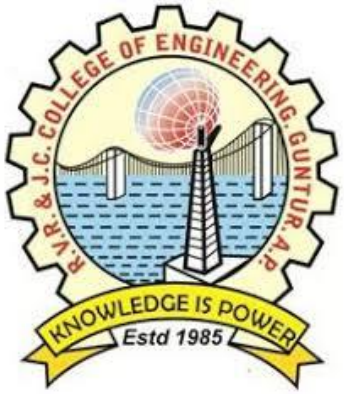
RVR & JC COLLEGE OF ENGINEERING, CHOWDAVARAM, GUNTUR-19
(Autonomous)



R – 20 REGULATIONS

Regulations, Scheme of Instruction, Examination and Detailed Syllabi
for
4-Year B. Tech Regular / Honors / Minor Course
In

Electrical & Electronics Engineering
(Semester System)

THE INSTITUTION

Established in 1985, Rayapati Venkata Ranga Rao & Jagarlamudi Chandramouli College of Engineering, Guntur is the 'Jewel in the Crown'of Nagarjuna Education Society, which took upon itself the responsibility of enriching the society through promotion of education, literature and culture. As it always happens, the genuine intentions of the promoters of the society received the support of the Almighty. Today eight educational institutions are functioning under the banner and patronage of Nagarjuna Education Society, with R.V.R. & J.C. College of Engineering, being the flag-ship of them

Institute Vision:

To develop integrated manpower with right attitude, possessing knowledge and skills, required to make an honorable living and contribute to the socioeconomic development and welfare of the society.

Institute Mission:

- To produce globally agile graduates with value orientation, professional competency, critical and creative thinking and lifelong learning.
- To enrich the society through education and research by generating proficient manpower, capable of contributing to the needs of the industry.
- To provide conducive learning environment, encompassing knowledge, communication and soft skills that enables the students to transform themselves into global leaders.

Institution Quality Policy is “Establishment of quality assurance system with continuous evaluation and monitoring to impart the best education to create ambience of excellence, recognizing the multicultural diversity and commitment to transform and assimilate the excellence in education and value system."

Department Profile

Department of Electrical and Electronics Engineering

The Department of Electrical and Electronics Engineering was established during the academic year 1994 - 1995 with an intake of 60 students. Now the annual intake of the department is 120. The Program was accredited and awarded 'A' Grade for Five years by National Board of Accreditation of AICTE in the year 2002, Reaccredited for Three years in 2007, 2012, 2017 and 2021.

The EEE department was permitted to start M.Tech course in Power Systems Engineering by AICTE, New Delhi, from the academic year 2004-2005 with an intake of 18 students.

EEE department is supported by well experienced & dedicated Faculty and skilled Non – Teaching staff. Faculty of EEE department are specialized in the core areas of Electrical & Electronics Engineering like Power Systems, Power Electronics, Control Systems, Electrical Machines & Industrial Drives, High voltage Engineering etc. Electrical installations of all laboratories and buildings are maintained by the department staff as an essential service since the inception of the college.

The department has the following laboratories with latest equipment as per AICTE norms.

1. Basic Electrical Engineering Lab
2. Advanced Electrical Machines Lab
3. Electrical Measurements Lab
4. Control Systems Lab
5. Microprocessors & Microcontrollers Lab
6. Power Electronics Lab
7. Computer Applications Lab
8. Power Systems Lab
9. Basic Electronics Lab
10. Electrical Workshop Practice Lab
11. Project Lab

In tune with the mission of the Department, Program Objectives, Program Outcomes and Program Specific Outcomes are aimed. Program Educational Objectives describe the expected accomplishments of graduates during the first few years after graduation. Program Outcomes are statements that describe what students are expected to know and be able to perform by the time

of graduation. Program Specific Outcomes describe expected outcomes of the B. Tech Program in Electrical & Electronics Engineering at RVR&JC College of Engineering. These relate to skills, knowledge and behaviors the student acquire during their course of study.

The department has its own Library in addition to main Library. The department has obtained permission from Government of Andhra Pradesh to carry out consultancy Work to the Industries/Organizations in and around Guntur.

Faculty members of the Department are dedicated and have the vision to work for the welfare and prospect of the students. Slow learners are identified and suggestions & guidance is given by Faculty of the Department to improve their ability and overall performance apart from career guidance. The Department is proud to state that the Academic results are always above 95%. It is regular practice to the Department students to won top University ranks consistently in Electrical & Electronics Engineering since its inception.

Faculty motivates the students to take part in National level Quiz competitions, Workshops, Seminars, Group discussions, Design contests, Paper presentation contests and Poster presentations. Students are also encouraged to take part in NCC, NSS, Sports and various Cultural activities. The Department students are taken to short and long Industrial study tours to provide Industrial exposure.

The department in association with IEEE student branch, ISTE chapter and EEE students Association (RAJEEA) organizes activities like quiz, workshops, seminars, Group discussion, paper contests and poster presentations etc. Every student of Electrical & Electronics Engineering will become a member of RVR&JC Electrical & Electronics Engineering Association (RAJEEA).

The students are trained and coaching is given to appear GRE, TOEFL, IES, GATE and Public sector examinations. Special emphasis is given on improvement of Professional skills, Communication skills and Entrepreneur skills. To enhance the Employability skills and to promote the entrepreneurship in synchronization with the industrial growth training is given to the students with the help of APSSDC skill development centre. Campus interviews are arranged through placement cell of RVR & JC College of Engineering. The Alumni of EEE Department spread throughout the world and serving to the needs of the society.

EEE Department Vision:

"To impart education leading to highly competent professionals in the field of Engineering who are globally competent and to make the Department a Centre for Excellence"

EEE Department Mission:

"Integrated development of professionals with knowledge and skills in the field of specialization, ethics and values needed to be employable in the field of Electrical Engineering and contribute to the economic growth of the employing organization and pursue lifelong learning"

Program Educational Objectives of B. Tech Program in Electrical & Electronics Engineering:

PEO I. To facilitate the students to become Electrical & Electronics Engineers who are competent, innovative and productive in addressing the broader interests of the organizations & society.

PEO II. To prepare the students to grow professionally with necessary soft skills.

PEO III. To make our graduates to engage and excel in activities to enhance knowledge in their professional works with ethical codes of life & profession.

Program Specific Outcomes of B. Tech Program in Electrical & Electronics Engineering:

Graduates of the program will be able to demonstrate knowledge

PSO1) In developing, Testing, Operation and Maintenance of Electrical & Electronics systems.

PSO2) In programming skills needed to develop application oriented software using C, Python, Java, Matlab, PSPICE, PSCAD, Labview etc..

PSO3) In Environmental issues and Green technologies.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

PO1) Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2) Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3) Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs

with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4) Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B.TECH ELECTRICAL & ELECTRONICS ENGINEERING

(w.e.f. the batch of students admitted from the academic year 2020-2021)

SEMESTER I (First Year)			**COURSE STRUCTURE**						
S.No.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE111	Mathematics-I	3	1	-	30	70	3	BS
2	EE112	Engineering Chemistry	3	-	-	30	70	3	BS
3	EE113	English for communication skills	3	-	-	30	70	3	HS
4	EE114	Basic Civil and Mechanical Engineering	3	1	-	30	70	3	ES
5	EE151	Engineering Chemistry Lab	-	-	3	30	70	1.5	BS
6	EE152	English Language Communication Skills Lab	-	-	3	30	70	1.5	HS
7	EE153	Engineering Workshop Practice Lab	1	-	4	30	70	3	ES
8	EE154	Basic Civil & Mechanical Engineering Lab	-	-	3	30	70	1.5	ES
9	EEMC1	Environmental Science	2	-	-	100	-	-	MC
10	EEMC0	Three weeks Orientation Program	-	-	-	-	-	-	
		TOTAL	15	2	13	340	560	19.5	TPW-30

SEMESTER II (First Year)			**COURSE STRUCTURE**						
SNo.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE121	Mathematics-II	3	1	-	30	70	3	BS
2	EE122	Engineering Physics	3	1	-	30	70	3	BS
3	EE123	Electrical Circuits	3	1	-	30	70	3	ES
4	EE124	Programming for Problem Solving	3	-	-	30	70	3	ES
5	EE161	Engineering Physics Lab	-	-	3	30	70	1.5	BS
6	EE162	Programming for Problem Solving Lab	-	-	3	30	70	1.5	ES
7	EE163	Engineering Graphics & Design Lab	1	-	4	30	70	3	ES
8	EE164	Electrical Circuits Lab	-	-	3	30	70	1.5	ES
9	EEMC2	Constitution of India	2	-	-	100	-	-	MC
		TOTAL	15	3	13	340	560	19.5	TPW-31

SEMESTER III (Second Year)			COURSE STRUCTURE						
S No	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE211	Mathematics-III	3	-	-	30	70	3	BS
2	EE212	Electrical Circuit Analysis	3	1	-	30	70	3	PC
3	EE213	Electronic Devices & Circuits	3	-	-	30	70	3	PC
4	EE214	Digital Electronics	3	1	-	30	70	3	PC
5	EE215	DC Machines	3	1	-	30	70	3	PC
6	EE251	DC Machines Lab	-	-	3	30	70	1.5	PC
7	EE252	Electronic devices & Digital Electronics lab	-	-	3	30	70	1.5	PC
8	EE253	Electrical & Electronics Circuits Simulation lab	-	-	3	30	70	1.5	PC
9	EESL1	Skill Oriented Course – I	1	-	2	100	-	2	SC
10	EEMC3	Ethics & human values	2	-	-	100	-	-	MC
		TOTAL	18	3	11	440	560	21.5	TPW-32

SEMESTER IV (Second Year)			COURSE STRUCTURE						
S No	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE221	Data Structures using C++	3	-	-	30	70	3	ES
2	EE222	Generation & Transmission of electrical Power	3	-	-	30	70	3	PC
3	EE223	Electromagnetic field theory	3	1	-	30	70	3	PC
4	EE224	Electronic circuits analysis	3	1	-	30	70	3	PC
5	EE225	AC machines	3	-	-	30	70	3	PC
6	EE261	Data Structures lab	-	-	3	30	70	1.5	ES
7	EE262	AC Machines Lab	-	-	3	30	70	1.5	PC
8	EE263	Pulse & Digital circuits lab	-	-	3	30	70	1.5	PC
9	EESL2	Skill Oriented Course – II	1	-	2	100	-	2	SC
10	EEMC4	Design Thinking & Product Innovation	2	-	-	100	-	-	MC
		TOTAL	18	2	11	440	560	21.5	TPW-31
Summer Internship (Mandatory) 3 to 4 weeks during summer vacation			-	-	-	-	-	-	
		Honors/ Minor courses (The hours of distribution can be 3-0-2 or 3-1-0)	4	0	0	30	70	4	HR/MR

SEMESTER V (Third Year)			COURSE STRUCTURE						
S No	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE311	Control systems	3	-	-	30	70	3	PC
2	EE312	Synchronous & Special Electrical machines	3	-	-	30	70	3	PC
3	EE313	Microprocessors & Micro controllers	3	1	-	30	70	3	PC
4	EE314	Professional Elective – I	3	-	-	30	70	3	PE
5	EE315	Open / Job-Oriented Elective – I	3	-	-	30	70	3	OE
6	EE351	Synchronous & Special Electrical machines lab	-	-	3	30	70	1.5	PC
7	EE352	Control systems lab	-	-	3	30	70	1.5	PC
8	EE353	Summer Internship	-	-	-	100	-	1.5	PR
9	EESL3	Skill Oriented Course – III	1	-	2	100	-	2	SC
		TOTAL	16	1	8	410	490	21.5	TPW-25
		Honors/ Minor courses (The hours of distribution can be 3-0-2 or 3-1-0)	4	0	0	30	70	4	HR/MR

SEMESTER VI (Third Year)			COURSE STRUCTURE						
S No	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE321	Renewable energy resources	2	1	-	30	70	2	PC
2	EE322	Power system Analysis	3	-	-	30	70	3	PC
3	EE323	Power Electronics	3	-	-	30	70	3	PC
4	EE324	Professional Elective - II	3	-	-	30	70	3	PE
5	EE325	Open / Job-Oriented Elective – II	3	-	-	30	70	3	OE
6	EE361	Electrical Measurements & Instrumentation Lab	1	-	4	30	70	3	PC
7	EE362	Power Electronics Lab	-	-	3	30	70	1.5	PC
8	EE363	Power Systems Lab	-	-	2	30	70	1	PC
9	EESL4	Skill Oriented Course – IV	1	-	2	100	-	2	SC
		TOTAL	16	1	11	340	560	21.5	TPW-28
		Honors/ Minor courses (The hours of distribution can be 3-0-2 or 3-1-0)	4	0	0	30	70	4	HR/MR
Internship / Certification (Mandatory) 6 to 8 weeks during summer vacation			-	-	-	-	-	-	

SEMESTER VII (Fourth Year)									COURSE STRUCTURE
S.No.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE411	Humanities and Social Science Elective	3	-	-	30	70	3	HS
2	EE412	Professional Elective – III	3	-	-	30	70	3	PE
3	EE413	Professional Elective – IV	3	-	-	30	70	3	PE
4	EE414	Professional Elective – V (MOOCS)	3	-	-	30	70	3	PE
5	EE415	Open / Job-Oriented Elective – III	3	-	-	30	70	3	OE
6	EE416	Open / Job-Oriented Elective – IV (MOOCS)	3	-	-	30	70	3	OE
7	EE451	Internship / Certification	-	-	-	100	-	3	PR
8	EESL5	Skill Oriented Course – V	1	-	2	100	-	2	SC
		TOTAL	19	-	2	380	420	23	TPW-21
		Honors/ Minor courses (The hours of distribution can be 3-0-2 or 3-1-0)	4	0	0	30	70	4	HR/MR

SEMESTER VIII (Fourth Year)									COURSE STRUCTURE
S.No.	Course Details		Scheme of Instruction			Scheme of Examination			Category Code
	Code No.	Subject Name	Periods per week			Maximum Marks		Credits	
			L	T	P	SES	EXT		
1	EE461	Project work & Internship in Industry	-	-	-	-	-	12	PR
		TOTAL	-	-	-	-	-	12	

Professional Elective Courses	
EEEL01	Power system protection
EEEL02	Industrial Drives
EEEL03	Electrical Distribution systems
EEEL04	Power system operation & control
EEEL05	Utilization of Electrical Power
EEEL06	Advanced Electric Drives
EEEL07	Signals and systems
EEEL08	Wind and Solar Energy Systems
EEEL09	Electrical Machine Design
EEEL10	HVDC Transmission Systems
EEEL11	Power Quality
EEEL12	Flexible AC Transmission Systems
EEEL13	High Voltage Engineering
EEEL14	Electrical Energy Conservation and Auditing
EEEL15	Power System Dynamics and Control
EEEL16	Line-Commutated and Active PWM Rectifiers
EEEL17	Industrial Electrical Systems
EEEL18	Smart Electric grids
EEEL19	Digital Control Systems
EEEL20	Control Systems Design
EEEL21	Digital Signal Processing
EEEL22	Computer Architecture
EEEL23	Electromagnetic waves
EEEL24	Computational Electromagnetics
EEEL25	Power system Deregulation
EEEL26	AI Tools techniques and applications
Open Elective Courses Offered by EEE Department	
EEOL1	Renewable energy sources
EEOL2	Utilization of Electrical Energy
	Skill courses
EESL1	APSSDC Course - Electrical Workshop Practice Lab
EESL2	Electronics Design Lab
EESL3	Micro Processors & Micro controllers Lab
EESL4	Soft Skills
EESL5	Computer simulation of electrical systems Lab

	Mandatory courses
EEMC1	Environmental Science
EEMC2	Constitution of India
EEMC3	Ethics & human values
EEMC4	Design Thinking & Product Innovation

Humanities and Social Science Electives	
HSEL1	Industrial Management & Entrepreneurship
HSEL2	Economics for Engineers
HSEL3	Introduction to Industrial Management
HSEL4	Project Management & Entrepreneurship

Honours in Electrical & Electronics Engineering

	Subject Code	Subject Name	Lecture Hours
Pool 1	EEH11	Power Quality	4
	EEH12	Power Plant Technology	4
	EEH13	Fuel cells & Battery Management Systems	4
	EEH14	HV and EHV Transmission systems	4
Pool 2	EEH21	Electrical machine design	4
	EEH22	Electrical Distribution systems & Automation	4
	EEH23	Energy efficient electrical systems	4
	EEH24	Industrial Safety Systems	4
Pool 3	EEH31	Smartgrids Big data & IOT	4
	EEH32	Distributed Generation & Microgrids	4
	EEH33	Energy Conservation & Audit	4
	EEH34	Digital Control systems	4
Pool 4	EEH41	Advanced Electrical Drives	4
	EEH42	Industrial Automation & Robotics	4
	EEH43	Electric Vehicles & Charging stations	4
	EEH44	HVDC & FACTS	4

Minors Tracks Offered – Inter disciplinary

Minor in EEE Eligibility: Students of all branches Except EEE

Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
EEMR1	Electrical Machines Theory & Performance	3	1	-
EEMR2	Electrical Power Generation & Utilization	4	-	-
EEMR3	Power Systems Engineering	3	1	-
EEMR4	Power Converters & Applications	3	1	-
EEMR5	Electrical Measurements & Instrumentation	3	1	-
EEMR6	Electric Vehicles	4	-	-

