Charts and Graphs:** Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		**CO3**
UNIT - IV	**STATISTICS WITH R**	**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		**CO4**
UNIT - V	**PRESCRIPTIVE ANALYTICS**	**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		**CO5**
	Total Periods:	**45**

Text Books:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

Reference Books:

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013
2. Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
3. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
4. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
6. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
7. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
8. Joseph F Hair, William C Black etal , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.

9. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
10. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.

Course Outcomes (CO)

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	I	j	k	l	1	2	3	4
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	1	2	1
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	1	2	1
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	1	2	1
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	1	2	1
C05	3	3	3	3	2	0	0	0	0	2	2	2	3	1	2	1

OCS106	DATA COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

Objectives

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols.

UNIT - I	INTRODUCTION AND PHYSICAL LAYER	9
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		CO1

UNIT - II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		**CO2**
UNIT - III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		**CO3**
UNIT - IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		**CO4**
UNIT - V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		**CO5**
	Total Periods:	**45**

Text Books:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second 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. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

Course Outcomes (CO)

CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.

CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	0	0	0	0	0	0	0	0	0	1	1	1	1
CO2	3	3	3	0	0	0	0	0	0	0	0	0	1	1	1	1
CO3	3	3	3	0	0	0	0	0	0	0	0	0	1	1	1	1
CO4	3	3	3	0	0	0	0	0	0	0	0	0	1	1	1	1
C05	3	3	3	0	0	0	0	0	0	0	0	0	1	1	1	1

OEC102	**COMMUNICATION STSTEMS**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio–economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT – I	**ANALOG MODULATION**	**9**
Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Super heterodyne receivers		**CO1**

UNIT – II	**PULSE MODULATION**	**9**

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder – Time Division Multiplexing, Frequency Division Multiplexing.		**CO2**
UNIT – III	**DIGITAL MODULATION AND TRANSMISSION**	**9**
Phase shift keying – BPSK, DPSK, QPSK – Principles of M–array signalling, PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers		**CO3**
UNIT – IV	**INFORMATION THEORY AND CODING**	**9**
Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon–Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding		**CO4**
UNIT – V	**SPREAD SPECTRUM AND MULTIPLE ACCESS**	**9**
PN sequences – properties – m–sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,		**CO5**
	Total Periods:	**45**

Text Books:

1. H Taub, D L Schilling, G Saha, 'Principles of Communication Systems' 3/e, TMH 2007
2. S. Haykin 'Digital Communications' John Wiley 2005

Reference Books:

1. B. P. Lathi, 'Modern Digital and Analog Communication Systems', 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – 'Analog and Digital Communications' TMH 2006
3. B. Sklar, Digital Communications Fundamentals and Applications' 2/e Pearson Education 2007.

Course Outcomes (CO)

CO1	Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2	Apply analog and digital communication techniques.
CO3	Use data and pulse communication techniques.
CO4	Analyze Source and Error control coding.
CO5	Understand concepts of spread spectrum and multiple access

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
C05	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1

OME102	DESIGN OF EXPERIMENTS	L	T	P	C
	(COMMON TO EEE & EIE)	3	0	0	3

Objectives

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE).
- To demonstrate knowledge and understanding of Taguchi's approach.
- To develop skills to design and conduct experiments using DOE and Taguchi's approach.
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT - I	FUNDAMENTALS OF EXPERIMENTAL DESIGNS	9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.		CO1

UNIT - II	SINGLE FACTOR EXPERIMENTS	9
Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.		CO2

UNIT - III	FACTORIAL DESIGNS	9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.		**CO3**
UNIT - IV	**SPECIAL EXPERIMENTAL DESIGNS**	**9**
Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design- introduction to response surface methods, central composite design.		**CO4**
UNIT - V	**TAGUCHI METHODS**	**9**
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies.		**CO5**
	Total Periods:	**45**

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

Reference Books:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

Course Outcomes (CO)

CO1	To understand the fundamental principles of Classical Design of Experiments.
CO2	To apply DOE for process understanding and optimisation.
CO3	Ability to design the factors using new algorithm
CO4	Ability to design various resolution using 2^k.
CO5	To apply Taguchi based approach to evaluate quality.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1	1
CO2	3	2	2	1	2	1	2	1	1	1	2	3	2	1	1	1
CO3	3	2	1	2	2	1	2	1	1	1	2	3	2	1	1	1
CO4	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1	1
C05	3	2	2	2	2	1	2	1	1	1	1	3	2	1	1	1

OME105	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
	(COMMON TO EEE &EIE)	3	0	0	3

Objectives

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- Basic idea about the planning in product design.
- Basic idea about the industrial design tools.
- Basic idea about patents.

UNIT I	INTRODUCTION	9
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.		CO1
UNIT II	**CONCEPT GENERATION AND SELECTION**	**9**
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.		CO2
UNIT III	**PRODUCT ARCHITECTURE**	**9**
Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.		CO3

UNIT IV	INDUSTRIAL DESIGN	9
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools –Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.		CO4
UNIT V	**DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**	**9**
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 1999.

REFERENCE BOOKS

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, “Tool Design –Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, New york, NY.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The student will be able to design some products for the given set of applications and also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.
CO2	Students can be able to understand the concepts in generation and selection crireria.
CO3	Ability to pipelined execution and in establishing the architecture for developing products.
CO4	Acquire knowledge on investigation for customer needs related to industrialisation.
CO5	Able to develop and execute the developed prototypes.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2	2
CO2	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2	2
C05	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2	2

OME106	TESTING OF MATERIALS	L	T	P	C
	(Common to EEE & CIVIL)	3	0	0	3

Objectives

- To understand the various material testing methods and standards.
- To understand the various mechanical testing
- To understand the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT - I	INTRODUCTION TO MATERIALS TESTING	9
Overview of materials: Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.		CO1

UNIT - II	MECHANICAL TESTING	9
Introduction to mechanical testing: Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.		CO2

UNIT - III	NON DESTRUCTIVE TESTING	9
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.		CO3

UNIT - IV	MATERIAL CHARACTERIZATION TESTING	9
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.		CO4
UNIT - V	**OTHER TESTING**	**9**
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		CO5
	Total Periods:	**45**

Text Books:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

Reference Books:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986. Publishing, 1998.

Course Outcomes (CO): At the end of the course students will have the,

CO1	Ability to Identify suitable testing technique to inspect industrial component
CO2	Ability to Identify suitable mechanical testing technique for industrial applications
CO3	Ability to understand the non destructive testing
CO4	Ability to know the various techniques for material characterization
CO5	Ability to use the special techniques and know its applications and limitations.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1	1
CO2	3	2	2	1	2	1	2	1	1	1	2	3	2	1	1	1
CO3	3	2	1	2	2	1	2	1	1	1	2	3	2	1	1	1
CO4	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1	1
C05	3	2	2	2	2	1	2	1	1	1	1	3	2	1	1	1

OME107	VIBRATION AND NOISE CONTROL	L	T	P	C
	(COMMON TO EEE, EIE & CIVIL)	3	0	0	3

Objectives

- Basic about the noise and its control methods
- The sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components
- About the noise in the automotive sources
- Various control techniques in controlling noise and vibrations.
- Know about the source of noise

UNIT - I	BASICS OF VIBRATION	9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.		CO1

UNIT - II	BASICS OF NOISE	9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.		CO2

UNIT - III	AUTOMOTIVE NOISE SOURCES	9
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust		CO3

noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.		
UNIT – IV	**CONTROL TECHNIQUES**	**9**
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.		**CO4**
UNIT – V	**SOURCE OF NOISE AND CONTROL**	**9**
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers		**CO5**
Total Periods:		**45**

Text Books:

1. Singiresu S.Rao, “Mechanical Vibrations”, 5th Edition, Pearson Education, 2010

Reference Books:

1. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University,2007
2. David Bies and Colin Hansen, “Engineering Noise Control – Theory and Practice”,4th Edition, E and FN Spon, Taylore & Francise e-Library,2009
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, “Theory of Vibration with Application”, 5th Edition Pearson Education,2011
4. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 1996
5. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book”, Second Edition, SAE International,1999.
6. Julian Happian-Smith - “An Introduction to Modern Vehicle Design”- Butterworth-Heinemann, 2004
7. Rao, J.S and Gupta, K., “Introductory course on Theory and Practice of Mechanical Vibration”, 2nd Edition, New Age International Publications,2010
8. Shabana. A.A., “Theory of vibrations – An introduction”, 2nd Edition, Springer,2010
9. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009
10. John Fenton, “Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing,1998

Course Outcomes (CO)	
CO1	Understand the basic of noise and vibrations.
CO2	Understanding causes, source and types of vibrations in machineries
CO3	Gaining knowledge in sources and measurement standard of noise
CO4	Ability to design and develop vibrations and noise control systems.
CO5	Ability to know techniques in controlling the noise and vibrations.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2	1
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2	1
CO4	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
C05	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1

OCH102	PROCESS MODELLING AND SIMULATION	L	T	P	C
	(Common to EEE & EIE)	3	0	0	3

Objectives

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the steady state lumped systems.
- To analyze the unsteady state lumped systems
- To analyze the steady state distributed systems
- To analyze the unsteady state distributed systems and various modeling approaches.

UNIT – I	INTRODUCTION	7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.		CO1

UNIT – II	STEADY STATE LUMPED SYSTEMS	9
Degree of freedom analysis, single and network of process units, systems yielding linear and non- linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.		CO2

UNIT – III	UNSTEADY STATE LUMPED SYSTEMS	9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.		CO3
UNIT – IV	**STEADY STATE DISTRIBUTED SYSTEM**	**7**
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.		CO4
UNIT – V	**UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES**	**13**
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.		CO5
	Total Periods:	**45**

Text Books:

1. Ramirez, W.; "Computational Methods in Process Simulation ", 2nd Education., Butterworths Publishers, New York,2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Education, McGraw-Hill Book Co., 1996

Reference Books:

1. Felder,R.M.andRousseau,R.W.,"Elementary Principles of Chemical Processes",John Wiley, Fourth edition 2018.
2. Franks, R. G. E., "Mathematical Modelling in Chemical Engineering ", John Wiley,2014.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Education,PHI Learning Ltd (2012).
4. Amiya K. Jana, "ChemicalProcess Modelling and Computer Simulation" 2nd Education,PHI Learning Ltd,(2012).

Course Outcomes (CO)

CO1	Student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the

	process models.
CO2	Ability to analyze steady state lumped system
CO3	Ability to analyze unsteady state lumped system
CO4	Ability to analyze steady state distributed system
CO5	Ability to understand unsteady state distributed system and various modelling approaches

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	E	f	g	h	I	j	k	l	1	2	3	4
CO1	3	2	2	1	1	2	2	1	1	1	1	1	2	2	2	1
CO2	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2	1
CO3	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2	1
CO4	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2	1
CO5	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2	1

OMB104	**QUALITY FOR MANAGEMENT SCIENCE**	**L**	**T**	**P**	**C**
(Common to Mechanical Engineering, Instrumentation and Control Engineering, Electronics and Instrumentation Engineering, Electronics and Communication Engineering, Computer Science Engineering, Information Technology, Civil Engineering)		3	0	0	3

Objectives

- To facilitate the understanding of Quality Management principles and process.