Minor in Electric Vehicles

Eligibility: All branches

Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
EVMR1	Energy Systems and Electrical Machines	3	1	-
EVMR2	Hybrid Electric vehicles	3	1	-
EVMR3	Plug-in Electric vehicles	3	1	-
EVMR4	Electric vehicle power train	3	1	-
EVMR5	Autotronics	3	1	-
EVMR6	BMS & Charging stations	3	1	-

Minor in Civil Engineering				
Eligibility: Students of all branches Except Civil Engineering				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CEMR1	Geomatics (Survey, GIS & GPS)	3	1	-
CEMR2	Construction Engineering & Management	3	1	-
CEMR3	Fundamentals of Structural Engineering	3	1	-
CEMR4	Water Resource Engineering	3	1	-
CEMR5	Environmental Engineering	3	1	-
CEMR6	Geotechnical Engineering	3	1	-
CEMR7	Transportation Engineering	3	1	-

Minor in Chemical Engineering				
Eligibility: Students of all branches Except Chemical Engineering				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CHMR1	Unit Operations	3	1	-
CHMR2	Principles of Chemical Process Calculations	3	1	-
CHMR3	Transfer operations	3	1	-
CHMR4	Reaction Engineering	3	1	-
CHMR5	Industrial Pollution Control Engineering	4	-	-
CHMR6	Principles of Safety Management	4	-	-

Minor in CSE				
Eligibility: Students of CE/ChE/ECE/EEE/ME branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CSMR1	Fundamentals of Data Structures	3	1	-
CSMR2	Computer Organization and Architecture	4	-	-
CSMR3	Operating System Concepts	4	-	-
CSMR4	Relational DataBase Management System	3	1	-
CSMR5	Programming with JAVA	3	1	-
CSMR6	Introduction to Algorithms	3	1	-
CSMR7	Principles of Software Engineering	4	-	-
CSMR8	Computer Networking Concepts	4	-	-

Minor in IT				
Eligibility: Students of CE/ChE/ECE/EEE/ME branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
ITMR1	Database Managent Systems	3	1	-
ITMR2	Unix and Shell Programming	3	1	-
ITMR3	Computer Networks	3	1	-
ITMR4	Software Engineering	3	1	-
ITMR5	Cryptography and Network Security	3	1	-
ITMR6	Machine Learning	3	1	-

Minor in CSE(AIML)				
Eligibility: Students of CE/ChE/ECE/EEE/ME branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CMMR1	Introduction to Artificial Intellegence	3	1	-
CMMR2	Machine Learning	3	1	-
CMMR3	Data Analytics	3	1	-
CMMR4	Deep Learning	3	1	-
CMMR5	Natural Language Processing (MOOCS)	-	-	-
CMMR6	Soft Computing (MOOCS)	-	-	-

Minor in CSE(IoT)				
Eligibility: Students of CE/ChE/ECE/EEE/ME branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
COMR1	Introduction to Internet of Things	3	1	-
COMR2	IoT Architecture and Protocols	3	1	-
COMR3	IoT Cloud and Data Analytics	3	1	-
COMR4	Smart Sensor Technologies	3	1	-
COMR5	Fundamental of IoT (MOOCS-I)	-	-	
COMR6	Introduction of Raspberry Pi and Arduino (MOOCS-2)	-	-	

Minor in ECE				
Eligibility: Students of all branches Except ECE &EEE				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
ECMR1	Electronics Devices & Circuits	3	1	-
ECMR2	Digital Logic Design	3	1	-
ECMR3	Network Analysis	3	1	-
ECMR4	Electronic Circuit Analysis	3	1	-
ECMR5	Signals and Systems	3	1	-
ECMR6	Microprocessors & Interfacing	3	1	-
ECMR7	Basic Communication	3	1	-

Minor in EEE				
Eligibility: Students of all branches Except EEE				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
EEMR1	Electrical Machines Theory & Performance	3	1	-
EEMR2	Electrical Power Generation & Utilization	4	-	-
EEMR3	Power Systems Engineering	3	1	-
EEMR4	Power Converters & Applications	3	1	-
EEMR5	Electrical Measurements & Instrumentation	3	1	-
EEMR6	Electric Vehicles	4	-	-

Minor in Mechanical Engineering				
Eligibility: Students of all branches Except Mechanical Engineering				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
MEMR1	Engineering Mechanics	3	1	-
MEMR2	Strength of materials and Fluid mechanics	3	1	-
MEMR3	Manufacturing Processes	4	-	-
MEMR4	Concepts of Thermal Engineering	3	1	-
MEMR5	Concepts of Mechanical Design	3	1	-
MEMR6	Computer Aided Design & Manufacturing	4	-	-
MEMR7	Additive Manufacturing	4	-	-

Minor in CSE(DS)				
Eligibility: Students of CE/ChE/ECE/EEE/ME branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CDMR1	Introduction to Data Science & Machine Learning	3	1	-
CDMR2	Analysing, Visualizing and Applying Data Science with Python	3	1	-
CDMR3	Web Data Mining	3	1	-
CDMR4	Business Analytics	3	1	-
CDMR5	Data Science for Engineers (MOOCs)	-	-	-
CDMR6	Deep Learning (MOOCs)	-	-	-

Industrial Tracks

Minor in Industrial Automation & Robotics				
Eligibility: All branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
ARMR1	Robotic Engineering	4	-	-
ARMR2	Mechatronics and Microcontrollers	3	1	-
ARMR3	Industrial Automation	4	-	-
ARMR4	Computer integrated Manufacturing	3	-	-
ARMR5	Fluidics and Control Systems	3	1	-
ARMR6	Mechanics of Robots	3	1	-
ARMR7	3D Printing	4	-	-

Minor in Electric Vehicles				
Eligibility: All branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
EVMR1	Energy Systems and Electrical Machines	3	1	-
EVMR2	Hybrid Electric vehicles	3	1	-
EVMR3	Plug-in Electric vehicles	3	1	-
EVMR4	Electric vehicle power train	3	1	-
EVMR5	Autotronics	3	1	-
EVMR6	BMS & Charging stations	3	1	-

Minor in Full Stack Development

Eligibility: All branches

Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
FSMR1	User Interface Design	3	1	-
FSMR2	Client Side Scripting	3	1	-
FSMR3	React JS	3	1	-
FSMR4	MEAN stack (MongoDB,Express JS, Angular JS,Node JS)	3	1	-
FSMR5	C# (.NET Framework)	3	1	-
FSMR6	Web Application Development Using ASP	3	1	-
FSMR7	J2ME	3	1	-
FSMR8	Modern Application Development (MOOCs)			
FSMR9	Advanced Python Programming(MOOCs)			

Minor in Cloud Computing

Eligibility: All branches

Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
CCMR1	Principals of Cloud Computing	3	1	-
CCMR2	Cloud virtualization	3	1	-
CCMR3	Cloud Application Development	3	1	-
CCMR4	Cloud Security	3	1	-
CCMR5	Edge Computing	3	1	-
CCMR6	Block Chain Security	3	1	-
CCMR7	High Performance Computing	3	1	-
CCMR8	Cloud Computing and Distribution Systems (MOOCs)			
CCMR9	Cloud Computing (MOOCs)			

Minor in VLSI

Eligibility: All branches

Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
VLMR1	HDL Programming	3	1	-
VLMR2	System Verilog and UVM	3	1	-
VLMR3	Synthesis and Formal Verification	3	1	-
VLMR4	Design for Testability	3	1	-
VLMR5	Physical Design Fundamentals	3	1	-
VLMR6	Advanced Physical Design	3	1	-

Minor in Safety Engineering				
Eligibility: All branches				
Subject Code	Subject Name	No of Hours		
		Lecture	Tutorial	Practical
SEMR1	Safety Management	4	-	-
SEMR2	Chemical Process Safety	4	-	-
SEMR3	Hazard Identification and Risk Assessment	4	-	-
SEMR4	Fire Technology	4	-	-
SEMR5	Environmental Safety	4	-	-
SEMR6	Safety in Petroleum and Petrochemical Industries	4	-	-

Open Electives Offered by Mechanical Engineering		**Open Electives Offered by Chemical Engineering**	
Eligibility: Students of all branches Except Mechanical Engineering		**Eligibility: Students of all branches Except Chemical Engineering**	
Subject Code	Subject Name	Subject Code	Subject Name
MEOL1	Operations Research	CHOL1	Energy Engineering
MEOL2	Applied Mechanics & Mechanical Engineering	CHOL2	Solid Waste Management
Open Electives Offered by CSE		**Open Electives Offered by IT**	
Eligibility: Students of CE/ChE/ECE/EEE/ME branches		**Eligibility: Students of CE/ChE/ECE/EEE/ME branches**	
Subject Code	Subject Name	Subject Code	Subject Name
CSOL1	Programming with JAVA	ITOL1	Data Structures and Algorithms
CSOL2	Relational DataBase Management System	ITOL2	Web Technologies
		ITOL3	Computer Architecture and Organization
Open Electives Offered by CSBS		**Open Electives Offered by CSE(DS)**	
Eligibility: Students of CE/ChE/ECE/EEE/ME branches		**Eligibility: Students of CE/ChE/ECE/EEE/ME branches**	
Subject Code	Subject Name	Subject Code	Subject Name
CBOL1	Operating Systems Concepts	CDOL1	Python for Data Science

CBOL2	Business Analytics	CDOL2	Data Science for Engineers
Open Electives Offered by CSE(AIML)		**Open Electives Offered by CSE(IoT)**	
Eligibility: Students of CE/ChE/ECE/EEE/ME branches		**Eligibility: Students of CE/ChE/ECE/EEE/ME branches**	
Subject Code	Subject Name	Subject Code	Subject Name
CMOL1	Fundamentals of Artificial Intelligence	COOL1	Architecting Smart IoT Devices
CMOL2	Programming with C++	COOL2	Fog Computing
Open Electives Offered by ECE		**Open Electives Offered by EEE**	
Eligibility: Students of all branches Except ECE		**Eligibility: Students of all branches Except EEE**	
Subject Code	Subject Name	Subject Code	Subject Name
ECOL01	Applied Electronics	EEOL1	Renewable energy sources
ECOL02	Microprocessors & Interfacing	EEOL2	Utilization of Electrical Energy
ECOL03	Linear ICs and Applications		
Open Electives Offered by Civil Engineering			
Eligibility: Students of all branches Except Civil Engineering			
Subject Code	Subject Name		
CEOL1	Basic Surveying		
CEOL2	Building materials and construction		

Job Oriented Electives		
Eligibility: Students of All branches Can Register		
Course Code	**Course Name**	**Service Department**
JOEL01	Big Data Processing	CSE
JOEL02	Full Stack Development	CSE
JOEL03	JavaScript Technologies	IT
JOEL04	Cloud Computing using AWS	IT
JOEL05	DevOps	CSBS
JOEL06	Enterprise Programming	CSBS
JOEL07	Predictive Modeling and Analysis	CSE (DS)
JOEL08	Data warehousing and mining	CSE (DS)
JOEL09	Interface and Programming With IoT Gateway	CSE (IoT)
JOEL10	IoT Cloud and Data Analytics	CSE (IoT)
JOEL11	Geospatial Technology	CE
JOEL12	Building Planning	CE
JOEL13	Quantity Estimation	CE
JOEL14	Bio Fuels	ChE
JOEL15	Environmental Engineering	ChE
JOEL16	Safety Management	ChE
JOEL17	Non-Conventional Energy Engineering	ChE
JOEL18	Biopharmaceutics and Drug Design	ChE
JOEL19	Embedded Systems-1	ECE
JOEL20	Embedded Systems-2	ECE
JOEL21	Open Source Systems	CSE (AI & ML)
JOEL22	Machine Learning	CSE (AI & ML)

EE 111 :: MATHEMATICS-I

(Matrix Theory, Calculus & Differential Equations)

Semester I [First Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and differential equations. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Find the matrix eigenvalues, and obtain the tool of power series and Fourier series for learning advanced Engineering Mathematics.
2. Evaluate multiple integrals and their usage.
3. Understand concepts like divergence, curl and integration of vector function.
4. Solve differential equations which model physical processes.

UNIT I [CO:1] (15)

Characteristic equation, Eigenvalues and eigenvectors, Cayley-Hamilton theorem (without proof), diagonalization of matrices, reduction of quadratic form to canonical form. Sequences, Series, Series of positive terms, Convergence tests : Comparison test (limit form) D'Alembert's ratio test, Raabe's test for convergence. Fourier series: Half range sine and cosine series, Parseval's formula.

UNIT II [CO:2] (15)

Evolutes and Involutes, Evaluation of improper integrals : Integrals without infinite limits of integration, Multiple Integrals: Double integrals (Cartesian and polar), change of order of integration, change of variables (Cartesian to polar), Area by double integration, triple integrals, volume by triple integrals, Beta and Gamma functions.

UNIT III [CO:3] (15)

Scalar and vector point functions, Gradient, directional derivative, divergence and curl, del applied twice to point and product of point functions (without proofs).

Vector integration: line integral, surface and volume integrals, Green's theorem (without proof), Stoke's theorem (without proof), Gauss divergence theorem (without proof).

UNIT IV [CO:4] (15)

First order ordinary differential equations : Linear, Bernouli and exact equations. Second order ordinary linear equations: Solution by method of variation of parameters Cauchy's homogeneous equation, Legendre's linear equation.

First order partial differential equations: Solution of first order linear and non linearPDE's (Charpit's method).

LEARNING RESOURCES:

TEXT BOOK:

B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition, 2017.

REFERENCE BOOK(s):

1. G.B. Thomas and R.L. Finney - Calculus and Analytic geometry, Pearson, 2002.
2. N.P. Bali and Manish Goyal - A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2010.
3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 2006.

WEB RESOURCES:

http://nptel.iitm.ac.in/courses/

EE 112 – ENGINEERING CHEMISTRY
Semester I / II [First Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:
1. To impart concepts involved in molecular structure and intermolecular forces.
2. To Understand the chemistry behind electrochemical energy systems.
3. To understand the chemical concepts involved in Water treatment and Corrosion.
4. To understand the about the major organic reactions and end products like conducting polymers.
5. To learn the analytical methods useful in characterization of compounds.

COURSE OUTCOMES:
After successful completion of the course, the students are able to
1. identify stable complexes and suitable electrochemical energy systems for end usage.
2. apply his knowledge for effective water treatment and corrosion prevention.
3. identify chemical reactions that are used in the synthesis of molecules and polymers
4. distinguish the ranges of the electromagnetic spectrum and characterize a given compound using analytical techniques

Course Content:

UNIT-I: Molecular structure, Intermolecular forces and Energy systems 15 Hrs.

Crystal field theory-salient features, energy level diagrams-tetrahedral and octahedral complexes, crystal field stabilization energies and magnetic properties.

Ionic, dipolar, Vander Waal's interaction and Hydrogen bonding, critical phenomena-Andrew's isotherms of CO_2, derivation of critical constants from Vander Waal's equation.

Electrode potential, electrochemical series, Nernst equation and its applications. Batteries-Primary (Dry cell) and secondary (Lead acid), Lithium battery (Li-MnO_2)- advantages, Fuel cell (H_2-O_2 cell).

UNIT-II: Water Chemistry and Corrosion 15 Hrs.

Water Chemistry-WHO standards, Municipal water treatment-Removal of suspended impurities-Sedimentation, Co-agulation and Filtration-Disinfection of water by chlorine, Break point chlorination, Dechlorination, Purification by ion-exchange method and reverse osmosis.

Corrosion-Introduction, Electrochemical theory of corrosion, galvanic corrosion, differential aeration corrosion, Factors-temperature, pH, overvoltage. Cathodic protection by sacrificial anodic method and impressed current method. Electroplating (Cu), Electrolessplating (Ni).

UNIT-III: Organic reactions and Polymers 15 Hrs.

Types of organic reactions-Substitution (SN_1 and SN_2), Elimination (E_1 and E_2), Addition-Markownikoff's rule and anti-Markownikoff's rule, Cyclisation (Diel's Alder reaction), Synthesis of aspirin.

Polymers-Functionality, Degree of Polymerization, Tacticity-Addition and condensation polymerization, Relationship between Structure and Properties of polymers (Strength, Crystallinity, Elasticity, Plastic Deformation, Glass transition temperature (T_g)), Factors affecting T_g.

Conducting polymers: Introduction, Examples, General applications, Mechanism of conduction in polyacetylene.

UNIT-IV: Spectroscopic techniques and its applications 15 Hrs.

Beer-Lambert's law, limitations, colorimetric determination of Fe(III) UV-VIS spectroscopy – electronic transitions, shifts-blue and red, Block diagram - brief introduction of components, Applications – purity and differentiation of conjugated and non-conjugated dienes.

IR Spectroscopy–condition to be IR active, vibrational modes of–AB_2, Block diagram-brief introduction of components, IR spectrum of CO_2 and H_2O molecules, General applications. Fluorescence and its applications in medicine.

LEARNING RESOURCES:

Text Books:

1. P.C.Jain and Monica Jain- Engineering chemistry, 16th edition, Dhanpat Rai Publishing Company.
2. Wiley Engineering chemistry, 2nd edition, Wiley India Private Limited.

Reference Books:

1. Bruce H. Mahan, University Chemistry, 3rd edition, Narosa Publishing House..
2. Shashi Chawla - A text book of Engineering chemistry, 3rd edition, Dhanpat Rai Publishing Company.