UNIT - I	**INTRODUCTION**	**9**
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention		**CO1**

UNIT - II	**TQM PRINCIPLES**	**9**
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.		**CO2**

UNIT - III	TQM TOOLS AND TECHNIQUES-I	9
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.		**CO3**

UNIT - IV	TQM TOOLS AND TECHNIQUES-II	9
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.		**CO4**

UNIT - V	QUALITY MANAGEMENT SYSTEM	9
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000- ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration-Environmental Management System: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001— Benefits of EMS.		**CO5**

Total Periods:	**45**

Text Books:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised 3rd Edition, Indian Reprint, Sixth impression, 2013.

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janaki Raman. B and Gopal.R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO 9001-2015 standards

Course Outcomes (CO)

CO1	The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.

CO3	Students can understand the organisational, communication and teamwork requirements for effective quality management
CO4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans
CO5	The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	4	0	0	0	0	4	4	4	4	4	4	4	0	0	0	4
CO2	3	0	0	0	0	4	4	4	4	4	4	4	0	0	0	4
CO3	4	0	0	0	0	3	4	4	3	3	4	4	0	0	0	4
CO4	4	0	0	0	0	3	4	3	3	3	4	4	0	0	0	4
C05	4	0	0	0	0	4	3	4	4	4	4	4	0	0	0	4

AUDIT COURSE

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.

UNIT – I	HISTORY OF MAKING OF THE INDIAN CONSTITUTION	5
History, Drafting Committee, (Composition & Working)		CO1

UNIT – II	PHILOSOPHY OF THE INDIAN CONSTITUTION	5
Preamble, Salient Features		CO2
UNIT – III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**5**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		**CO3**
UNIT – IV	**ORGANS OF GOVERNANCE**	**5**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		**CO4**
UNIT – V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		**CO5**
UNIT – VI	**ELECTION COMMISSION**	**5**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		**CO5**
	Total Periods:	**30**

Reference Books:

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar 'Framing of Indian Constitution',1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes (CO)

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India

CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4	Discuss the passage of the Hindu Code Bill of 1956.
CO5	Discuss about the role and functioning of election commission.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

Objectives

- Understand value of education and self-development
- Imbibe good values in students
- Let the students know about the importance of character

UNIT – I	INTRODUCTION TO VALUE EDUCATION	6
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements		CO1

UNIT – II	IMPORTANCE OF VALUES	6
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.		CO2

UNIT – III	INFLUENCE OF VALUE EDUCATION	6
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth.		CO3

UNIT – IV	VALUE EDUCATION IN SOCIAL EMPOWERMENT	6
Character and Competence–Holy books vs Blind faith. Self-management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.		CO4

Total Periods:	30

Reference Books:

1. Chakroborty, S.K.'Values and Ethics for organizations Theory and practice', Oxford University Press, New Delhi

Course Outcomes (CO)

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality.
CO4	Developing the competence and self-control

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

Objectives

- Review existing evidence on their view topic to inform programme design and policy
- Making under taken by the DFID, other agencies and researchers.
- Identify critical evidence gaps to guide the development

UNIT – I	INTRODUCTION AND METHODOLOGY	6
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.		CO1

UNIT – II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries – Curriculum, Teacher education.		**CO2**
UNIT – III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		**CO3**
UNIT – IV	**PROFESSIONAL DEVELOPMENT**	**6**
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.		**CO4**
UNIT – V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy – Teacher education – Curriculum and assessment – Dissemination and research impact.		**CO5**
	Total Periods:	**30**

Reference Books:

1. J. Ackers, F. Hardman,'Classroom interaction in Kenyan primary schools', Compare, Vol. 31, No. 2, Page: 245-261, 2001.
2. M. Agrawal,'Curricular reform in schools: The importance of evaluation', Journal of Curriculum Studies, Vol. 36, No. 3, Page:361-379,2004.
3. K. Akyeampong,'Teacher training in Ghana-does it count? Multi-site teacher education research project' (MUSTER) Country report 1, London, 2003.
4. K. Akyeampong,K. Lussier, J. Pryor and J. Westbrook,'Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?' International Journal Educational Development, Vol. 33, No. 3, Page: 272–282, 2013.
5. R. J. Alexander 'Culture and pedagogy: International comparisons in primary education', Oxford and Boston: Blackwell, 2001.
6. M. Chavan,'Read India: Amass scale, rapid, 'learning to read' campaign', 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes (CO)	
CO1	Students will be able to understand what pedagogical practices are being used by teachers in informal and informal classrooms in developing countries.
CO2	Students will be able to understand the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
CO3	Students will be able to understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Students will be able to understand professional development, curriculum and assessment
CO5	Students will be able to understand the research design and its impact.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1
CO4	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1
CO5	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

Objectives

- To achieve overall health of body and mind
- To overcome stress

UNIT – I	INTRODUCTION TO YOGA	10
Definitions of Eight parts of yoga.(Ashtanga)		CO1

UNIT – II	YAM AND NIYAM	10
Yam and Niyam – Do`s and Don't's in life – i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.		CO2

UNIT – III	ASAN AND PRANAYAM	10
Asan and Pranayam – Various yoga poses and their benefits for mind & body – Regularization of breathing techniques and its effects – Types of pranayam		CO3
	Total Periods:	30

Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I', Janardan Swami Yoga bhyasi Mandal, Nagpur.
2. 'Rajayoga or conquering the Internal Nature, by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Course Outcomes (CO)

CO1	Students will be able to develop healthy mind in a healthy body thus improving social health also
CO2	Improve efficiency
CO3	Students will be able to understand effects of regularization of breathing techniques