Web References:

1. Engineering Chemistry (NPTEL Web Book by B.L. Tembe, Kamaluddin & M.S. Krishnan)
2. http://www.powerstream.com/BatteryFAQ.html#lec
3. http://freevideolectures.com/Course/3029/Modern-Instrumental-Methods-ofAnalysis.

EE 113 :; ENGLISH FOR COMMUNICATION SKILLS

Semester I / II [First Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

Course Objectives:

To enable students improve their lexical and communicative competence and to equip students with oral and written communication skills.
To help students understand and learn the correct usage and application of Grammar principles.
To get them acquainted with the features of successful professional communication.
To enable students acquire various specific features of effective written communication.

Course Outcomes:

After successful completion of the course, the students are able to

1. Use vocabulary contextually.
2. Compose effectively the various forms of professional communication.
3. Apply grammar rules efficiently in spoken and written forms.
4. Improve clarity to locate and learn the required information.

UNIT-I **[CO:1]** **[10]**

Vocabulary Building

1.1 - Root words from foreign languages and their use in English
1.2 - Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.3 -Synonyms, antonyms, and standard abbreviations.
1.4 - One word substitutes.

UNIT-II **[CO:1,2,3]** **[10]**

Writing Skills

2.1- Proposal writing
2.2- Letter-writing
2.3- Techniques for writing precisely (précis writing)
2.4- E-mail writing

UNIT-III **[CO: 3]** **[10]**

Identifying Common Errors in Writing

3.1- Subject-verb agreement
3.2- Noun-pronoun agreement
3.3- Articles
3.4- Prepositions
3.5- Tenses
3.6- Redundancies

UNIT-IV **[CO:1,2,3,4]** **[10]**

Nature and Style of sensible Writing

4.1 - Description & Narration (Paragraph Writing). [CO:1,2,3]
4.2 - Essay Writing (Expository Essay). [CO:1,2,3]
4.3 - Note-Making and Note-Taking. [CO:1,2,4]
4.4 - Methods of preparing notes. [CO:1,2,4]

Learning Resources:

Text Book:

1. Communication Skills. Sanjay Kumar and Pushpa Lata.Oxford University Press.

References:

1. Remedial English Grammar. F.T. Wood. macmillan.2007
2. On Writing Well. William Zinsser. Harper ResourceBook. 2001
3. Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press.2006.
4. Practical English Usage.Michael Swan. OUP. 1995Press

EE 114 :: Basic Civil & Mechanical Engineering

Semester I [First Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

Course objectives:
To enable the circuit branch students to acquire fundamental knowledge in Civil and Mechanical Engineering disciplines for application oriented concepts.

Course Outcomes:
Upon successful completion of the course the student will be able to
1. Acquire knowledge of surveying and materials used in construction industry
2. Understand the concepts of foundation and structures , Understanding the concepts of mechanics
3. Be acquainted with power plants and the equipment used in power plants
4. Understand the working principles of IC engines, refrigeration systems and transmission of mechanical energy.

Course Contents:

A – CIVIL ENGINEERING

UNIT – I

12 hours

Surveying and Civil Engineering Materials

a) **Surveying:** Objectives; Classification; Fundamental Principles; Measurements of distance- chaining a line on flat surface, Measurement of Angles by Theodolite, Levelling-Basic Definitions and Methods, Height of Instrument method, Area measurement-Triangular method-illustrated problems.

b) **Building Materials:** Stones- Types, Properties; Bricks- Types, Properties, Classification of Bricks based on Quality; Cement-Types, Physical Properties of OPC; Sand; Cement Mortar- Properties and uses.

UNIT – II

12 hours

Building components and structures

a) **Structures**: Elements of a Building and Basic Requirements of a Building, Brick masonry and Stone masonry; Foundations- Types of Foundations

b) **Mechanics**: Internal and external Forces-Stress, Strain, Elasticity, Shear force, Bending Moment and Torsion; simple problems on SFD and BMD for cantilever and simply supported beams due to point load and UDLs

B – MECHANICAL ENGINEERING

UNIT III 15 hours

BOILERS, TURBINES and PUMPS

(a) Boilers – Classification, Working of Babcock-Wilcox water tube boiler and Cochran Fire tube boiler, Differences between Fire tube and Water tube boiler.

Pumps – construction and working of Reciprocating and Centrifugal pumps.

(b) Turbines

Water Turbines – Classification, construction and working of Pelton wheel turbine, Francis turbine and Kaplan turbine

UNIT IV 15 hours

(a)THERMAL SYSTEMS:

I.C Engines - Classification of IC Engines – Components in I.C engine, working principle of SI & CI engines – comparison of 2 stroke & 4 stroke engine and SI & CI engines - Applications.
Refrigeration and Air Conditioning – Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – summer and winter air conditioning systems.

(b)TRANSMISSION OF POWER: Transmission of Power – Belt Drives – Types of Belts – Materials – Velocity Ratio – Ratio of Tensions – Flat Belt – V-Belt — Rope Drives — Gear Drives – Types – Speed Ratio – Materials – Simple problems in Transmission of Power by Belt drives.

Text Books:

1. Surveying by Dr. K. R. Arora, Rajsons Publications Pvt. Ltd
2. Basic Civil Engineering by S. S. Bhavikatti; New Age International (P) Lmited, Publishers
3. Mathur, Mehta&Tewari, Elements of Mechanical Engineering, DhanpatRai& Sons, 13/E.

Reference Books:

1. Mechanics of materials; by Dr. B. C. Punmia, Er. A. K. Jain and Dr. Arun kumar Jain
2. Engineering mechanics by S S Bhavikatti & K. G. Rajasekharappa; New Age International
3. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
4. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

EE 151 :: ENGINEERING CHEMISTRYLAB
Semester I / II [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

1. To learn concepts of equivalent weight, molecular weight, normality, molarity, weight and volume percent.
2. To know the methods of determining hardness and chloride ion content of water sample.
3. To learn the redox methods to determine Fe^{2+} ions present in solution.
4. To know principles and methods involved in using instruments like conductivity bridge and potentiometer
5. To know the molecular properties like surface tension, viscosity.
6. To know synthetic methods for preparation of drugs and polymer

Course outcomes:

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

1. Estimate the Fe(II) content of a given solution and chloride/hardness content of water.
2. Measure molecular properties such as surface tension, viscosity.
3. Measure conductance of solutions, redox potentials of a cell.
4. Synthesize a small drug molecule and polymer.

List of Experiments:

1. Estimation of Mohr's salt using $KMnO_4$.
2. Estimation of Mohr's salt using $K_2Cr_2O_7$.
3. Determination of chloride ion content of water.
4. Determination of Hardness of water using EDTA method.
5. Determination of Fe(II) strength using $K_2Cr_2O_7$ potentiometrically.
6. Determination on strength of NaOH using HCl conductometrically.
7. Determination of surface tension.
8. Determination of Viscosity.
9. Determination of Saponification / acid value of oil.
10. Preparation of p-bromo acetanilide.
11. Preparation of Phenol Formaldehyde resin.
12. Determination of partition co-efficient of I_2 in water.
13. Determination of R_f value using TLC.
14. Verification of Freundlich isotherm using adsorption of acetic acid on activated charcoal.

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

EE 152 :: ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

Semester I / II [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

1. To Identify speaker's purpose and tone; make inferences and predictions about spoken discourse, discuss and respond to content of a lecture or listening passage orally and/or in writing.
2. To Acquaint the students with the Standard English pronunciation, i.e., Receive Pronunciation (RP), with the knowledge of stress and intonation.
3. To Develop production and process of language useful for social and professional life.
4. To develop in them communication and social graces necessary for functioning. Improve the dynamics of professional presentations.
5. To develop critical reading and comprehension skills at different levels.

Course Outcomes:

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

1. Comprehend relationships between ideas and make inferences and predictions about spoken discourse.
2. Speak English with a reasonable degree of accuracy in pronunciation.
3. Develop appropriate speech dynamics in professional situations.
4. Use effective strategies and social graces to enhance the value of communication.
5. Develop effective communication and presentation skills and using language effectively to face interviews with success.

Oral Communication

(This unit involves interactive practice sessions in Language Lab)

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Interviews
5. Formal Presentations
6. Reading Comprehension

Learning Resources:

References:

(i) *Communication Skills.* Sanjay Kumar and Pushpa Lata. Oxford University Press.
(ii) *Practical English Usage.* Michael Swan. OUP. 1995 Press
(iii) *Exercises in Spoken English.* Parts.I- III. CIEFL, Hyderabad. Oxford University
(vi) Technical English .M. Sambaiah, Wiley Publications, New Delhi

EE 153 ENGINEERING WORKSHOP PRACTICE LAB (THEORY & LAB)
Semester I / II [First Year]

L	T	P	C	Int	Ext
1	0	4	3	30	70

Course Objectives:

Engineers, whatever be their line of activity, must be proficient with all aspects of manufacturing, however it should not be forgotten that practice without theory is blind and the theory without practice is lame.

1. Students involved in acquiring manufacturing skills must have balanced knowledge of theory as well as practice.
2. Imparts basic knowledge of various tools and their use in different sections of manufacture such as fitting, carpentry, tin smithy, moulding, casting, welding, electrical wiring, PCB work on electronic circuits and practice with machine shop tools & equipments.

Learning Out Comes:

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

1. Gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricate components using different materials.

Detailed Contents

Lectures and Videos: **[10]**

1. Manufacturing Methods: Introduction to various types of manufacturing methods –casting - forming - various machining operations such as turning, milling, shaping, drilling, slotting etc.,, - various joining methods such as welding, brazing, soldering etc.,- Advanced manufacturing methods(3 Lectures).
2. CNC machining and Additive manufacturing(1 Lecture)
3. Fitting operations and power tools (power hack saw, table mounted circular saw, wood turning lathe, bench grinder, concrete mixer, concrete vibrator etc.,) (1 Lecture)
4. Basic principles involved in electrical circuits and electronic PCB circuits(1 Lecture)
5. Carpentry(1 Lecture)
6. Welding(arc welding & gas welding)(1 Lecture)
7. Metal casting(1 Lecture)
8. Plastic moulding, glass cutting(1 Lecture)

Text books:

1. Hajra Choudhury S, K., Hajra Choudhury A.K and Nirjhar Roy S.K., "Elements of Workshop Technology", VolumeI and Volume II,2010, Media promoters and publishers private limited, Mumbai.

Reference books:.

1. Kalpakjian S and Steven S.Schmid.,"Manufacturing Engineering and Technology" 4th edition, Pearson Education, India, 2002.
2. Rao P.N., "Manufacturing Technology", Volume I &II, Tata McGrawHill House, 2017

Work shop Practice: **[60]**

Objectives:

Students acquiring practical knowledge on various manufacturing techniques and will be able to fabricate components with their own hands.

Outcomes:

Up on completion of laboratory, students will be able to gain the manufacturing skills and get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

List of Exercises - Trade wise Experiments:

1. Welding shop(both arc &gas welding)

- Square butt joint
- Lap joint

- Single v butt joint
- Gas welding & Cutting

2. Fitting Shop& Casting

- Inclined fit
- Half round fit
- V fit
- Moulding and casting of Hand wheel

3. Practice on electrical wiring and Electronic circuit boards

- One bulb controlled by one switch &one bulb controlled by two switches
- Two bulbs controlled by one switch (Stair case connection)
- Tube light connection
- Measurement of resistance, voltage and current with the help of a multi-meter & soldering on an electronic PCB circuit.

4. Machine Shop

- Practice of machining operations on Lathe, Milling, Shaping, Drilling and Slotting Machines.

5. Carpentry

- Lap joint
- Cross lap joint
- Dovetail joint
- Turning on wood turning Lathe

6. Tin Smithy

- Rectangular tray
- Funnel
- Pipe joint
- Rectangular Scoop

Plastic moulding and glass cutting

Note: A minimum of 2 (Two) from each trade - Total 12 (Twelve) experiments - have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

Text book:

P.Kannaiah, K.L.Narayana., Workshop Manual, Second Edition, Scitech Publications (INDIA) Pvt.Ltd.

EE 154 :: Basic Civil & Mechanical Engineering Lab
Semester I [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objective:

To provide exposure to the students with hands on experience on basic engineering practices in Civil, Mechanical Engineering.

Course Outcomes:

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

1. Prepare basic surveying reports
2. Use the civil engineering instruments appropriately
3. Study the operation of Pumps and IC engines
4. Conduct performance tests on IC engines
5. Able to find viscosity, flash & fire points of oils and fuels.

List of Experiments:

A- CIVIL ENGINEERING

1. Chain Surveying
2. Measurement of Distance.
3. Measurement of Angles.
4. Measurement of Levelling
5. Measurement of Areas.
6. Measurement of Stress & Strain using UTM.
7. Measurement of Strength of Bricks & Concrete.
8. Performance Study on Single Stage Centrifugal Pump.

B- MECHANICAL ENGINEERING

1. VTD on four stroke diesel engine and PTD on two stroke petrol engine
2. Load test on single cylinder, 4-stroke diesel engine with electric dynamometer
3. Determination of Flash and Fire points using Cleveland's apparatus
4. Determination of viscosity of given oil using Redwood viscometer I
5. Study of refrigeration and air conditioning tutors
6. Study of boilers and mountings

NOTE: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for University Examinations.

EE 121 :: MATHEMATICS–II
(Transform Calculus and Numerical Methods)
Semester II [First Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes:

The students will be able to:

1. find Laplace and inverse transforms of a function.
2. know how integral transforms can be used in engineering.
3. solve system of equations numerically.
4. know how to apply numerical methods in the mathematical models.

UNITI: [15]

Laplace transforms – Introduction, properties of Laplace transforms, Evaluation of integrals by Laplace transforms, Laplace transform of periodic function.

Inverse Laplace transforms – Method of partial fractions, other method of finding inverse transforms - $tf(t) = L^{-1}\left[-\frac{d}{ds}F(s)\right]$, Convolution theorem.

UNIT II: [15]

Applications to differential equations – Solving second order ordinary differential equations with constant coefficients using Laplace transforms.

Fourier transforms – Fourier transforms, Fourier sine and cosine transforms and inverse transforms.

UNITIII: [15]

Numerical solution of equations – Newton Raphson method, Gauss-Seidal method. Finite differences – Forward and backward differences, differences of a polynomial. Interpolation– Newton's forward and backward interpolation formulae (without proof),

Lagrange's interpolation formula (without proof), inverse interpolation. Numerical differentiation – Finding first and second order derivatives using Newton's forward and backward differences formulae.

UNIT IV: [15]

Numerical Integration – Trapezoidal rule and Simpson's one third rule. Numerical solution of first order ordinary differential equations–Taylor's series method, Euler's method, Runge-Kutta method of fourth order.

Numerical solution of partial equations – Classification of second order equations, solutions of Laplace and Poisson's equations.

LEARNING RESOURCES:

TEXT BOOK:

1. B.S.Grewal - Higher Engineering Mathematics, Khanna publishers, 42nd edition.

REFERENCE BOOKs:

1. Erwin Kreyszig - Advanced Engineering Mathematics, 8th edition, New Age International (P) Ltd., 2007.
2. N.P. Bali and Manish Goyal – A text book of Engineering Mathematics, Lakshmi Publications.

WEB RESOURCES:

http://nptel.iitm.ac.in/courses/

EE 122 :: ENGINEERING PHYSICS

Semester II [First Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

Objectives:

1. To impart knowledge and understanding the basic principles of waves & oscillators.
2. To understand about basic phenomena of light waves, fundamentals of Lasers & its applications.
3. To understand wave particle duality, uncertainty principle etc. by learning the prerequisite quantum physics.
4. Introducing the concept of electron motion in periodic potentials and formation of P-N junction from the basics of semiconductors.

Course Outcomes:

After successful completion of the course, the students are able to

1. Identify and illustrate physical concepts and terminology used in waves & oscillations.
2. The optical phenomena such Interference, diffraction, basics concepts of lasers and their applications
3. Some of the basic laws related to quantum mechanics such as wave particle duality, uncertainty principle, Schrodinger wave equation & its applications etc.
4. Basic concepts in physics of solids & semiconductors.

UNIT-I:

Waves & Non-dispersive transverse and longitudinal waves in one dimension [15]

Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator, forced mechanical and electrical oscillators, impedance, steady state motion of forced damped harmonic oscillator.

Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them.

UNIT-II :

Wave Optics [15]

Interference& Diffraction: Interference in thin films(cosine law), Newton'srings (theory &derivation for diameter of the rings, Michelson interferometer(description & working) Fraunhofer diffraction from a single slit and a circularaperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction grating - theoryand its resolving power.

Lasers: Introduction to interaction of radiation with matter, Einstein's A&B coefficients. Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, spontaneous and stimulated emission. Population inversion, pumping, different types of lasers: solid-state laser (Nd:YAG),gas laser(He-Ne), applications of lasers.

UNIT-III: Introduction to Quantum Mechanics: [15]

Wave nature of Particles, Heisenberg's uncertainty principle-experimental verification electron diffraction-single slit), Time-dependent and time-independent Schrodinger equation forwave function, probability interpretation.

Solution of Wave Equation: Solution of stationary-state Schrodinger equation for one dimensional problems-particle ina box, linear harmonicoscillator, Scattering from a potential barrierand tunnelling (Qualitative treatment): relatedexamples likealphadecay, scanning tunnelingmicroscope.

UNIT-IV:

Introduction to Solids and Semiconductors: [15]

Failures of classical Free electron theory, quantum free electron theory (assumptions),Fermi –Dirac distribution function, Fermi level, density of energy states, Bloch's theorem for particles in a periodic potential, Kronig-Penney model (qualitative),effective mass of an electron.