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT – I	NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY	10
Verses-19,20,21,22 (wisdom) – Verses-29,31,32 (pride & heroism) – Verses-26,28,63,65 (virtue) – Verses-52,53,59 (dont's) – Verses-71,73,75,78 (do's).		CO1
UNIT – II	APPROACH TO DAY-TO-DAY WORK AND DUTIES	10

Shrimad Bhagwad Geeta: Chapter 2– Verses 41, 47,48 – Chapter 3– Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,1	**CO2**

UNIT – III	**PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA**	**10**
Chapter2– Verses 56, 62, 68 Chapter 12 – Verses 13, 14, 15, 16,17, 18 – Personality of role model – Shrimad Bhagwad Geeta – Chapter2– Verses 17, Chapter 3– Verses 36,37,42 – Chapter 4– Verses 18, 38,39 Chapter18 – Verses 37,38,63		**CO3**
	Total Periods:	**30**

Reference Books:

1. Gopinath, P. Rashtriya Sanskrit Sansthanam, 'Bhartrihari's Three Satakam', Niti-sringar-vairagya, New Delhi,2010.
2. Swami Swarupananda, 'Srimad Bhagavad Gita', Advaita Ashram, Publication Department, Kolkata, 2016.

Course Outcomes (CO)

CO1	Students will be able to study the Shrimad-Bhagwad-Geeta that will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

Objectives

- To engage the students in understanding rural realities

- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I	**QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN**	**9**
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.		**CO1**

UNIT - II	**RURAL ECONOMY AND LIVELIHOOD**	**9**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . **Assignment:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		**CO2**

UNIT - III	**RURAL INSTITUTIONS**	**9**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		**CO3**

UNIT - IV	**RURAL DEVELOPMENT PROGRAMMES**	**9**
Field work: Each student selects one programme for field visit Field based practical activities: • Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities • Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site		**CO5**

• Field visit to Swachh Bharat project sites, conduct analysis and initiate problem-solving measures • Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) • Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization • Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps • Participate in Gram Sabha meetings, and study community participation • Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries • Attend Parent Teacher Association meetings, and interview school drop outs • Visit local Anganwadi Centre and observe the services being provided • Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. • Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys • Raise understanding of people's impacts of climate change, building up community's disaster preparedness • Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants • Formation of committees for common property resource management, village pond maintenance and fishing .	
Total Periods:	**45**

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

Course Outcomes (CO)

CO1	Able to understand of rural life, culture and social realities

CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C05	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

Objectives

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT - I	INTRODUCTION TO CULTURE	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.		CO1

UNIT - II	INDIAN LANGUAGES AND LITERATURE	9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature.		CO2

UNIT - III	RELIGION AND PHILOSOPHY	9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT - IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic 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.		CO4
UNIT - V	**EDUCATION SYSTEM IN INDIA**	**9**
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		CO5
	Total Periods:	**45**

Reference Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. 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

Course Outcomes (CO)

CO1	Understand philosophy of Indian culture
CO2	Distinguish the Indian languages and literature
CO3	Learn the philosophy of ancient, medieval and modern India
CO4	Acquire the information about the fine arts in India. Know the contribution of scientists of different eras
CO5	Understand education systems in India

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C05	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1008	**SANGA TAMIL LITERATURE APPRECIATION**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

Objectives

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in SangaTamil Literature.
- 'Attruppadai' in SangaTamil Literature.
- 'Puranaanuru' in SangaTamil Literature.
- 'Pathitrupaththu' in SangaTamil Literature.

UNIT - I	**SANGA TAMIL LITERATURE AN INTRODUCTION**	**9**
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables.		**CO1**

UNIT - II	**AGATHINAI AND PURATHINAI**	**9**
Tholkappiyar's Meaningful Verses –Three literature materials – Agathinai's message - History of Culture from Agathinai – Purathinai – Classification – Mesage to Society from Purathinai.		**CO2**

UNIT - III	**ATTRUPPADAI**	**9**
Attruppadai Literature – Attruppadai in 'Puranaanuru' – Attruppadai in'Pathitrupaththu'-Attruppadai in 'Paththupaattu'.		**CO3**

UNIT - IV	**PURANAANURU**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**

UNIT - V	**PATHITRUPATHTHU**	**9**
Pathitrupaththu in 'Ettuthogai'–Pathitrupaththu's Parables–Tamil dynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		**CO5**

Total Periods:	**45**

Text Books:

1. Sivaraja Pillai, The Chronology of the Early Tamils, SagwanPress,2018.
2. HankHeifetz and GeorgeL. Hart, The Purananuru,Penguin Books,2002.

Reference Books:

1. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub,1997.
2. GeorgeL. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.
3. XavierS.Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub.House, 1967.

Course Outcomes (CO)

CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate 'Agathinai' and 'Purathinai' in their personal and societal life.
CO3	Appreciate and apply the messages in 'Attruppadai' in their personal and societal life.
CO4	Appreciate and apply the messages in 'Puranaanuru' in their personal and societal life.
CO5	Appreciate and apply the messages in 'Pathitrupaththu' in their personal and societal life.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C05	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

VALUE ADDED COURSES

EVA101	MODELLING AND SIMULATION OF SOLAR PV SYSTEM
EVA102	FPGA AND ITS APPLICATIONS TO POWER CONVERTERS
EVA103	INDUSTRIAL POWER SYSTEM ANALYSIS USING ETAP
EVA104	DESIGN & DEVELOPMENT OF REAL-TIME EV BATTERY TESTING SYSTEM
EVA105	ELECTRONICS CIRCUITS DESIGN FOR POWER ELECTRONICS
EVA106	PROTEUS DESIGN SUITE SIMULATION SOFTWARE

EVA101 MODELLING AND SIMULATION OF SOLAR PV SYSTEM

L	T	P	C
1	0	1	2

Objectives

This course aims in better understanding the technical and practical knowledge in Solar Photo Voltaic system for an Engineering graduates to become an entrepreneur and to get the job in solar PV Industries.