Intrinsic and extrinsic semiconductors, Intrinsic charge carrier concentration (derivation), dependence of Fermi level on carrier-concentration and temperature(equilibrium carrier statistics)(in brief), diffusion and drift currents, P-N junction(formation, energy level diagram and built in potential, I-V Characteristics).

Text Books:

M.N. Avadhanulu, P.G. Kshirasagar - A text book of Engineering Physics, 9th edition, S. Chand & Company Ltd., New Delhi, 2018.

References Books:

1. E.Hecht - Optics, Pearson Education, 2008.
2. A.Ghatak - Optics, McGraw Hill Education, 2012.
3. O.Svelto - Principles of Lasers, Springer Science & Business Media, 2010.
4. D.J.Griffiths - Quantum mechanics, Pearson Education, 2014.
5. R.Robinett - Quantum Mechanics, OUP Oxford, 2006.
6. D.McQuarrie - Quantum Chemistry, University Science Books, 2007.
7. Donald A.Neeman - Semiconductor Physics and Devices : Basic Principle (Fourth edition), TMH, 2012.
8. E.S.Yang - Microelectronic Devices, McGraw Hill, Singapore, 1988.
9. B.G.Streetman - Solid State Electronic Devices, Prentice Hall of India, 1995.
10. SL Kakani & Shubhra kakani - Engineering Physics, 3rd Edition, CBS Publications Pvt. Ltd., New Delhi.
11. I.G.Main - Vibrations and waves in physics, Cambridge University Press, 1993.
12. H.J.Pain - The Physics of vibrations and waves, Wiley, 2006.
13. Hitender K. Mallick, A.K.Singh - Engineering Physics:, McGraw Hill Education(India) Pvt. Ltd., New Delhi.

EE 123 - ELECTRICAL CIRCUITS
Semester II [First Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

Course Objectives:

1. To develop an understanding of the fundamental laws and elements of electrical circuits.
2. To develop the ability to apply circuit analysis to DC and AC circuits.
3. To understand transient and steady-state response of RLC circuits.

Course Outcomes:
After successful completion of the course, the student will be able to:

1. Outline the fundamental laws and elements of electrical circuits.
2. Solve problems on alternating current analysis and resonance.
3. Apply network theorems for the analysis of electrical circuits.
4. Obtain the transient and steady-state response of electrical circuits.

UNIT– I [Text Book 1&2] [15]

INTRODUCTION OF CIRCUIT ELEMENTS:

Basic definition of the unit of Charge, Voltage, Current, Power and Energy, Circuit concept, Active and Passive circuit elements; Ideal, Practical and dependent sources and their V-I characteristics, Source transformation, Voltage and Current division; V-I characteristics of Passive elements and their series / parallel combination; Star Delta transformation, Energy stored in Inductors and Capacitors, Kirchhoff's Voltage law and Kirchhoff's Current law. Mesh and Nodal Analysis.

UNIT– II [Text Book 1&2] [15]

INTRODUCTION TO ALTERNATING CURRENTS AND VOLTAGES:

Instantaneous, Peak, Average and RMS values of various waveforms; Crest factor, Form factor; Concept of phase and phase difference in sinusoidal waveforms; Phase relation in pure resistor, Inductor and capacitor; Impedance diagram, phasor diagram, series and parallel circuits, compound Circuits. Computation of active, reactive and complex powers; power factor.

UNIT –III [Text Book 1] [15]

NETWORK THEOREMS:

Superposition theorem, Thevenin's and Norton's theorems, Reciprocity, Compensation, Maximum power transfer theorems, Tellegan's and Millman's theorems, Application of theorems to DC circuits. Sinusoidal steady state Mesh and Node Analysis. Application of network theorems to AC circuits.

RESONANCE: Series resonance, Impedance and phase angle, voltages and currents, bandwidth and Q factor and its effect on bandwidth, magnification, parallel resonance, resonant frequency, variation of impedance with frequency , Q factor, magnification, reactance curves in parallel resonance.

UNIT– IV [Text Book1&2] [15]

Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel R-L, R-C, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for
standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions.

Learning Resources:

Text books:

1. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
2. A Sudhakar and Shyam Mohan SP, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, 2015.

Reference books:

1. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education,2004.
2. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.
3. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
4. D. Roy Choudhury, "Networks and Systems", New Age International Publications,1998.

Web resources:

1. http://www.egate.ws/
2. http://cosmolearning.org/courses/circuit-theory/
3. http://www.nptelvideos.in/2012/11/circuit-theory.html
4. http://elearning.vtu.ac.in/P9/notes/06ES34/Unit1-KCV.pdf
5. http://pbtstudies.blogspot.in/

EE 124 - Programming for Problem Solving
Semester II [First Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

Course Objectives:

The objectives of the course are, to make the students understand:
1. Basic problem solving process using Flow Charts and algorithms.
2. Basic concepts of control structures in C.
3. Concepts of arrays, functions, pointers and Dynamic memory allocation in C.
4. Concepts of structures, unions, files and command line arguments in C.

Course Outcomes:

After successful completion of the course, the students will be able to
1. Develop algorithms and flow charts for simple problems.
2. Use suitable control structures for developing code in C.
3. Design modular programs using the concepts of functions and pointers.
4. Develop code for complex applications using structures and file handling features.

Course Content:

Unit I **[15]**

Introductory Concepts: Block Diagram of Computer, Computer Characteristics, Hardware vs Software, how to Develop a Program, Software Development Life Cycle, Structured Programming, Types of Programming Languages, Introduction to C program, Program Characteristics.

Introduction to C Programming: Character set, Identifiers and Keywords, Data types, Constants, type qualifiers, Declaration and Initialization of variables.

Operators & Expressions: Arithmetic Operators, Unary Operators, Relational and Logical Operators, Assignment Operators, Conditional Operator, Input/ Output functions.

Unit II: **[15]**

Control Statements: Branching, Looping, Nested Control Structures, Switch Statement, Break Statement, continue Statement, and Goto Statement

Arrays: Defining an Array, Processing an Array, Multidimensional Arrays & Strings.

Unit III **[15]**

Functions: Defining a Function, Accessing a Function, Function prototypes, Passing Arguments toa Function, Passing Arrays to Functions, Recursion, Storage Classes

Pointers: Fundamentals, Pointer Declarations, Passing Pointers to a Function, Pointers and Arrays, Dynamic memory allocation, Operations on Pointers, Arrays of Pointers.

Unit IV **[15]**

Structures and Unions: Defining a Structure, Processing a Structure, User-Defined Data Types,Structures and Pointers, Passing Structures to Functions, Self-Referential Structures, Unions.

Files Handling: Opening and Closing a Data File, Reading and Writing a Data File, Processing a Data File, Unformatted Data Files, Accessing the File Randomly.

Command line arguments, C-preprocessor directives.

Learning Resources:

Text Book:

Programming with C (Schaum's Outlines) by Byron Gottfried, Third Edition, Tata McGraw-Hill.

Reference Books:

1. Programming in C by Stephen G. Kochan, Fourth Edition, Pearson
2. C Complete Reference, Herbert Sheildt, TMH., 2000.
3. Programming with C by K R Venugopal & Sudeep R Prasad, TMH., 1997.
4. The C Programming Language by Brian W. Kernighan & Dennis M. Ritchie, Second Edition, Prentice Hall.
5. A Structured Programming Approach Using C by Behrouz A. Forouzan, Richard F. Gilberg,Third Edition, Cengage 2007.

Web References:

1. http://cprogramminglanguage.net/
2. http://lectures-c.blogspot.com/
3. http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
4. http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

EE 161 :: ENGINEERING PHYSICS LAB
Semester II [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

1. To give background in experimental techniques and to reinforce instruction in physical principles.
2. To find measurement, data, error, or graphical analysis in addition to illustrating a physical principle
3. To give skills that can transfer critical thinking into problem solving methods, how to identify what data is important, how to collect that data and then draw conclusions from it.

Course Outcomes:

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

1. Use CRO, Function generator, Spectrometer for making measurements
2. Test the optical instruments using principles of interference and diffraction
3. Understand the concepts learned in the Physics theory.
4. Carry out precise measurements and handling sensitive equipment.
5. Draw conclusions from data and develop skills in experimental design.

List of Experiments:

1) Some basic measuring instruments: Screw gauge, Vernier Callipers, Spherometer, Travelling Microscope etc., & General instructions.
2) To study the characteristic curves of a given Photocell and determine the Planck's constant.
3) To determine the radius of curvature of a given Plano-convex lens by Newton's Rings experiment.
4) To calculate the frequency & amplitude of sinusoidal waves and calibration of a given audio oscillator – Lissajous' Figures.
5) To determine the magnetic field along the axis of circular current carrying coil.
6) To measure the a.c. supply frequency using A.C. sonometer.
7) To determine the quality factor of a given series resonance LCR circuit.
8) To determine the specific resistance of a given wire by Carey- Foster's Bridge.
9) To determine Fill factor of a given photovoltaic cell.
10) To determine the energy band gap of a given semiconductor.
11) To determine the wavelengths of spectral lines of mercury light using diffraction grating.
12) To study the laser beam characteristics like wavelength using diffraction grating aperture divergence.
13) To determine the NA of a given optical fiber and hence to find the acceptance angle.
14) To find the dispersive power and resolving power of a grating.
15) To determine the magnetic field in Helmoltz coil.
16) To determine the refractive index of the material of a prism.
17) To determine the Four probe method apparatus for measurements of resistivity and conductivity.
18) To determine the rigidity modulus of the given wire material using Torsional pendulum.

Reference books:

1) Students reference manual : Department of physics, RVR & JC College of Engg.
2) Engineering Physics Lab Manual; Dr. C.V.Madhusudhana Rao, V. Vasanth Kumar, 3rd edition, Scitech publications(India) Pvt. Ltd. Chennai.
3) Engineering Physics Practicals: Dr.B. Srinivasa Rao, V.K.V.Krishna, K.S.Rudramamba University Science Press, Daryaganj, NewDelhi.

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

EE 162 - Programming for Problem Solving Lab
Semester II [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

1. To understand the basic problem solving process using Flow Charts and algorithms.
2. To understand the basic concepts of control structures in C.
3. To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
4. To use the concepts of structures, unions, files and command line arguments in C.

Course Outcomes:

After successful completion of the course, the students are able to

1. Develop algorithm and flowchart for simple problems.
2. Use suitable control structures and arrays for developing code in C.
3. Design modular structured programs using functions and recursion.
4. Develop code for complex applications using structures, pointers and file handling features.

List of Exercises / Activities:

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings:
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls:
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation:
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations
Note: A minimum of 10(Ten) experiments have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

EE 163 :: ENGINEERING GRAPHICS & DESIGN Lab

Semester I / II [First Year]

L	T	P	C	Int	Ext
1	0	4	3	30	70

Course Objectives

The course will enable the students to

1. Expose the students to standards and conventions followed in preparation of engineering drawings.
2. Make them understand the concepts of orthographic and isometric projections
3. Develop the ability of conveying the engineering information through drawings.
4. Make them understand the relevance of engineering drawing to different engineering domains.
5. Develop the ability of producing engineering drawings using drawing instruments.
6. Enable them to use computer aided drafting packages for the generation of drawings.

Course Outcomes

After completion of this course, students will be able to

1. Prepare engineering drawings as per BIS conventions mentioned in the relevant codes.
2. Produce computer generated drawings using CAD software.
3. Use the knowledge of orthographic projections to represent engineering information / concepts and present the same in the form of drawings.
4. Develop isometric drawings of simple objects reading the orthographic projections of those objects.
5. Convert pictorial and isometric views of simple objects to orthographic views.

(Units I to IV shall be taught in conventional drawing method and Unit V shall be taught with the aid of computer)

UNIT-I

General: Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering.

Conic sections: Construction of Ellipse, Parabola, Hyperbola and Rectangular Hyperbola. (General method only)

Curves: Cycloid, Epicycloid, Hypocycloid and Involute; and **Scales**

UNIT-II

Method of Projections: Principles of projection - First angle and third angle projection of points, Projection of straight lines inclined to both planes. Traces of lines.

Projections of planes: Projections of planes inclined to both the planes, projections on auxiliary planes.

UNIT-III

Projections of Regular Solids: Projections of solids (Prism, Pyramid, Cylinder and Cone) with varying positions.

Sections of Solids: Sections of Prisms, Pyramids, cylinders and Cones. True shapes of sections. (Limited to the cutting plane perpendicular to one of the principal plane).

Development of surfaces: Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

UNIT-IV

Isometric Projections: Principles of Isometric projection-Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids

Orthographic Projections: Conversion of pictorial views into Orthographic views and Vice-versa. (Treatment is limited to simple castings).

Perspective Projections: Introduction to Perspective Projection

UNIT-V

Over view of Computer Aided drafting (AutoCAD) : Introduction, starting and customizing AutoCAD screen, usage of different menus, toolbars(drawing, editing, dimension, text, object properties..etc), tabs (Object, snap, grid, polar, ortho, otrack..etc) and command prompt. Setting units, limits, layers and viewports (Isometric, Top, Front, back..etc). 2D drawings of various mechanical and structural components, electrical and electronic circuits. Orthographic and Isometric views of mechanical castings and simple structures.

Suggested Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

EE 164 :: ELECTRICAL CIRCUITS LAB
Semester II [First Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

The main objectives of this lab course are

1. To conduct experiments on electrical circuits.
2. To design experimental setups for theorems.
3. To know the response of electrical circuits for different excitations

Course Outcomes:

Upon completion of this laboratory, the student will be able to:

1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Use common electrical measuring instruments.
4. Conduct experiments on RLC circuits to study resonance phenomenon.
5. Verify the network theorems.

List of experiments/demonstrations:

1. Familiarisation of Electrical Installations and Electrical Testing Equipment: Miniature circuit breakers (MCBs), Moulded Case Circuit Breakers (MCCBs), Earth-leakage circuit breakers (**ELCBs**), Fuses, Types of Wires, Wire Gauges, continuity test, megger, Cables and Earthing.
2. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, wattmeter, multi-meter, oscilloscope, measurement ofbasic parameters.
3. Verification of KVL& KCL.
4. Verification of Thevenin's Theorem.
5. Verification of Superposition Theorem.
6. Verification of Maximum power transfer theorem
7. Verification of reciprocity theorem.
8. Verification of Norton's Theorem.
9. Measurement of active power in single phase circuit by using single wattmeter.
10. Series resonance characteristics.
11. Parallel resonance characteristics.
12. Parameters of choke coil.
13. To study R-L series circuits (AC)
14. To study R-C series circuits (AC)
15. To study R-L-C series circuits (AC)
16. To study R-L-C parallel circuits (AC).

Note: A minimum of 10(Ten) experiments have to be Performed and recorded by the candidate to attain eligibility for Semester End Practical Examination.

EE 211 – Mathematics-III
Semester III [Second Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:

1. To familiarize the students with statistical techniques.
2. To equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

COURSE OUTCOMES:

Upon completion of the course, the students will learn:

1. The ideas of random variables and various discrete and continuous random variables and their properties.
2. The application of various probability distribution concepts to solve the engineering problems.
3. The basic ideas of statistics including correlation, regression, least squares fit to various curves.
4. The statistical methods for analyzing experimental data by testing the hypotheses.

COURSE CONTENT:

Unit-I : Basic Probability: **[Text Book – 1] [10]**

Discrete random variables and their properties, Expectation of Discrete Random Variables, Continuous random variables and their properties, Expectation of Continuous Random Variables, Distribution functions and densities, Moments, Chebyshev's Inequality.

Unit-II : Discrete and Continuous Probability Distributions: **[Text Book – 1] [10]**

Binomial distribution, infinite sequences of Bernoulli trials, Poisson approximation to the Binomial distribution- Evaluation of statistical parameters for these distributions.

Normal, Exponential and Gamma densities-. Evaluation of statistical parameters for these distributions.

Unit-III : Applied Statistics: **[Text Book – 1] [10]**

Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Unit-IV: Small and Large sample tests: **[Text Book – 1] [10]**

Test for single mean, difference of means, test for ratio of variances, Chi-square test for goodness of fit for Binomial and Poisson Distributions, and independence of attributes.

Tests of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

LEARNING RESOURCES:

TEXT BOOK:

1) Miller & Freund's Probability and Statistics for Engineers – Richard A. Johnson

REFERENCE BOOKS:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003
3) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
5) N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2010.
6) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7) Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
8) S.C.Gupta and V.K.Kapoor., Fundamentals of Mathematical Statistics, Sultan Chand & Co

EE 212 – Electrical Circuit Analysis
Semester III [Second Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:

1. To introduce AC three phase power measurement techniques
2. To calculate response of network functions by pole zero diagrams and Fourier transforms
3. To analyse two port network parameters and coupled circuits
4. To design filter circuits and synthesize networks

COURSE OUTCOMES:

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

1. Calculate and measure power in 3-phase circuits
2. Use of networks functions, Fourier series, transforms for electrical circuit analysis
3. Illustrate two port networks and applications of coupled circuits
4. Design filter circuits and synthesize electrical networks

COURSE CONTENT:

UNIT – I **[Text book -1]** **[15]**

Poly phase systems: Advantages of 3-phase systems – generation of 3-phase voltages - phase sequence - star & delta connections - interconnection of 3-phase sources and loads - voltage, current & power in star & delta connected systems - analysis of 3-phase balanced circuit - measurement of 3-phase power- 2 wattmeter method. Analysis of 3-phase unbalanced systems – star / delta transformation method - application of KVL and Millman"s method.

UNIT-II **[Text book -1]** **[15]**

Network Functions: Network functions for the one port and two port networks -Poles and Zeros of network functions Restrictions on pole and zero locations for driving point functions and transfer functions - Time domain behavior from the pole zero plot.

Fourier Series & Fourier Analysis: Trigonometric and exponential Fourier series, representation of periodic function by Fourier series, Fourier transforms of simple functions, Applications to circuit analysis.

UNIT –III **[Text book -2]** **[15]**

Two port networks: Open circuit impedance and short circuit admittance parameters, transmission (ABCD) and inverse transmission parameters, hybrid and inverse hybrid parameters, reciprocal and symmetrical conditions, interrelation between parameters, inter connection of 2-port networks.

Coupled circuits: Defining self and mutual inductance, coefficient of coupling, dot convention, development of circuit equations in time domain and frequency domain, solution of coupled circuits, series and parallel connections of two coupled coils, tuned circuit analysis (single and double tuned)

UNIT – IV **[Text book -2]** **[15]**

Filters: Classification- T and Π networks – Characteristics - Constant K filters.

Network Synthesis: Hurwitz polynomial – properties of positive real functions – Synthesis of RC, RL & LC driving point impedances and RL, RC admittances – CAUER and FOSTER methods of Synthesis.

LEARNING RESOURCES:

TEXT BOOKS:

1) W.H.Hayt&J.E.Kimmerly - Engineering circuit analysis, 8th Edition,TMH, 2013
2) A.Sudhakar and Shyammohan - Circuits and Networks: Analysis and synthesis, 5th Edition, TMH, 2015

REFERENCE BOOKS:

1) M Nahvi , Joseph Edminister , K Rao - Electric Circuits, (Schaum's Outline Series) , 5th edition, TMH, 2017
2) F.F. Kuo - Network analysis and synthesis, 2nd edition, Wiley student edition, 2006
3) Cunningham & J.A. Stuller - Basic circuit analysis, 1st edition, Jaico publishing, 1996
4) M.E. Vanvalkenberg - Network analysis, 3rd Edition, Pearson Education, 2019
5) M.S.Sukhija and T.K.Nagsarkar - Circuits and Networks: Analysis, design and synthesis, 2nd edition, Oxford press, 2016

WEB REFERENCES:

1. project.mvps.org/networkanalysis.htm % Applications of NA
2. books.google.com/books/about/Network_Analysis.html?id=17IP... % References
3. www.allaboutcircuits.com › ... › DC NETWORK ANALYSIS % DC network analysis
4. www.microimages.com/documentation/Tutorials/network.pdf % Network analysis tutorials
5. www.robcross.org/network_tutorials.htm % Network analysis tutorials

EE 213 – Electronic Devices & Circuits
Semester III [Second Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:
1. To understand the basics of semiconductor devices.
2. To understand the principle of operation, characteristics and applications of Diode, Tunnel Diode.
3. To understand the principle of operation and characteristics of Bipolar Junction Transistor, photo transistor, transistor biasing and thermal stabilization.
4. To understand the BJT operation as an amplifier, characteristics of JFET and MOSFET.
5. To analyze the frequency response of transistor amplifier circuits.

COURSE OUTCOMES:
After completion of the course, the students are able to:
1. Describe the basics of semiconductor devices.
2. Illustrate the principle of operation, characteristics and applications of Diode, Tunnel diode.
3. Interpret the principle of operation and characteristics of Bipolar Junction Transistor, photo transistor, transistor biasing and thermal stabilization.
4. Design various Equipment which are used in the construction and operation of electronic devices.
5. Analyze the frequency response of transistor amplifier circuits.

COURSE CONTENT:

UNIT – I **[Text book -1]** **[15]**

PN JUNCTION: Basic Structure of the PN Junction, Zero applied Bias, Forward and Reverse applied Bias, PN Junction Current, Generation-Recombination Currents, Junction Break Down, Zener diode as voltage regulator, Capacitances of The Diode. Tunnel Diode.

Applications: NON-LINEAR WAVE SHAPING: Clipping circuits with diodes, clipping at two independent levels, transfer characteristics of clippers, multi-diode circuits, clamping circuits. RECTIFIERS: Half wave Rectifier and Full wave Rectifier with and without Capacitor filter only.

UNIT-II **[Text book -1]** **[15]**

BIPOLAR TRANSISTOR: Transistor Action, Hybrid-Pi Equivalent Circuit, Characteristics of BJT in Common Emitter, Common Base and Common Collector modes, Photo Transistor with applications.

TRANSISTOR BIASING: The Operating Point, Bias Stability, Biasing Techniques, Stabilization against variations in I_{CO} , V_{BE} and β , Thermal Runaway.

UNIT –III **[Text book -1]** **[15]**

BJT AMPLIFIERS: The Bipolar Linear Amplifiers, Common Emitter Amplifiers, Common Collector Amplifier, Common Base Amplifier and Multistage Amplifiers. [Theory only].

FIELD EFFECT TRANSISTOR: JFET: Construction, operation and Device Characteristics, MOSFET: E-MOSFET & D-MOSFET Construction, operation with Characteristics.

UNIT – IV **[Text book -1]** **[15]**

MOSFET AMPLIFIERS: DC Circuit Analysis, Common Source Amplifier, Common Drain Amplifier, Common Gate Amplifier and Multistage Amplifiers. [Theory only]

FREQUENCY RESPONSE: Amplifier Frequency Response, System Transfer Function, Transistor Amplifiers with Circuit Capacitors, Bipolar Transistor Frequency Response, FET Frequency Response, High Frequency Response of Transistor Circuits. [Theory only]

LEARNING RESOURCES:

TEXT BOOKS:

1. Donald A. Neamen, Micro electronics circuit analysis and design, 4th edition, TMH, 2010.
2. Jacob Millman and Christos C. Halkias, Integrated Electronics, TMH, 1972.

REFERENCE BOOKS:

1. Donald A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, TMH, 2007.
2. Ben G Streetman and Sanjay Banerjee, Solid State Electronic Devices, 5th Edition,2000
3. Varsha Agrawal Anil K. Maini , Electronic Devices and Circuits, Wiley (2009)

Web References:

1. https://nptel.ac.in/courses/117/102/117102061/
2. https://nptel.ac.in/courses/117/104/117104071/
3. https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/electronic-materials/14-semiconductors/

EE 214 – Digital Electronics
Semester III [Second Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:

1. To understand different types of number systems used in digital systems. Boolean functions simplification using Karnaugh map and theorems.
2. Combinational circuits design procedure and implementing them.
3. The operation and design methodology for sequential circuits.
4. To understand about different types of IC logic families & the programmable logic devices like ROM, PLA & PAL.

COURSE OUTCOMES:

After completion of the course, the students are able to:

1. Illustrate basic digital logic fundamentals such as numbering systems, Boolean functions minimization methods.
2. Describe the operation and design procedure of combinational circuits.
3. Comprehend the operation and design methodology for sequential circuits.
4. Explain different types of IC logic families & memory elements.

COURSE CONTENT:

UNIT – I **[Text books -1&2]** **[15]**

Number Systems & Codes: Decimal, Binary, Octal, Hexadecimal Number systems and their conversions, r's and (r-1)'s Complements, BCD codes, Excess-3 code, Gray code, Hamming code.
Boolean algebra: Boolean expressions and theorems, Logic gates, Universal gates, standard forms of logic expressions, simplification of Boolean functions using K maps (up to five variables).

UNIT-II **[Text books – 1&2]** **[15]**

Combinational Logic Circuits: General design procedure for Combinational logic circuits, Design and applications of Binary Adders and Subtractors, Comparators, Encoders, Decoders, Multiplexers and Demultiplexers, Design of BCD to 7 Segment Decoder, Parity Generator and Checker, BCD Adder / Subtractor, Carry look ahead adders.

UNIT –III **[Text books -1&3]** **[15]**

Sequential Elements: Latches & flipflops (SR, D, JK & T), Timing Considerations, Characteristic Table, Characteristic Equation, Excitation table, State table and State diagrams for SR, D, JK & T Flip-flops, Conversion from one type of Flip-flop to another.
Sequential Circuits: Shift Registers, Counters – synchronous & asynchronous.

UNIT – IV **[Text book -1]** **[15]**

IC Logic Families: Brief overview of Transistor as a switch, Logic gate characteristics – propagation delay, speed, noise margin, fan-out and power dissipation, Standard TTL and static CMOS gates.
Programmable Logic Devices: ROM, Programmable Logic Arrays (PLA), Programmable Array Logic (PAL).

LEARNING RESOURCES:

TEXT BOOKS:

1. M Morris Mano, Digital Logic and Computer Design, PHI/Pearson Education, 2003.
2. Fundamentals of Digital Circuits, A.Anand Kumar, 4th Edition, Pearson Education.

REFERENCE BOOKS:

1. Wakerly J.F., Digital Design: Principles and Practices, Pearson India, 4th Edition, 2008.
2. RP Jain, Modern Digital Electronics, 3rd Edition, TMH, 2003
3. Thomas L. Floyd - Digital Fundamentals, 10th Edition, Person Education, 2011.
4. Donald D. Givone - Digital Principles and Design, TMH, 2003.

Web References:

1. https://nptel.ac.in/courses/117103064/

2. https://nptel.ac.in/courses/117105080/3

EE 215 – DC Machines
Semester III [Second Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:
1. To provide students with strong foundation on the classification, construction, performance, testing and applications of D.C generators and Motors.
2. To enable the students to have a fair knowledge about construction, working principle, operation and applications of D.C generators and Motors.

COURSE OUTCOMES:
After completion of the course, the students are able to:
1. Illustrate the details of magnetic circuits and their applications, properties of magnetic materials and electro mechanical energy conversion
2. Describe the working principle, construction, types of D.C generators, armature reaction and commutation.
3. Develop the characteristics of D.C generators and illustrate their applications. Illustrate the principle of D.C motors and torque equations.
4. Examine the characteristics of D.C motors and their applications, Illustrate the methods of speed control of D.C motors and necessity of starters.
5. Develop procedures for testing of D.C motors and calculate efficiency.

COURSE CONTENT:

UNIT – I **[Text book -2]** **[15]**

Magnetic Circuits: Introduction – simple magnetic circuit - magnetic circuits with air gap - Air-gap fringing fields- Magnetic equivalent circuit - properties of magnetic materials -Hysteresis and eddy current losses - permanent magnetic materials. **Electro Mechanical Energy Conversions:** Energy in Magnetic system -field energy and mechanical force - mechanical energy. Torques in systems with permanent magnets.

UNIT – II **[Text book -1, Text book -2,Reference book-1]** **[15]**

D.C. Machines: Constructional features - Types of Windings - Lap and Wave, Principle operation of DC Generators. Emf Equation, types of DC generators, Commutation, Armature reaction, interpolar and compensating windings. Losses and efficiency of generator, No load and load characteristics of all types of DC generators and their applications, Parallel operation of D.C. Generators.

UNIT-III **[Text book -1, Text book -2,Reference book-1]** **[15]**

D.C. MOTORS: Principle of DC Motor, concept of back emf, torque equation, power stages of DC Motor, Characteristics of DC motors (series, shunt and compound), Applications. Speed control of DC shunt motor – Armature voltage control, Field flux Control. Ward-Leonard control (Voltage control), Various methods of Speed Control of DC Series Motor.

UNIT - IV **[Text book -1, Text book -2,Reference book-1]** **[15]**

Starters of D.C motors: Necessity of a starter in a D.C motor, various starting techniques for DC motors: Three-point starter, four-point starter. Losses, efficiency of D.C motor and testing of DC Machines - Brake test, Swinburne's Test, Hopkinson's Test, Retardation Test, Field Test . Principle of operation of Amplidyne and Metadyne.

LEARNING RESOURCES:

TEXT BOOKS:
1. P.S. Bhimbra - Electric Machinery, 7th edition, Khanna Publications, 1973
2. I.J. Nagrath& D.P. Kothari "Electric Machines", 4th edition, Tata McGraw - Hill Publishers, 2019

REFERENCE BOOKS:
1. J. B. Gupta - Theory & performance of Electric Machines, S.K. Kataria&Sons, 2013

2. Irving L. Kosow - Electric Machinery & Transformers, Pearson, 2nd edition, 2007
3. Clayton &Hancock - Performance and Design of D.C Machines, CBS publishers, 2004
4. S. Kamakshaiah - Electro mechanics - I (D.C. Machines), Right Publishers, 1st edition, 2005
5. A.E. Fritzgerald, C. Kingsley & S. Umans –Electric Machinary, McGraw-Hill Companies, 6th editon 2017.
6. Samarjit Ghosh - Electrical Machines, Pearson 2nd edition, 2012

Web References:

1. www.nptel.iitm.ac.in/courses/IIT-MADRAS/Electrical_Machines.../2_1.pdf
2. www.gtbit.org/downloads/emecsem3/emecsem3n4qbank.pdf
3. www.freevideolectures.com
4. www.swe.siemens.com/spain/web/.../Catalogo%20motores%20cc.pdf
5. www.einsteincollege.ac.in/Assets/.../electrical%20engg%20notes.pdf

EE 251 – DC Machines Lab
Semester III [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:
1. To conduct experiments on theory taught in electrical machines.
2. To conduct experiments on DC machines (Generator, motor).
3. To introduce PSPICE as simulation tool for circuits.
4. To conduct nodal analysis, superposition theorem using PSPICE.

COURSE OUTCOMES:
After completion of the course, the students are able to:
1. Predetermine performance of DC machine.
2. Determine performance of DC machines by direct tests.
3. Develop programs for circuit analysis using PSPICE.

LIST OF EXPERIMENTS:

1. Determination of Z, Y parameters of a given two port network
2. Open circuit characteristics of separately excited / self-excited D.C shunt generator
3. Load test on D.C Shunt Generator
4. Load test on D.C Compound Generator
5. Load test on D.C series generator
6. Swinburne's Test
7. Speed control of DC shunt motor
8. Brake test on D.C Shunt Motor
9. Hopkinson's test on D.C Machines
10. Retardation test on D.C. Machine
11. Simulation of RLC circuits i) Steady state analysis ii) Transient analysis
12. Simulation of Thevenin,s and Norton's theorems
13. Simulation of Maximum power transfer theorem and superposition theorem
14. Simulation of Load test on D.C Shunt Generator
15. Simulation of Speed control of DC shunt motor.
16. Field test on D.C series machines.

LEARNING RESOURCES:

TEXT BOOKS:
1. P.S. Bhimbra, 'Electric Machinery' Khanna Publications, 7thedition.
2. I.J. Nagrath& D.P. Kothari 'Electric Machines ', Tata McGraw - Hill Publishers.

WEB REFERENCES:
1. www.gtbit.org/downloads/emecsem3/emecsem3lmannual.pdf
2. www.centennialcollege.ca/Programs/Documents/.../ECME-123.pdf
3. www.iitk.ac.in/ee/labs/CSL/support_files/EE380_labmanual.pdf
4. www.bcit.ca/study/courses/elex7240

EE 252 – Electronic devices & Digital Electronics lab
Semester III [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To plot the characteristics of basic electronic devices like p-n junction diode, zener diode, BJT characteristics in various configurations, JFET, UJT.
2. To design and verify the self bias circuit.
3. To design Combinational logic circuits such as adders, subtractors, decoders, code converters, multiplexers.
4. To design Sequential logic circuits such as flip-flops, shift registers, synchronous and asynchronous counters.

COURSE OUTCOMES:

Upon successful completion of the practical, the student will be able to:

1. Obtain the characteristics of devices like p-n Junction diode, zener diode, BJT in CE, CB configurations, JFET, UJT, Design the self bias circuit.
2. Design the Zener voltage regulator to meet the specifications.
3. Design Combinational logic circuits such as adders, subtractors, Code converters, decoders, multiplexers.
4. Design Sequential logic circuits such as flip-flops, shift registers, synchronous and asynchronous counters.

LIST OF EXPERIMENTS:

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT and DIP), Bread Boards and Printed Circuit Boards (PCBs);
2. Identification, Specifications, Testing of Active Devices – Diodes, BJTs, JFETs, MOSFETs, Power Transistors, SCRs and LEDs;
3. Study and Operation of Digital Multi Meter, Function / Signal Generator, Regulated Power Supply (RPS), Cathode Ray Oscilloscopes; Amplitude, Phase and Frequency of Sinusoidal Signals using Lissajous Patterns on CRO; CRO
4. Study the characteristics of PN Junction and Zener diode.
5. Study the characteristics of Transistor in Common Emitter configuration.
6. Study the characteristics of Transistor in Common Base configuration.
7. Verification of Transistor Self Bias Circuit.
8. Study the Characteristics of Junction Field Effect Transistor.
9. Study the Characteristics of Uni junction Transistor.
10. Study of Half wave rectifier with and without filters.
11. Study of Full wave rectifier with and without filters.
12. Realization of Gates using Discrete Components.
13. Realization of Gates using Universal Building Block (NAND only).
14. Design of Combinational Logic Circuits like Half-adder, Half-subtractor, Full-adder and Full-subtractor.
15. Design of Code converters (Binary to Gray).
16. Design of Multiplexers & Decoders.
17. Verification of Truth Tables of Flip Flops using Gates.
18. Design of Shift Register, Ring Counter and Johnson Counter using Flip Flops.
19. Design of Asynchronous counter- Mod counter, Up counter, Down counter and Up/Down counter using Flip Flops.
20. Design of Synchronous Counter- Mod Counter, Up counter, Down counter and Up/Down counter using Flip Flops.
21. Design of Sequence Generators using shift Registers and Multiplexers.