- To know the concept of solar pv system design and installation for residential, Industrial, Commercial and Agricultural Places.
- To understand the design of on-grid, off-grid and hybrid solar PV system for 24 hrs.
- To choose the criteria for the design of power converters for PV system
- To know the application of solar pv systems in transport, industry, agriculture and Residential buildings
- To know the state policy, startup, compliance mechanism with Ministry of Corporate Affairs in Solar PV.

Unit I Introduction and Basics of Solar PV 9

Renewable and Non Renewable energy sources, Impact of Fossil Fuel, Energy Scenario - Global and National, Electricity Fundamentals, Energy Policy, Overview of Solar Photovoltaic Cells-Building Blocks -types-Modules- and Array Configuration-Tracking Device.

Unit II Design and Techniques for Solar PV System 9

DC-DC, DC-AC Converters, MPPT, Charge Controller, Inverters, On Grid- Off Grid-Single phase-Three phase and Balance of Components. Grid connection issues: Leakage current, Islanding, harmonics, active/reactive power feeding, Electrical Safety, Tariff Calculation

Unit III Modelling of Solar PV System 9

Design of Off Grid and Ongrid solar PV system using PV Syst & Open Solar software (design, irradiance, PV design and Orientation, performance, simulation, Tilting, Tracking, shadow effects, Load Calculation ad Analysis Estimating User's - Sizing Solar PV, Costing of Solar Components and plant.

Unit IV Solar Energy - Round The Clock 9

Solar Thermal Power Generation, Energy Storage Systems, Energy Management Systems, Solar Thermal, Hydro Thermal Energy Generation, Vapor Absorption Chiller. Types of Batteries, Battery Swapping.

Unit V Applications of Solar PV system 9

IoT on Solar PV system, Design and Developing charge controller, Arduino based sun tracking PV system, Design of Solar powered circuits, Solar Street light, Entrepreneurship and Startup.

Total Hours: 45

Course Outcome:

- Clear knowledge about off- grid system, on- grid system and hybrid system design and Installation
- Practical experience on installation procedure for residential, Industrial and Commercial PV systems
- Scope, Business and Job Opportunities in Solar Photovoltaic, Solar Thermal and Solar Water Pumping Technologies
- Become an entrepreneur in solar PV Technology

Text Books:

1. Solar Photovoltaics Fundamentals, Technologies and Applications, 3rd Ed. Prentice Hall of India, 2016. C. S. Solanki

2. Handbook for Solar Photovoltaic (PV) Systems, "Installation, Operation & Maintenance of Solar PV Microgrid Systems", A Handbook for Trainers.

3. PHOTOVOLTAIC SYSTEMS Analysis and Design", A.K. Mukerjee and Nivedita Thakur.

4. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN - 13:9789380090122), 2011.

References:

1. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers Kindle Edition by Chetan Singh Solanki.

2. Design and Installation of a Grid-Connected PV System, John Christer Sivertsen Petter Søyland.

Web References:

1. www.mnre.gov.in
2. https://solarrooftop.gov.in
3. http://teda.in/
4. http://www.tnerc.gov.in/
5. https://www.tangedco.gov.in/

EVA101 MODELLING AND SIMULATION OF SOLAR PV SYSTEM

Schedule

Day	Topic covered	No. of Hours
1	Renewable and Non Renewable energy sources Impact of Fossil Fuel Energy Scenario Global and National Electricity Fundamentals Energy Policy Overview of Solar Photovoltaic Cells	9
2	DC-AC Converters MPPT, Charge Controller, Inverters, On Grid- Off Grid connection issues Tariff Calculation	9
3	Design of solar PV system using PV Syst & Open Solar software Load Calculation Sizing Solar PV Costing of Solar Components and plant.	9
4	Solar Thermal Power Generation Energy Management Systems Types of Batteries, Battery Swapping.	9
5	IoT on Solar PV system Arduino based sun tracking PV system Solar Street light, Entrepreneurship and Startup	9

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EVA102 FPGA and its applications to power converters

L	T	P	C
1	0	1	2

OBJECTIVES:

- To study FPGA technology and its uses
- To understand the design flow in FPGA and VHDL programming
- To understand the FPGA based gating pulse generation for DC-DC converters
- To understand the FPGA based firing pulse generation for AC-AC converters
- To understand the FPGA based PWM modulators for VSI

UNIT – I INTRODUCTION TO FPGA 9

FPGA- Fundamentals, parts- Flip flops-LUTs- multipliers- DSP slices, Design Flow, Digital circuits- logic gates- multiplexers, LED blinking using FPGA development board.

UNIT – II VHDL PROGRAMMING 9

Basic terminology, Entity declaration, Architecture Body, configuration and package declaration, package body, Basic language elements- Identifiers, data objects, data types, operators, Behavioral modeling- realization of digital logic circuits.

UNIT – III FPGA CONTROLLED DC-DC CONVERTERS 9

DC-DC converters- Buck converter- Design- Time Ratio Control- FPGA based duty cycle control: design flow- generation of ramp signal and duty cycle control

UNIT – IV FPGA CONTROLLED AC-AC CONVERTERS

9

AC-AC converters- single phase AC voltage and cyclo converters- Design- Zero firing angle control and Phase angle control- graphical method- Firing pulse generation using FPGA

UNIT – V FPGA CONTROLLED INVERTERS 9

Single phase Voltage Source Inverter- single pulse, multiple pulse and sinusoidal PWM control.
Three Voltage Source Inverter- square wave (180° and 120°) conduction modes- graphical method, Sinusoidal PWM (Look up Table method)
Multilevel inverters- five level CHBMLI, PWM modulator design using FPGA: carrier and reference signal and PWM modulator design.