EE 253 – Electrical & Electronics Circuits Simulation lab
Semester III [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:
1. To Learn about the OrCAD PSpice Spice circuit simulator application
2. To Learn about the Matlab/Simulink graphical programming environment.
3. To create Basic Electrical & Electronic Circuit using PSpice.
4. To create Basic Electrical & Electronic Circuit using Matlab/Simulink.

COURSE OUTCOMES:
Upon successful completion of this practical course, the student will be able to:
1. Implement Basic Electrical & Electronic Circuits by simulation using PSpice.
2. Implement Basic Electrical & Electronic Circuits by simulation using Matlab/Simulink.

LIST OF EXPERIMENTS:
1. Simulation of nodal analysis for DC circuits.
2. Simulation of DC Circuit for determining Thevenin's equivalent.
3. Simulation of transient and parametric analysis of series RLC circuits using sine input.
4. Simulation of maximum power transfer theorem for dc circuits.
5. Simulation of reciprocity theorem for dc circuits.
6. Simulation of superposition theorem for dc circuits.
7. Simulation of ac circuits.
8. Simulate and study V-I characteristics of a Diode using PSPICE.
9. Simulate and study V-I characteristics of a Zener Diode using PSPICE.
10. Simulate and study V-I characteristics of a Zener Diode as Voltage Regulator using PSPICE.
11. Simulate and study Half-wave and Full-wave Rectifier using PSPICE.
12. Simulate and study Diode Clipper and Clamper circuit using PSPICE.
13. Simulate and study Input and Output characteristics of a NPN-BJT using PSPICE.
14. Simulate and study Input and Output characteristics of a PNP-BJT using PSPICE.
15. Simulate and study Input and Output characteristics of a J-FET using PSPICE.
16. Simulate and study transient & frequency response of a BJT amplifier in common-emitter configuration using PSPICE.
17. Simulate and study transient & frequency response CS Amplifier using PSPICE.
18. Simulation of single phase Half-wave and Full-wave Rectifier without filter for R & RL load using Matlab/Simulink.
19. Simulation of single phase Half-wave and Full-wave Rectifier with Capacitive filter for R & RL load using Matlab/Simulink.

LEARNING RESOURCES:
REFERENCE BOOKS:

1. Basic Electrical Engineering- By M.S.Naidu and S. Kamakshiah – TMH.
2. Basic Electrical Engineering –By T.K.Nagasarkar and M.S. Sukhija, Oxford.
3. Introduction to PSpice Using OrCAD for Circuits and Electronics", M. H. Rashid, 3rd Edition Pearson/Prentice Hall, 2004.
4. Nassir H. Sabah "Electronics: Basic, Analog, and Digital with PSpice", 2010 by CRC Press
5. John Okyere Attia "PSPICE and MATLAB for Electronics: An Integrated Approach", CRC Press, 2002.

EESL1 – Skill Oriented Course – I
Semester III [Second Year]

L	T	P	C	Int	Ext
1	0	2	2	100	0

APSSDC Skill oriented course

EE 221 – Data Structures using C++
Semester IV [Second Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:
The objectives of the course are, to make the students understand:

1. Object Oriented Programming features of C++.
2. Concepts of encapsulation, inheritance, and polymorphism.
3. Concepts of Lists, Stacks and Queues.
4. Binary trees and sorting techniques.

COURSE OUTCOMES:
After successful completion of the course, the students will be able to:

1. Develop programs using object oriented features of C++.
2. Make use of the concepts encapsulation, inheritance, and polymorphism.
3. Apply operations on linear and non-linear data structures.
4. Implement sorting techniques.

UNIT I *Text Book - 1* **(12)**

An Overview of C++ : The Origins of C++, What is Object Oriented Programming, some C++fundamentals, Old-Style *Vs* Modern C++, Introducing C++ Classes, Function Overloading, Operator Overloading, Inheritance, Constructors and Destructors, The C++ Keywords, The General Form of a C++ Program.

Classes and Objects: Classes, Structures and Classes, Unions and Classes are Related, Friend Functions, Friend Classes, Inline Functions, Parameterized Constructors, Static Class Members, When Constructors and Destructors are Executed, Scope Resolution Operator, Nested Classes, Local Classes, Passing and Returning Objects, Object Assignment.

Arrays, Pointers, References and the Dynamic Allocation: Arrays of Objects, Pointers, References, Dynamic Allocation Operators, the Placement Forms of new and delete.

UNIT II *Text Book - 1* **(12)**

Function Overloading, Copy Constructors and Default Arguments : Function Overloading, Overloading Constructor Functions, Copy Constructors, Finding the Address of an Overloaded Function, Overload Anachronism, Default Arguments, Function Overloading and Ambiguity.

Operator Overloading: Creating Member Operator Function, Overloading Using a Friend Function, Overloading new delete, Overloading Special Operators & Comma Operator.
Inheritance: Base-Class Access Control, Inheritance and protected members, Inheriting Multiple Base Classes, Constructors, Destructors and Inheritance, Granting Access, Virtual Base Classes.

UNIT III *Text Book - 2* **(12)**

LINKED LISTS: Abstract Data Types, The List ADT, Linked Lists, Doubly Linked Lists, Circular Linked lists.

THE STACK and QUEUE ADT: Stack Model, Implementation of Stacks and Queues.

UNIT IV *Text Book - 2* **(12)**

TREES: Preliminaries, Binary Trees, Binary Tree Traversals, Binary Search Tree.
SORTING: Shell sort, Merge sort, Quick sort, Heap sort.

Learning Resources:
Text Book(S):

1. The Complete Reference - C++ by Herbert Schieldt, 4/e, Tata McGraw Hill (UNIT I & II)

2. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4/e , Pearson (UNIT III & IV)

Reference Book(S):

1. Object Oriented Programming with C++, E. Balaguruswamy, 4/e, Tata McGraw Hill.
2. An Introduction to Data Structures with Applications, Trembley and Sorenson, 2/e, Tata McGraw Hill, 2001.

Web Resources:

http://nptel.iitm.ac.in/courses/

EE 222 – Generation & Transmission of electrical Power
Semester IV [Second Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:

1. To make the student to understand various types of electrical power generation in detail.
2. To discuss various factors associated with power plants, power plant economics & Tariff structure.
3. To calculate transmission line parameters.
4. To introduce various types of insulators and their testing.

COURSE OUTCOMES:

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

1. Articulate various economical aspects while selecting a particular type of power station.
2. Illustrate different types of power stations with their components
3. Distinguish between types of conductors used for electrical system and assess the performance of transmission lines.
4. a) Classify, test and calculate string efficiency of insulators.
   b) Describe the travelling wave phenomenon.

COURSE CONTENT:

UNIT – I [TEXT BOOK-1] [15]

Choice of power stations and units: Types of power stations - choice of generation - size of generator units - load duration curve - effect of variable load on plant operation and design.

Economical Aspects: Economics of generation - factors affecting cost of generation - Definitions: load factor - diversity factor - plant use factor - reduction of cost by inter connected stations. Power factor considerations - causes of low power factor - methods of improving power factor - phase advancing and generation of reactive KVAR - most economical power factor for constant KW load and constant KVA type loads.

Tariff : Characteristics of Tariff - types of Tariff.

Thermal power stations : Selection of site for thermal station - layout and salient features - boilers - economizers - condensers - coal handling-feed water treatment - steam turbines - turbo generators.

UNIT – II [TEXT BOOK-1] [15]

Hydroelectric Stations: Hydrology - hydrographs - mass curves – classification of hydroelectric plants - general arrangement and operation of hydroelectric plants and its function.

Nuclear Power Stations: Principles of nuclear power station - basic factors in designing of reactors - pressurized water reactor – boiling water reactor - CANDU reactor - liquid metal cooled reactor - shielding and safety precautions.

Gas Turbine Plants: Layout of gas turbine plant - principle of operation-open cycle and closed cycle plants. Improvement of thermal efficiency of gas plant.

Combined cycle Plants: Introduction - stag combined cycle plant - combined cycle with nuclear gas turbine and fossil fuel fired steam turbine.

UNIT – III ([TEXT BOOK-1] [15]

Transmission line parameters: Expressions for inductance and capacitance of single phase and 3- phase lines of symmetrical and transposed configurations.

Concept of self GMD (GMR) and mutual GMD - double circuit lines and bundled conductors - effect of ground on capacitance - line charging KVAR calculations, inductive interference.

Transmission line theory: Short, medium and long lines – regulation and efficiency - π, T and rigorous methods of solution - ABCD constants. Surge impedance loading - Ferranti effect.

UNIT – IV [TEXT BOOK-2] [15]

Insulators: Types of insulators - voltage distribution in a string of suspension insulators, Failure of insulator and testing.

Travelling wave Phenomenon: Travelling waves on transmission lines, attenuation of travelling waves. Protection against travelling waves: Rod gaps - sphere gaps – different types of arrestors and surge absorbers.

LEARNING RESOURCES:

TEXT BOOKS:

1. J.B. Gupta , "A course in Power Systems", 11th Edition, S.K. Kataria & Sons Publications, 2013.

2. S.N. Singh, "Electric Power Generation, Transmission & Distribution", PHI,2003.

REFERENCE BOOKS:

1. C.L. Wadhwa, "Electrical power systems", New Age Intl. (P) Limited 3rdEdition.
2. D.P. Kothari & I.J. Nagrath, "Modern power system analysis", TMH, 3rd edition, 2003.

WEB RESOURCES:

1. https://www.electrical4u.com/materials-used-for-transmission-line-conductor/
2. https://www.electricaleasy.com/2016/03/basics-of-electrical-power-transmission.html
3. https://en.wikipedia.org/wiki/Electricity_generation
4. https://jntua.ac.in/gate-online classes/registration/downloads/material/a159185656721.pdf

EE 223 – Electromagnetic field theory
Semester IV [Second Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:

1. To develop an understanding of electromagnetic field fundamentals by emphasizing both mathematical, analytical rigor and physical conceptual reasoning.
2. Provide an ability to analyze engineering systems based on electrostatic fields, steady electric currents.
3 Develop an ability to analyze magneto static fields.
4. To analyze time varying electric & magnetic fields also develop a solid grasp about Maxwell's equations in different forms and media.

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

1. Illustrate the concepts of fields.
2. Solve electrostatic field problems.
3. Solve various magneto static field problems.
4. Demonstrate time varying electric, magnetic fields and the concepts of Maxwell's equations.

COURSE CONTENT:

UNIT – I **[TEXT BOOK 1 &2] [15]**

Electrostatics –I:

Coordinate systems: Cartesian, cylindrical, spherical co-ordinates, Experimental law of coulomb, Electric field intensity, Field due to a continuous volume charge distribution, Field due to a line charge, sheet of charge.Electric flux density, Gauss's law, Applications of Gauss law, Maxwell's First equation (Electrostatics), Energy expended in moving a point charge in an electric field.

UNIT – II **[TEXT BOOK 1 &2] [15]**

Electrostatics – II:

Definition of potential and potential difference. The potential field of a point charge, system of charges, potential gradient, the dipole and Energy density in electrostatic field. Current and current density, continuity of current, conductor properties and boundary conditions. The nature of dielectric materials, boundary conditions for perfect dielectric materials. Capacitance, Several capacitance examples, Derivations of Poisson's and Laplace's equations, Examples of the solution of Laplace's equation.

UNIT – III **[TEXT BOOK 1 &2] [15]**

Magneto statics:

Biot-Savart's Law, Ampere's Circuital Law, Magnetic Flux and Magnetic Flux Density, scalar and vector magnetic potentials. Magnetic Forces: Force on a moving charge- Lorentz force equation, Force on a differential current element, Force between differential current elements, Force and torque on a closed circuit. Inductors and inductances: Inductor, Self Inductance, mutual inductance, energy stored and energy density in a magnetic field, Magnetic boundary conditions.

UNIT – IV **[TEXT BOOK 1 &2] [15]**

Time Varying Fields and Maxwell's Equations: Faraday's law, Displacement current, Maxwell's equations in point form, integral form. The Uniform Plane Wave: Wave propagation in free space, dielectrics and good conductors: skin effect, Poynting theorem and wave power.

LEARNING RESOURCES:

TEXT BOOKS:

1. W H Hayt, J A Buck 'Engineering Electromagnetics', 8th Edition TMH, 2012.
2. Mathew NO Sadiku, 'Elements of Electromagnetics', 6th Edition Oxford University Press, 2014.

REFERENCE BOOKS:

1. Joseph A Edminister, 'Theory and Problems of Electromagnetics', 4th Edition, Schaum's Outline Series, Mc-Graw Hill International, 2014
2. EC Jordan and KG Balmain, 'Electromagnetic Waves and Radiating Systems', 2nd Edition PHI2003.

WEB RESOURCES:

1. *http://nptel.ac.in/courses/108106073/*
2. *http://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/*
3. *http://freevideolectures.com/Course/2340/Electromagnetic-Fields#*

EE 224 – Electronic circuits analysis
Semester IV [Second Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:
1. To know the responses of RC low-pass and high-pass circuits for standard inputs
2. To know the working of multivibrators using BJTs
3. To introduce feedback concepts and discuss advantages of using feedback in electronic circuits
4. To analyze the four ideal feedback circuit configurations
5. To describe the concept of power amplifier and characteristics of power transistors
6. To determine maximum power efficiency of several circuit configurations of class-A and class-AB power amplifiers
7. To analyze and design oscillators that provides sinusoidal signals at specified frequencies.
8. To derive expressions for errors that define the goodness of the sweep circuit and to study various sweep circuits

COURSE OUTCOMES:
After successful completion of the course, the students are able to
1. a) Sketch the responses of RC high-pass and low-pass circuits for various applications
   b) Describe the working of multivibrators using BJTs
2. Determine circuit characteristics of feed back amplifiers
3. Design class-A and class-AB power amplifiers
4. a) Describe the functioning of oscillators that provide sinusoidal signals at specified frequencies.
b) Illustrate the operational characteristics of voltage sweep generators.

COURSE CONTENT:
UNIT I **[Text Books-1, 2] [16]**

LINEAR WAVE SHAPING: Responses of RC high-pass circuit and low-pass circuit to sinusoidal, step, pulse, square and ramp inputs, Criteria for good differentiation and integration

MULTIVIBRATORS (using BJTs): Bistable Multivibrator: fixed bias Bistable multivibrator, commutating capacitors, unsymmetric and symmetric triggering, Schmitt triggers, Methods to eliminate hysteresis, operation of collector coupled monostable and astable multivibrator.

UNIT II **[Text Book - 2] [10]**

FEEDBACK AMPLIFIERS: Introduction to feedback, basic feedback concepts, Ideal feedback topologies: Series-Shunt configuration, Shunt-Series configuration, Series-Series configuration, Shunt-Shunt configuration.

UNIT III **[Text Book - 2] [10]**

POWER AMPLIFIERS: Power Transistors, Classes of Amplifiers, Class-A Power Amplifiers, Class-AB Push-Pull Complementary Output Stages (diode biasing, using VBE multiplier)

UNIT IV **[Text Books-1, 2[16]**

OSCILLATORS(using BJT): Basic principles for oscillation, Phase Shift Oscillator, Wien-Bridge oscillator, Hartley Oscillator, Colpitts Oscillator, Crystal Oscillator.

VOLTAGE SWEEP GENERATORS: Introduction, exponential sweep generators: using UJT, using CB configuration, improving sweep linearity: Miller integrator sweep generator and Bootstrap sweep generator.

LEARNING RESOURCES:

TEXT BOOK(s):
1. Pulse and Digital Circuits by Venkata Rao.K, Rama Sudha.K, Manmadha Rao.G , Pearson, first edition.
2. Electronic Circuits: Analysis and Design by Donald A Neamen, Third Edition TMH.

REFERENCE BOOK(s):

1. Mothiki S. Prakash Rao, Pulse Digital & Switching Waveforms, 2nd Edition, TMH.
2. S. Salivahanan, N. Suresh Kumar, ELECTRONIC DEVICES & CIRCUITS, Tata McGraw-Hill Education, 2017.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108/102/108102095/
2. https://nptel.ac.in/courses/117/101/117101106/

EE 225 – AC Machines
Semester IV [Second Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:

1. To provide students with strong foundation on the classification, construction, performance, testing and applications of Transformers and Induction Motors.

2. To enable the students to have a fair knowledge about construction, working principle, operation and applications of Transformers and Induction Motors.

COURSE OUTCOMES:

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

1. Apply the concepts of constructional and operational features to determine efficiency, regulation and operational performance of transformers.
2. Illustrate the three phase transformers connections and parallel operation.
3. To sketch the operational characteristics and equivalent circuits of poly phase induction motors from their construction and operation.
4. To design starters, speed control mechanisms of induction motors and to describe the operation and applications of induction generators.
5. Evaluate the performance of 1-ph induction motors.

COURSE CONTENT:

UNIT - I **[Text Books – 1,2] [15]**

Transformers: Constructional features of transformers - EMF equation – no load and load phasor diagram - equivalent circuit of single phase transformers. Regulation - losses - efficiency and all day efficiency .Testing of transformers: OC & SC tests - Sumpner's test etc. Auto transformers.

UNIT - II **[Text Books – 1,2] [15]**

3-phase transformer windings and its connections. Open delta - Scott connected transformers - 3 phase to 2 phase conversion. Parallel operation of Single Phase Transformers and its load sharing. Tap changing in transformers, methods of cooling.

UNIT - III **[Text Books – 1,2] [15]**

Poly Phase Induction Motors: Rotating magnetic field in two phase & three phase systems - construction and operation of 3-phase induction motors. Torque equation and torque slip characteristics - equivalent circuit. Power losses – Efficiency, Testing of induction motors – No load and Blocked rotor Tests, Circle Diagrams.

UNIT –IV **[Text Books – 1,2] [15]**

Types of starters - Speed control of 3-Phase Induction motors- Voltages control, Supply Frequency Control(V/f), Rotor resistance control, Pole changing and Cascaded method. Crawling and Cogging - Double cage rotors - Induction generators and their applications.

Single Phase Induction Motors: Double field revolving theory – starting methods Split phase - capacitor start and run -shaded pole motors -characteristics and their applications. Equivalent Circuits of single phase induction motors.

LEARNING RESOURCES:

TEXT BOOKS:

1. Electric Machinery by P.S. Bhimbra, Khanna Publications 7th edition.
2. Electric Machines by I.J. Nagrath&D.P.Kothari,TataMcGraw Hill, 7th Edition.2005.

REFERENCE BOOKS:

1. Langsdorf "Theory of Alternating Current Machinery" Tata McGraw-HillCompanies,2nd edition.
2. P.C. Sen John "Principles of Electrical machines and power electronics" Wiley & Sons 2003. 3. Irving L. Kosow "Electrical Machinery & Transformers" PHI.
4. J.B.Gupta "Theory of performance of electrical machines", S.K.Khataria& Son's Publications.
5. M.G. Say "Performance & Design of AC Machines" BPB Publishers.
6. S.K.Battacharya "Electrical machines" TataMcGraw Hill, 3rd edition.
7. B.L.Theraja,A.K.Theraja "A Text book of Electrical technology Volume-II" S.Chand

WEB RESOURCES:

1. www.electrical4u.com/electrical-transformer/three-phase-transformer.php % reference for single phase & three transformers
2. www.hammondpowersolutions.com/products/locate_by_product/Autotransformers /index.php % reference for autotransformers
3. www.electrotechnik.net/2006/08/in-autotransformer-primary-and.html % for autotransformers 4. www.allaboutcircuits.com/vol_2/chpt_13/7.html % poly phase induction

EE 261 – Data Structures lab
Semester IV [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To comprehend Object Oriented Programing features of C++.
2. To develop programs with the concepts of encapsulation and compile time polymorphism.
3. To develop programs with concepts of inheritance, Runtime polymorphism and Templates.
4. To develop programs with concepts of Lists, Stacks and Queue ADT's.
5. To develop programs with Binary trees and ADT's of BST and Various sorting techniques.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Implement basic Object Oriented features of C++.
2. Implement the concepts of encapsulation and compile time polymorphism.
3. Implement the concepts of Inheritance, Runtime polymorphism and Templates.
4. Implement Lists, Stacks and Queue ADTs.
5. Implement BST ADT and different sorting algorithms.

List of Experiments:

1. Create a class HUGEINT by which we would be able to use much wider range of integers. Perform addition operation on two HUGEINTs.
2. Create a class TIME with appropriate data members to represent TIME. Construct a class implementation section to compare two TIMEs, to increment TIME by one second, to decrement TIME by one second and appropriate constructors to create TIME objects.
3. Write a class declaration for DATE and allow the operations to find nextday(), previousday(), leapyear(), compare() with appropriate constructors and destructors.
4. Create a user defined datatype STRING, allow possible operations by overloading (Relational operators, [], ( ), >, =).
5. Define RATIONAL class. Allow possible operations on RATIONALs by overloading operators (Arithmetic, Unary operators,>).
6. Program to implement (a) Single inheritance (b) Multiple inheritance (c) Hierarchical inheritance (d) Multipath inheritance.
7. Program to implement (a) runtime polymorphism (b) abstract base class concept.
8. Program to implement operations on single linked list.
9. Program to implement operations on doubly linked list.
10. Program to implement stack operations using arrays (with class templates) and linked lists.
11. Program to implement Queue operations using arrays and linked list.
12. Program to sort n elements using

a) Merge Sort (with function templates).b) Quick Sort. c) Heap Sort.

13. Program to demonstrate BST ADT.

Note: A minimum of 10(Ten) experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Practical Examination

Learning Resources:

1. E Balaguruswamy, Object Oriented Programming with C++
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++

EE 262 – AC Machines Lab
Semester IV [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

Course Objectives:

The main objectives of this lab course are
1. To design experimental setup for calculating two port network parameters.
2. To design experiments to study the performance and operation of transformers.
3. To develop experimental setups for studying the performance and operation of squirrel cage and slip ring induction motors.
4. To perform Direct and Indirect tests.
5. To separate the losses of an Induction motor.

Course learning outcomes:

Upon successful completion of the course, the student will be able to:
1. Design experiments for testing of transformers.
2. Operate the transformers in parallel.
3. Provide supply in industries when 2-phase is required like furnaces by using Scott connection.
4. Analyze the performance characteristics of Induction motors.
5. Draw the equivalent circuits of the transformers and Induction motors.
6. Asses the performance of the given transformers and Induction motors.

List of Experiments:

1. OC & SC tests on single - phase transformer
3. Load test on single - phase transformer
4. Sumpner‟s test on Transformers
5. Scott Connection of Transformers
6. Parallel Operation of Two Single - Phase Transformers
7. Load test on 3 - phase squirrel cage induction motor
8. Load test on 3 - phase slip ring induction motor
9. No load and Blocked rotor test on 3 - phase induction motor
10. Brake test on single - phase induction motor
11. Determination of Equivalent Circuit of Single - Phase Induction Motor
13. Harmonic analysis of transformer
14. Separation of losses of 3-phase Induction motor
15. Simulation of Parallel Operation of Two Single - Phase Transformers
16. Simulation of Load test on 3 - phase squirrel cage induction motor
17. Simulation of Load test on 3- phase Transformer
18. Simulation of Speed control of 3–phase Induction Motor

LERARNING RESOURCES:

1. P.S. Bhimbra, „Electric Machinery‟ Khanna Publications, 7th edition.
2. I.J. Nagrath & D.P. Kothari ‟Electric Machines „, Tata McGraw - Hill Publishers.

WEB REFERENCES:

1. www.gtbit.org/downloads/emecsem3/emecsem3lmannual.pdf
2. www.centennialcollege.ca/Programs/Documents/.../ECME-123.pdf
3. www.iitk.ac.in/ee/labs/CSL/support_files/EE380_labmanual.pdf
4. www.bcit.ca/study/courses/elex7240

EE 263 – Pulse & Digital circuits lab
Semester IV [Second Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To provide the practical knowledge on the applications of Linear and Non-linear components such as LPF, HPF, Clippers, Clampers, Oscillator circuits, Multivibrators and Feedback amplifiers.
2. To study the Frequency response and determine the parameters of single-stage and two-stage amplifiers.
3. To analyse and Design the Power amplifier circuits
4. To furnish the applications and generation of pulse signals using IC 741 & OP-AMPS.

COURSE OUTCOMES:

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

1. Design the linear and Non-linear wave shaping circuits using active and passive components.
2. Analyse the frequency response and to determine the various parameters of the single-stage and two-stage amplifiers.
3. Design the power amplifiers, oscillators and feedback amplifiers.
4. Develop the schematics of sweep circuits
5. Design circuits for specific applications using OP-Amps.

LIST OF EXPERIMENTS:

1. Design of RC high pass and low pass circuits for square wave inputs.
2. Design the biased shunt clippers and clampers using diodes.
3. To study the frequency response of voltage-shunt amplifier without feedback and with feedback
4. To determine the parameters of Darlington Emitter Follower.
5. Design of RC phase shift oscillator using transistors.
6. Design of Colpitt's oscillator using transistors.
7. Design of Hartley oscillator using transistors.
8. Design of UJT relaxation oscillator.
9. Design of Astable Multivibrator and to study its response.
10. Design of Monostable Multivibrator and to study its response.
11. Design of Bistable multivibrator to study its response.
12. Design of Schmitt trigger using BJT.
13. Transformer-coupled Push-Pull Class B amplifier
14. Complementary symmetry Push-Pull Class B amplifier.
15. Transistor as a switch
16. The output-voltage waveform of Boot strap sweep circuit
17. The output voltage waveform of Miller sweep circuit
18. Pulse Synchronization of An Astable circuit

List of Experiments beyond the Curriculum

19. To study the Performance analysis of a series voltage regulator using IC 723.

20. Linear applications of OP-AMP (i) Inverting Amplifier (ii) Non-inverting amplifier (iii) Summer (iv) Voltage-Follower (v) Integrator and Differentiator.

21. Generation of Square and Triangular Waves using OP-AMP (LM 741).

22. Design the biased shunt clippers and clampers using OP-AMPS.

LEARNING RESOURCES:

REFERENCE BOOKS:

1. J.Millman, C.C.Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2nd Ed., 1991.
2. Anil K.Maini, Varsha Agarwal, "Electronic Devices and Circuits",1st Edition, Wiley Publishers,2009.
3. Robert L.Boylested and Louis Nashelsky, "Electronic Devices and Circuit Theory",8th Edition, PHI, 2003.

EESL2 – Skill Oriented Course - II
Semester IV [Second Year]

Electronics Design Lab

L	T	P	C	Int	Ext
1	0	2	2	100	0

Course Objectives:

1. To Collect the knowledge of architecture of ARM 7 processor.
2. To Learn to program, verify, analyze and troubleshoot arm C language programs.
3. To Understand the arduino for different applications.
4. To Learn to interface ARM 7 processor & arduino with supporting hardware.

Course Outcomes:

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

1. Write programs in ARM for a specific Application.
2. Interface and write programs related to memory operations.
3. Write programs for interfacing the display, motor and sensor.
4. Learn arduino programming through examples.

LIST OF EXPERIMENTS

I) ARM Experiments

1. Study of ARM evaluation system.
2. Write a program to toggle all the led to port and with some time delay.
3. Write a program to interface LCD.
4. Write a program to interface Stepper motor.
5. Write a program for interfacing of DC motor.
6. Write a program to study and characteristics of the programmable gain amplifier (PGA).
7. Write a Program realization of low pass, high pass and band pass filters and their characteristics.
8. Write a program to verify Timer operation in different modes.
9. Write a program for digital function implementation using digital blocks.
   A. Counter for blinking LED
   B. PWM
   C. Digital buffer and digital inverter

II) Arduino Experiments

1. Study of ardunio components and IDE.
2. Isolated gate MOSFET driver based DC motor and solenoid driver arduino nano shiled.
3. Multi sensor shield for arduino nano with light, magnetic field & temperature sensor.
4. Serial plotter using arduino.
5. Controlling the speed and direction of DC motor using ardunio.
6. Seven segment display using ardunio.
7. DC voltage , current and power measurement using ardunio.

III) Design & Fabrication of a working model using Arm/ Ardunio/ Any other processor

Text Books:

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.
2. Nigel Gardner, "The Microchip PIC in CCS C". Ccs Inc, 2nd Revision Edition, 2002.

Web References:

1. https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English
2. https://www.electronics-lab.com/projectcategory/projects/arduino/
3. https://www.exploreembedded.com/wiki/

EE 311 – Control Systems

Semester V [Third Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES

Main objectives of this course are

1. To provide sufficient theoretical and analytical background to understand the concepts of control systems and to learn the mathematical applications related to control systems
2. To develop skills for applying them in future on various engineering applications
3. To analyse and design of feedback control systems
4. To give an idea on state space analysis, modelling and analysis of linear control systems using state space representation

COURSE OUTCOMES

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

1. Illustrate the types of continuous linear control systems and to model the physical systems to determine transfer function.
2. Analyse the control system to obtain specifications and stability conditions in time domain approach.
3. Determine the conditions for stability by root locus and in frequency domain with Plots.
4. Demonstrate the concepts of controllers design and state variable analysis of LTI systems.

COURSE CONTENT

UNIT – I **[Text book-1] [13]**

Introduction: Basic concept of simple control system – open loop – closed loop control systems. Effect of feedback on overall gain – stability sensitivity and external noise.
Types of feedback control systems – Liner time invariant, time variant systems and nonlinear control systems

Mathematical models and Transfer functions of Physical systems: Differential equations – impulse response and transfer functions – translational and rotational mechanical systems. Transfer functions and open loop and closed loop systems. Block diagram representation of control systems – block diagram algebra – signal flow graph – Mason's gain formula
Components of control systems: DC servo motor – AC servo motor – synchro transmitter & receiver

UNIT – II **[Text book-1] [15]**

Time Response analysis: Standard test signals – step, ramp, parabolic and impulse response function – characteristic polynomial and characteristic equations of feedback systems – transient response of first order and second order systems to standard test signals.
Time domain specifications - steady state response – steady state error and error constants. Effect of adding poles and zeros on over shoot, rise time, band width – dominant poles of transfer functions.
Concepts of Stability: Absolute, relative, conditional, bounded input –bounded output, zero input stability, conditions for stability, Routh –Hurwitz criterion.

UNIT –III **[Text Book 1] [15]**

Root locus Technique: Introduction – construction of root loci
Stability in frequency domain: Introduction – correlation between time and frequency responses – polar plots – Bode plots – Nyquist stability criterion – Nyquist plots. Assessment of relative stability using Nyquist criterion – closed loop frequency response.

UNIT – IV [Text Book 1] [15]

Introduction to Compensation Techniques: P,PI,PID Techniques.

State variable analysis: Concepts of state, state variables and state models – Diagonalisation – solution of state equations – state models for LTI systems. Concepts of Controllability and Observability.

LEARNING RESOURCES:

TEXT BOOKS:

1. I.J.Nagrath & M Gopal, Control Systems Engineering, New Age International 5th edition, 2009.
2. B.C. Kuo & Farid Golnaraghi, Automatic control systems, Wiley India,8th edition.

REFERENCE BOOKS:

1. Schaum Series, Feedback and Control Systems, TMH, 3rd edition.
2. A.K.Jairath, Problems & Solutions of Control Systems, CBS Problems &Solutions Series, 6th Edition.
3. A. Anand Kumar, Control Systems, PHI, 2nd edition
4. K. Ogata, Modern Control Engineering, PHI, 5th edition, 2010
5. S. Hasan saeed, Automatic Control Systems, 6th Revised Edition, Katson Educational Series.

WEB REFERENCES:

1. users.ece.utexas.edu/~buckman/Svars1.pdf % Reference for state space analysis

2. http://techteach.no/publications/control_system_toolbox/ % Reference for Matlab control system tool

3. http://csd.newcastle.edu.au/simulations/roll_sim.html % Reference for design problem

4. www.dprg.org/tutorials/2003-10a/motorcontrol.pdf % Control system design for robo application

EE 312 – Synchronous & Special Electrical machines

Semester V [Third Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:

1. To provide students with strong foundation on the classification, construction, performance, testing and applications of synchronous Machines.

2. To enable the students to have a fair knowledge about construction, working principle, operation and applications of Special Machines.

COURSE LEARNING OUTCOMES:

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

1. Describe the Construction, Working principle and operating characteristics of three phase Synchronous Generator
2. Outline the specifications of synchronous generators and solve problems involving synchronous machines operating alone or in parallel.
3. Illustrate the Three phase synchronous Motor operation, Characteristics, Performance and Applications.
4. Describe the principle of operation, Construction and Applications of single phase ac series motor and Single Phase Synchronous Motors.
5. Outline the Construction, Operating principles and Applications of Stepper Motors, BLDC Motor, Switched Reluctance Motor and Liner Induction Motor

COURSE CONTENT:

UNIT - I **[Text Book- 1&3] [19]**

Synchronous Generators: Construction, Excitation Systems – DC Excitation, AC Excitation and Brushless Excitation, EMF-Equation with sinusoidal flux - winding factors - harmonics in generated voltage and their suppression - armature reaction - synchronous impedance – vector diagram - load characteristics - methods of determining regulation – direct load - EMF, MMF, ZPF and ASA.

UNIT - II **[Text Book- 1 &2] [15]**

Blondel two reaction method for salient pole machine - phasor diagram - slip test - regulation of salient pole machines - parallel operation - synchronizing with infinite bus bars - synchronizing power - effect of variation of excitation and mechanical input on parallel operation – load sharing - losses and efficiency.

UNIT - III **[Text Book- 1&2] [14]**

Synchronous Motor: Theory of operation - starting methods – phasor diagrams - variation of current and power factor with excitation – minimum and maximum power for a given excitation and power circles - V and inverted V curves - hunting and its prevention - synchronous condenser and its applications.

UNIT - IV **[Text Book- 2 & 3] [12]**

Single Phase Series (Universal) motors: Principle of operation and characteristic of AC series motors - Repulsion motors and its applications.

Single phase Synchronous motors: Basic concepts and principle of operation and applications of reluctance motor and hysteresis motor.

Stepper Motors: Construction, Principle of operation & Application of Variable Reluctance Stepper Motor - Permanent Magnet Stepper Motor.

Other Special Motors: Construction, Principle of operation & Application of BLDC Motor, Switched reluctance motor, Principle of Operation of Linear Induction Motor and its Applications.