OUTCOMES:

CO1: Ability to understand the architecture of FPGA

CO2: Ability to understand VHDL programming

CO3: Capability to design firing pulse generator for DC-DC converters using FPGA

CO4: Capability to design firing pulse generator for AC-AC converters using FPGA

CO5: Ability to design PWM modulators for VSI using FPGA

Text Books:

1. Jayaram Bhasker, "A VHDL Primer", PTR Prentice Hall, Englewood Cliffs, N ew Jersey 07632, 1992.
2. Dubey.G.K, "Power Semi conductor controlled drives", Prentice Hall Inc., New Jersey1989.

References:

Bimal K. Bose. 'Modern Power Electronics and AC Drives', PHI / Pearson Education, 2002.

EVA102 FPGA and its applications to power converters

Schedule

Day	Topic covered	No. of Hours
1	FPGA- Fundamentals DSP slices, Design Flow LED blinking using FPGA development board	9
2	VHDL PROGRAMMING Entity declaration, Architecture Body configuration package declaration	9
3	Buck converter- Design FPGA based duty cycle control	9
4	single phase AC voltage and cyclo converters- Design Firing pulse generation using FPGA	9
5	Single phase Voltage Source Inverter Three Voltage Source Inverter five level CHBMLI, PWM modulator design using FPGA	9

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EVA103 Industrial Power System Analysis using ETAP L T P C

1 0 1 2

Unit-1 Introduction to power system (9)

Steady state analysis – Transient analysis – RMS simulation -EMT simulation-Types of software available in the market-real time -Installed capacity of generation – POSOCO-CEASRLDC- light off event -blackout event

Unit-2 Load flow analysis (9)

Introduction to load flow analysis -IEEE3002.2 and IEEE 399- Grid-Bus-Transmission line – Ferranti effect – Transformer modelling -OLTC selection -Generator modelling – Power factor correction -capacitor bank sizing – solar inverter-wind turbine generators – ZIP load modelling

Unit -3 Short circuit analysis (9)

Types of faults -symmetrical fault -asymmetrical fault -IEC60909-Assumption-Cfactor- fault -fault far from source -fault near to the source-impedance optimization—manual calculationsignificance of X/R ratio-circuit breaker- breaking -making -DC current-types of earthing in the transformer

Unit -4 Protection coordination (9)

Introduction to protection in LV, MCB, MCCB, ACB, Thermal magnetic release -LV protection setting calculation – protection setting calculation for 50,51,50N,51N for the transformer, feeder, bus coupler, incomer, motor protection – earth fault protection coordination – Time characteristic curve validation – sequence of operation verification

Unit -5 Harmonic Analysis (9)

Basics of Linear load-non-linear load-power quality issues – THD, TDD, IEEE-519 limits, impact of capacitor bank in non linear load -Harmonic load flow analysis-Impact of source impedance- resonance – impedance scan- need of filter – passive filter modelling – real time project

Course outcome

- Clear knowledge about the power system analysis.
- Clarity on why the power system studies is performed and how the simulation software work based on the fundamental maths and engineering .
- Clear idea on how the industrial network for the various domain and how the equipment is optimized. • Clear idea on how to perform the Load flow, short circuit, relay coordination and harmonic analysis in the ETAP.

Text books

1. IEEE standards
2. Power system analysis by john J.Grainger
3. Harmonics and Power Systems By Francisco C De La Rosa
4. (Power Engineering 16) J. C. Das - Power System Analysis_ Short-Circuit Load Flow and Harmonics-Marcel Dekker (2002)

Reference

- Power projects blogs

EVA103 Industrial Power System Analysis using ETAP

Schedule

Day	Topic covered	No. of Hours
1	power system Steady state analysis – Transient analysis POSOCO-CEASRLDC- light off event -blackout event	9
2	load flow analysis -IEEE3002.2 and IEEE 399 OLTC selection ZIP load modelling	9
3	Types of faults fault near to the source-impedance optimization circuit breaker DC current-types of earthing in the transformer	9
4	Introduction to protection in LV, MCB, MCCB, ACB, Thermal magnetic release protection setting calculation for 50,51,50N,51N for the transformer Time characteristic curve validation – sequence of operation verification	9
5	Basics of Linear load-non-linear load-power quality issues Harmonic load flow analysis need of filter passive filter modelling real time project	9

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EVA104 Design & Development of Real-Time EV Battery Testing system

L	T	P	C
1	0	1	2

Course Objective:

- To understand the requirements for the EV battery tester based on the specific needs and goals of the project.
- To Create software to interface with the hardware components and collect data from the battery under test..
- To Implement Testing Algorithms: Develop testing algorithms to analyze the battery's performance such as SoC,, measuring voltage and current responses, and calculating battery parameters in real-time.
- To Develop a user-friendly interface for the battery tester, which allows users to input testing parameters, view real-time data, and analyze test results.
- To Create a schematic diagram that illustrates the connections between the various components of the battery tester using Easy Eda

Unit-1 - PCB Design Fundamentals: Symbols, Schematics, and Easy EDA 9

Introduction to PCB design – Understanding PCB Symbols - Understanding schematics and component identification - Creating a new PCB design using EasyEDA-Accessing Easy Eda Libraries- Placing components on the PCB- Routing the PCB design

Unit-2 - Mastering PCB Design: Schematic Development, Layout Planning, and Gerber Generation 9

Design consideration for Analog and Digital circuits – Schematic development for Analog and Digital circuits-Layout Planning –PCB Art work –PCB trace width calculation-Checking DRC-Gerber Generation-Custom made Components.

Unit-3- Getting Started with Arduino Nano: Features, Programming, and GPIO Control 9

Introduction to Arduino Nano: Understanding the basics of Arduino Nano, including its features, architecture, and pinout diagram - Arduino Programming: Setting up the Arduino development environment, including installing the Arduino IDE (Integrated Development Environment), configuring the board, and uploading code to the Arduino Nano board - GPIO Programming: Understanding the General Purpose Input/Output (GPIO) pins of Arduino Nano and learning how to configure and control them using code.

Unit-4- LifePO4 batteries- Understanding Characteristics, Topologies, and Charging Algorithms 9

Introduction to LiFePO4 Batteries: Understanding the characteristics, advantages, and limitations of LiFePO4 batteries, including their nominal voltage, capacity, energy density, charging/discharging characteristics, and safety consideration- Charger Topologies- LiFePO4 charger design-Charging and discharging Algorithms.

Unit-5 – Designing Charge/discharge algorithm and testing 9

Developing Charging and discharging Algorithm in Arduino Uno, including measuring battery voltage, current, SoC, Watt-hour and pack temperature. Plotting parameters graphically in realtime and Analysis.

TOTAL HOURS : 45

Course Outcome:

- Understanding of EV Battery Testing Principles.
- PCB Design Skills: Learners will develop proficiency in designing PCBs for real-time EV battery testers.
- Prototyping and Testing: Learners will gain hands-on experience in building prototypes of real-time EV battery testers and integrating them with other hardware components.
- Safety Compliance: Learners will understand the importance of safety regulations and standards in the design and development of EV battery testers.
- Learners will develop skills in creating comprehensive documentation, including schematics, layout files, BOM, assembly instructions, and test procedures, for their battery tester designs.
- Learners will stay updated with the latest industry trends and emerging technologies in the field of EV battery testing.

EVA104 Design & Development of Real-Time EV Battery Testing system

Schedule

Day	Topic covered	No. of Hours
1	Introduction to PCB design Understanding PCB Symbols Creating a new PCB design using EasyEDA	9
2	Design consideration for Analog and Digital circuits Layout Planning Checking DRC Gerber Generation Custom made Components.	9
3	Understanding the basics of Arduino Nano Setting up the Arduino development environment GPIO Programming: Understanding	9
4	Introduction to LiFePO4 Batteries Charger Topologies LiFePO4 charger design-Charging and discharging Algorithms	9
5	Developing Charging and discharging Algorithm in Arduino Uno Plotting parameters graphically in realtime and Analysis.	9

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EVA105 Electronics Circuits Design for Power Electronics

L	T	P	C
1	0	1	2

OBJECTIVES:

- To study the operation and use of electron devices: Diodes, Transistor and SCR
- To understand the design procedure for basic DC power supply and voltage doubler using PN Junction Diode
- To understand the applications of BJT as Switch and temperature control system
- To understand the design of voltage dimmer and back-up power supply using SCR
- To understand the PCB design flow for voltage regulator circuit using Express PCB

UNIT I INTRODUCTION 9

PN Junction Diode- Transistor- SCR, MOSFET: Construction and operating characteristics under different biasing conditions- Introduction to PCB design software- Schematics- component placing- creating the layout.

UNIT II DESIGN OF REGULATED DC POWER SUPPLY AND VOLTAGE DOUBLER 9

Basic DC Power Supply: Half- Bridge rectifier- Effect of Barrier voltage- PIV- Transformer Coupling- Full wave rectifier-Center tapped full wave rectifier- PIV-Bridge full wave rectifier- PIV-Power supply filters- capacitor filter- Ripple voltage calculation- surge current- voltage regulator using LM 317 IC- voltage doubler.

UNIT III PWM GENERATOR DESIGN FOR DC CHOPPER 9

DC Chopper- Buck operation- Power circuit design- component selection- Pulse Width Modulator (PWM) - Signal generator (ramp or triangle) and PWM generator design using analog circuits.

UNIT IV FIRING ANGLE CONTROL FOR SINGLE PHASE CONTROLLED RECTFIER 9

Single Phase Controlled rectifier- Half controlled and full- bridge converter design- Phase angle control- phase synchronization circuit design- phase angle control using analog circuits.

UNIT V PWM FOR SINGLE PHASE INVERTER 9

Single Phase H- Bridge inverter Design- components- gate drive circuits- single pulse width modulation- Multiple pulse width modulation- square wave operation- Sinusoidal pulse width modulation- Analog circuit design.

Total Hours: 45

OUTCOMES:

- Ability to understand the characteristics of electron devices
- Capability to design firing angle control and PWM control using electronic circuits
- Skilled in designing PCB layout and end product

Text Books:

1. Muhammad Rashid, "Power Electronics, Circuits, Devices& Applications:, Fourth Edition, Pearson, 2017.
2. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
3. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008.
4. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7th Edition, 2014.

References:

1. Boylestad, R. L. - Electronic Devices and Circuit Theory, Prentice Hall, 11th ed.

EVA105 Electronics Circuits Design for Power Electronics

Schedule

Day	Topic covered	No. of Hours
1	Introduction to PN Junction Diode- Transistor- SCR, MOSFET Introduction to PCB design software	9
2	Basic DC Power Supply: Half- Bridge rectifier- Full wave rectifier-Center tapped full wave rectifier voltage regulator using LM 317 IC	9
3	DC Chopper- Buck operation PWM generator design using analog circuits	9
4	Single Phase Controlled rectifier- bridge converter design phase synchronization circuit design	9
5	Single Phase H- Bridge inverter Design Sinusoidal pulse width modulation - Analog circuit design	9

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EVA106 Proteus Design Suite Simulation Software L T P C

1 0 1 2

Course Objective:

- Able to understand the basic principles of circuit design and simulation.
- Able to learn how to use Proteus software for circuit simulation in a virtual environment.
- Able to learn how to debug and optimize circuits which can help them develop better designs in less time.
- Able to Develop proficiency in designing and simulating circuits for a range of applications using Proteus.
- Able to Enhance problem-solving and analytical skills.

Unit-1 – Proteus Design Suite Fundamentals 9

Introduction to Proteus software – Creating new project- Grid view and Adjustment-Library – Preparing schematic – Measuring instruments - Electrical rules checking-Run simulation-Graphical data analysis.

Unit-2 – Proteus for Analog Circuit Design 9

Understanding the behavior of RLC Components, Plotting VI characteristics of diode, transistor and Mosfets, DC Analysis, AC analysis, Transient response analysis, Build various applications using Transistors, opamps, Integrated chips

Unit-3- Proteus for sensor interfaces 9

Sensor selection and configuration- Analog-to-digital conversion- Signal conditioning:-Modelling of sensors

Unit-4- Proteus in Embedded systems 9

Introduction Proteus Digital Library – Microcontroller Library Management- Interfacing with Microchip MPLAB IDE, Programming Microcontrollers, Flashing Programs in virtual microcontrollers-Debug-Simulation - Graphical Plotting –Building various embedded applications

Unit-5 – Advanced Simulation Techniques in Proteus 9

Monte Carlo analysis- Worst-case analysis - Sensitivity analysis - Optimization techniques modeling non-linear components

TOTAL HOURS : 45

EVA106 Proteus Design Suite Simulation Software

Schedule

Day	Topic covered	No. of Hours
1	Introduction to Proteus software Measuring instruments Electrical rules checking-Run simulation	9
2	Understanding the behavior of RLC Components, Plotting VI characteristics Build applications using Transistors, opamps, Integrated chips	9
3	Sensor selection and configuration Analog-to-digital conversion Signal conditioning Modelling of sensors	9
4	Introduction Proteus Digital Library Interfacing with Microchip MPLAB IDE, Programming Microcontrollers	9
5	Monte Carlo analysis Worst-case analysis Sensitivity analysis Optimization techniques Modeling non-linear components	9

Head of the department
Dr. JAYARAMA PRADEEP, M.E.,Ph.D.
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OLD MAMALLAPURAM ROAD,
CHENNAI - 600 119.

APPROVED ONLINE COURSES FOR B.E / B.TECH PROGRAM(R2021)

Department of Electrical and Electronics Engineering

APPROVAL OF ONLINE COURSES FOR UGPROGRAMME

Date 18/11/2023

To

The Controller of Examinations
St. Joseph's College of Engineering
OMR, Chennai - 600119.

Sub: Approval and recommendations of Online courses to be offered for B.E / B.Tech Program (R2021) – Regarding

Sir,

Towards attaining industrial employability and fulfilling the Curriculum gap, the following Swayam Online Certification Courses are approved and recommended by the Department Course Approval Committee.

S. No.	Assigned Course Code	Name of the Swayam Online Course with NPTEL Code	Course Duration	Credits Offered
1.	EOC101	noc23-ee86 Fundamentals of Nano and Quantum Photonics	12 weeks	03 credits
2.	EOC102	noc24-ee32 Fuzzy Sets, Logic, and Systems & Applications	12 weeks	03 credits
3.	EOC103	noc23-ge40 Fundamentals of Artificial Intelligence	12 weeks	03 credits
4.	EOC104	noc23-ee100 Applied Linear Algebra for Signal Processing, Data Analytics and Machine Learning	12 weeks	03 credits
5.	EOC105	noc23-ee137 VLSI Design Flow: RTL to GDS	12 weeks	03 credits
6.	EOC106	noc23-ge41 Solar Energy Engineering and Technology	12 weeks	03 credits
7.	EOC107	noc24-ee45 Sensors and Actuators	12 weeks	03 credits
8.	EOC108	noc24-cs08 An Introduction to Artificial Intelligence	12 weeks	03 credits
9.	EOC109	noc24-ee27 Semiconductor device modeling and Simulation	12 weeks	03 credits
10.	EOC110	noc24-mg47 Principles of Management	12 weeks	03 credits
11.	EOC111	noc24-ee60 Power Quality	12 weeks	03 credits

12.	EOC112	noc24-ee37 Smart Grid: Basics to Advanced Technologies	12 weeks	03 credits
13.	EOC113	noc24-ee56 Industrial Automation and Control	12 weeks	03 credits
14.	EOC114	noc24-cs51 Introduction to Machine Learning	12 weeks	03 credits
15.	EOC115	noc24-ch26 Renewable Energy Engineering: Solar, Wind and Biomass Energy Systems	12 weeks	03 credits

The students are permitted to opt for anyone of the above online courses during their UG Programme under the Regulations of 2021.

Members of the Course Approval Committee

S. No.	Staff Name	Designation	Signature
1.	Dr Jayarama Pradeep	HOD / Professor	
2.	Dr T V Narmadha	Professor	
3.	Dr M Ramesh Babu	Professor	
4.	Dr T D Sudhakar	Professor	
5.	Dr V Chamundeeswari	Associate Professor	
6.	Dr N Chidambararaj	Associate Professor	

Approved by

HOD with seal

Dr. JAYARAMA PRADEEP, M.E.,Ph.D.,
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PRINCIPAL with seal

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