LEARNING RESOURCES:

TEXT BOOKS:

1. Electric Machinery by P.S. Bhimbra, Khanna Publications 7th edition.
2. Electric Machines - by I.J. Nagrath& D.P. Kothari, Tata McGraw-Hill Publishers, 3rd Edition 2004.
3. Theory & Performance of Electrical Machines by J.B Gupta, S.K. Kataria & Sons; Reprint 2013 edition (2013).

REFERENCE BOOKS:

1. Alternating current Machines by A.F. Puchatein, T.C. Lloyd and A.G.Conarad Asia publishing house, 1962.
2. Theory of Alternating Current Machinery by Langsdorf, Tata McGraw-Hill, 2nd Edition.
3. Principles of Electrical machines and power electronics by P.C. Sen John Wiley & Sons 2003
4. Electric Machinery - by A.E. Fitzgerald, C.Kingsley and S.Umans, McGraw-Hill Companies, 6th edition, 2003.

WEB REFERENCES:

1. http://www.nptelvideos.com/electrical_engineering/
2. http://nptel.iitm.ac.in/
3. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Roorkee/Electrical%20Machines %202 %20%28Video%29.html
4. http://www.creativeworld9.com/2011/02/learn-electrical-machines-iiithrough.html

EE 313 – Microprocessors & Micro controllers

Semester V [Third Year]

L	T	P	C	Int	Ext
3	1	0	3	30	70

COURSE OBJECTIVES:

1. To understand the architecture of 8086 family, addressing modes, instruction description and assembler directives of 8086 microprocessors.
2. To develop the programming skills for applying them on various applications.
3. Learning Digital Interfacing, Analog interfacing with 8086.
4. Learning architecture, pin diagram, addressing modes of 8051, instruction set of 8051, counters and timers of 8051, interfacing with 8051.

LEARNING OUTCOMES:

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

1. Describe 8086 microprocessor addressing modes, registers and instruction sets.
2. Write and debug assembly language programs.
3. Develop the procedures for Digital and Analog interfacing with 8086.
4. Describe the architecture, addressing modes, instruction set, counters and interfacing with 8051 micro controller.

COURSE CONTENT:

UNIT - I [Text Book-1&2] [16]

Microprocessor: introduction to microcomputers and microprocessors, introduction and architecture of 8086 family, addressing modes, instruction description and assembler directives of 8086 microprocessors.

UNIT - II [Text Book-1&2] [15]

8086 programming and system connections: Program development steps, writing programs for use with an assembler, assembly language program development tools, writing and using procedures and assembler macros.

An example of minimum mode system, and maximum mode of 8086 operation. addressing memory and ports in microcomputer system. 8086 interrupts and interrupt responses.

UNIT - III [Text Book-1&2] [13]

Digital Interfacing: Programmable parallel ports, handshake IO, interface Microprocessor to keyboards. DAC principle of operation, specifications and different types of DACs and interfacing.

Analog Interfacing: A/D converter specifications, types, interfacing to different types of A/D converters.

Programmable devices: Introduction to Programmable peripheral devices 8254, 8259, 8251, DMA data transfer, RS232 communication standard.

UNIT - IV [Text Book-2&3] [16]

Introduction:-Introduction to microcontrollers, comparing microprocessors and microcontrollers, Architecture:- Architecture of 8051, pin configuration of 8051microcontroller, hardware input pins, output pins ports and external memory, counters and timers, serial data input and output and interrupts. Programming & interfacing 8051:- Addressing modes of 8051 microcontroller, Instruction set of 8051 microcontroller ,Simple programs using 8051 microcontroller.

LEARNING RESOURCES

TEXT BOOKS:

1. Duglus V. Hall, Microprocessor and Interfacing, Revised 2nd Edition, TMH,2006.
2. A.K.RAY Advanced Microprocessors and peripherals.
3. Kenneth J. Ayala, The 8051 Microcontroller Architecture Programming and Applications, 2nd Edition, Penram International Publishers (I), 1996.

REFERENCE BOOKS:

1. John Uffenbeck, The 80X86 Family, Design, Programming and Interfacing, 3rd Edition, Pearson Education, 2002.
2. Barry Bray, the intel microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium processors, architecture, programming, and interfacing, 6th Edition, PHI edition. Mohammed Ari Mazidi and Janci Gillispie, The 8051 Microcontroller and Embedded Systems, Pearson Education Asia, New Delhi, 2003.

WEB REFERENCES:

https://nptel.ac.in/content/storage2/courses/106108100/pdf/Teacher_Slides/mod1/M1L3.pdf

https://www.youtube.com/watch?v=K8q7kT6CvVE&list=PLuv3GM6-gsE01L9yDO0e5UhQapkCPGnY3&index=6

EE 351 – Synchronous & Special Electrical machines lab

Semester V [Third Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To develop experimental setups for studying the performance and operation of synchronous generators.
2. To develop experimental setups for studying the performance and operation of synchronous motors.
3. To develop experimental setups for studying the performance and operation of special machines.

COURSE LEARNING OUTCOMES:

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

1. Examine performance of alternators using various methods.
2. Analyse the performance of synchronous motors
3. Assess direct and quadrature axes reactance for a given synchronous machine
4. Inspect the parameters of special motors.

LIST OF EXPERIMENTS:

1. Load test on alternator – for UPF, Inductive and Capacitive loads
2. Regulation of alternator by synchronous impedance and MMF methods
3. Regulation of alternator by ZPF & ASA methods
4. Synchronization of alternator with infinite bus – P and Q control
5. Parallel operation of two synchronous machines
6. V and inverted V curves of synchronous motor
7. Synchronous motor performance with constant excitation
8. Separation of losses in single-Φ transformer by V/F method
9. Measurement of Xd and Xq of a three phase alternator by slip test
10. Load test on Universal motor
11. Measurement of Xd" and Xq" of a three phase alternator
12. Load test on 1-Φ synchronous reluctance motor
13. Power factor correction using synchronous motor
14. Load test on hysteresis motor
15. Load test on 1-Φ repulsion motor

TEXT BOOKS:

1. P.S. Bhimbra, 'Electric Machinery' Khanna Publications, 7th edition.
2. I.J. Nagrath& D.P. Kothari 'Electric Machines ', Tata McGraw - Hill Publishers.
3. Theory & Performance of Electrical Machines by J.B Gupta, S.K. Kataria & Sons; Reprint 2013 edition (2013).

Web References:

1. www.gtbit.org/downloads/emecsem3/emecsem3lmannual.pdf
2. www.centennialcollege.ca/Programs/Documents/.../ECME-123.pdf
3. www.iitk.ac.in/ee/labs/CSL/support_files/EE380_labmanual.pdf
4. www.bcit.ca/study/courses/elex7240

EE 352 – Control Systems lab

Semester V [Third Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To know the significance of P, PI, PID controllers used in design of control system.
2. To understand the operating characteristics of servo motors, position control system.
3. To check the frequency response of first and second order systems.
4. To find transfer function of DC Motor.

COURSE OUTCOMES:

Upon completion of the course the student will be able to

1. Design a linear control system to meet required specifications.
2. Check frequency responses of higher order systems in addition to first and second order.
3. Operate servo motors and synchro's used for various applications in industry.
4. Use control systems tool box in MATLAB.

LIST OF EXPERIMENTS:

1. Time response of second order systems.
2. Characteristics of synchros.
3. Effect of feedback on D.C servomotor.
4. Transfer function of D.C motor.
5. Effect of P, PD, PID controller on a second order system.
6. Simulation of transfer functions using operational amplifier.
7. Lag and lead compensation - Magnitude and phase plot.
8. Transfer function of D.C generator.
9. Temperature controller using PID.
10. Characteristics of magnetic amplifier.
11. Characteristics of A.C servo motor.
12. Stepper motor control.
13. D.C. position control.
14. P, PI, PD, PID control using Op-Amps.
15. Frequency response of first and second order systems.
16. To study PLC systems.

LEARNING RESOURCES:

REFERENCE BOOKS:

1. Control systems engineering by I.J. Nagrath & M. Gopal, New Age publisher, 5/E.
2. Control systems by A. Ananda Kumar, PHI.

WEB REFERENCES:

1. www.wikipedia.com
2. http://nptel.iitm.ac.in

EESL3 – Skill Oriented Course – III

[Microprocessors & Microcontrollers Lab]

Semester V [Third Year]

L	T	P	C	Int	Ext
1	0	2	2	100	0

COURSE OBJECTIVES:

1. To develop the microprocessor and microcontroller based programs for various applications.

COURSE OUTCOMES:

Upon completion of the course the student will be able to

1. Develop programs on the 8086 microprocessors and 8051 microcontroller.
2. Interface 8086 microprocessor and 8051 microcontroller for various simple applications

LIST OF EXPERIMENTS:

Experiments Based on ALP (8086)

1. Programs on Data Transfer Instructions.
2. Programs on Arithmetic and Logical Instructions.
3. Programs on Branch Instructions.
4. Programs on Subroutines.
5. Sorting of an Array.
6. Programs on Interrupts (Software and Hardware).
7. 8086 Programs using DOS and BIOS Interrupts.

Experiments Based on Interfacing with 8086 and Experiments Based on Microcontroller (8051)

8. DAC Interface-Waveform generations.
9. Stepper Motor Control.
10. Keyboard Interface / LCD Interface.
11. Data Transfer between two PCs using RS-232 C Serial Port
12. Programs on Data Transfer Instructions using 8051 Microcontroller.
13. Programs on Arithmetic and Logical Instructions using 8051 Microcontroller.
14. Applications with Microcontroller 8051.

EE 321 – Renewable energy resources

Semester VI [Third Year]

L	T	P	C	Int	Ext
2	1	0	2	30	70

COURSE OBJECTIVES:

1. To know the depletion rate of conventional energy resources and importance of renewable energy resources.
2. To know alternate viable energy sources to meet the energy requirements.
3. To discuss about solar energy, wind energy, tidal energy and geothermal energy as alternate resources.
4. To know how biogas is produced & digester for power generation.

COURSE OUTCOMES:

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

1. Illustrate the national scenario of energy production, consumption and storage systems.
2. Describe the basics of solar energy, collectors & generation of electricity from solar energy & photovoltaics.
3. Assess wind energy potential and explain the features of wind turbines and wind generators.
4. Outline the details of ocean energy, temperature differences & principles, extraction of energy from waves, Geothrmal and Biogas.

COURSE CONTENT:

UNIT – I **[Text Book- 1&2] (8)**

Principle of Renewable Energy: Comparison of renewable and conventional energy sources - Ultimate energy sources - natural energy currents on earth - primary supply to end use - Spaghetti & Pie diagrams - energy planning - energy efficiency and management.
Energy Storage Systems: Pumped Hydro- Compressed air storage-Energy storage by fly wheels- Electrical battery storage-Thermal sensible energy storage-Latent heat energy storage.

UNIT – II **[Text Book- 2, Ref Book- 1](12)**
Solar Energy: Extra terrestrial solar radiation - terrestrial solar radiation - solar thermal conversion- solar thermal central receiver systems, Solar pond, Distributed systems.
Photovoltaics: Photovoltaic energy conversion - solar cell- Construction- conversion efficiency & output-VI characteristics.

UNIT – III **[Text Book- 2] (12)**
Wind energy: Planetary and local winds - vertical axis and horizontal axis wind mills. **Principles of wind power:** maximum power – actual power - wind turbine operation - electrical generator.

UNIT – IV **[Ref Book- 1] (12)**
Energy from Oceans: Ocean temperature differences - principles of OTEC plant operations. **Wave energy:** devices for energy extraction - tides - simple single pool tidal system, two pool tidal system.
Geothermal Energy: Origin and types: Hydrothermal, Geo-pressurized & Petro thermal.
Bio fuels: Classification – direct combustion for heat and electricity generator - anaerobic digestion for biogas - biogas digester - power generation.

LEARNING RESOURCES
TEXT BOOKS:

1. John Twidell& Toney Weir "Renewable Energy Sources" E&F.N. Spon
2. EL-Wakil"Power Plant Technology" McGraw-Hill Publications.

REFERENCE BOOKS:

1. G.D.Rai"Non-Conventional Energy Sources"Khanna Publishers.
2. Abbasi&Abbasi"Renewable Energy Sources" Their impact on global warming and pollution by – PHI.

WEB RESOURCES:

1. https://justenergy.com/blog/7-types-renewable-energy-future-of-energy/
2. https://www.eia.gov/energyexplained/renewable-sources/
3. https://studentenergy.org/renewable-energy/

EE 322 – Power System Analysis

Semester VI [Third Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:

1. To provide students with sufficient theoretical and analytical background to understand the analysis of power system in steady state.
2. To make the student to learn the representation of PU system, symmetrical components, sequence networks fault analysis and stability assessment.
3. To develop skills for applying them in future on various engineering applications.

COURSE OUTCOMES:

After successful completion of the course, the students are able to:

1. Apply the concept of per unit system and develop bus admittance matrix.
2. Perform power flow analysis using iterative techniques.
3. Evaluate symmetrical and unsymmetrical faults in power system network.
4. Analyze stability phenomena in power system.

COURSE CONTENT:

Unit – I **[Text Book-1,2]** **(12)**

Single line diagram – Impedance and Reactance diagrams – Per Unit Quantities – changing the base – selection of base – per unit quantities in three phase systems – advantages of per unit representation.
Graph theory: Definitions – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y– bus matrix by singular transformation and direct inspection methods.

Unit – II **[Text Book-2]** **(8)**

Load Flow Studies: Necessity of load flow studies – Static load flow equations – Load flow solution using Gauss-Seidel Method – computation for load buses and computation for PV buses –acceleration factor – Newton-Raphson method for load flow solution (polar coordinates only)– Problems on 3–bus system only.

Unit – III **[Text Book-1]** **(12)**

Symmetrical Fault Analysis: 3–Phase short circuit currents and reactances of synchronous machine– Symmetrical fault analysis using thevenin's theorem – Short circuit MVA calculations.

Symmetrical Components and Networks: Introduction – symmetrical component transformation – power in terms of symmetrical components – sequence impedances of power system components –construction of sequence networks of a power system.

Unsymmetrical Fault Analysis: Single line to ground – Line to line – double line to ground faults on an unloaded alternator. Unsymmetrical faults on power systems.

Unit – IV **[Text Book-1]** **(10)**

Power System Stability Analysis: Elementary concepts of Steady state – Dynamic and Transient Stabilities – Steady State Stability Power Limit – Power Angle Equation & Power Angle Curve. Derivation of Swing Equation – Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.- Solution of Swing Equation: Point-by-Point Method. Methods to improve Stability.

LEARNING RESOURCES:

TEXT BOOKS:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Computer methods in Power System Analysis by Stagg, G.W. & El-Abiad TMH.

REFERENCE BOOKS:

1. Modern Power system Analysis – by I.J.Nagrath&D.P.Kothari: Tata Mc Graw–Hill Publishing Company, 2nd edition.
2. Power System Analysis by HadiSaadat – TMH Edition.

WEB REFERENCES:

http://freevideolectures.com/Course/2353/Power-Systems-Analysis

EE 323 – Power Electronics
Semester VI [Third Year]

L	T	P	C	Int	Ext
3	0	0	3	30	70

COURSE OBJECTIVES:
1. To provide sufficient knowledge about theoretical and analytical background to understand the concepts of various Power Electronics devices.
2. To provide sufficient knowledge about various power electronic converters.

COURSE OUTCOMES:
Upon successful completion of the course, the student will be able to:
1. Compare characteristics of switching devices
2. Evaluate the performance of rectifiers
3. Describe the operation of DC-AC Inverters and applications
4. Illustrate the operation of DC-DC converters with applications
5. Evaluate the operation of Cycloconverters and AC Voltage Controllers

COURSE CONTENT:

UNIT-I [Text Book- 1, 2] (12)

Power devices: SCR - Theory of operation of SCR - Two transistor model of SCR - Characteristics and ratings - SCR turn on and turn off methods - Firing circuits R, RC, UJT and Ramp comparator Firing circuits. Protection of SCR - Series and parallel operation of SCRs.

P-N-P-N devices: SCS, LASCR, DIAC, TRIAC, GTO characteristics.

UNIT-II [Text Book- 1] (12)

Single Phase Converters: Principles of phase controlled converter operation – single phase half wave converters - single phase half controlled converter and single phase fully controlled converters with R, RL types of loads. Effect of freewheeling Diode - single phase dual converter. Effect of source inductance.

Three Phase Converters: Three phase half wave converters and three phase full wave converters with R, RL loads - three phase dual converter. Effect of source inductance.

UNIT-III [Text Book- 1, 2] (12)

Single Phase Inverters: Principle of inverter operation - single phase half and full bridge inverters- Mc Murray Bedford half bridge inverters.

Three Phase Inverters and PWM Techniques: Three phase inverters (120,180 modes of operation), single phase PWM Techniques-single, multiple and sinusoidal PWM, three phase sinusoidal PWM. **AC Voltage Controllers:** Single phase AC voltage controllers –two SCR's in anti parallel – With R and RL loads. Derivation of RMS load voltage, current and power factor.

UNIT-IV [Text Book- 1, 2] (12)

Choppers: Principle of choppers - Time ratio control and Current limit control strategies, step up and step down choppers -different classes of chopper circuits (Principle of operation only). Applications of choppers. Steady state time domain analysis of type-A chopper. voltage commutated and current commutated chopper (Principle of operation only).

Cycloconverters: Principle and operation of single - phase mid-point and Bridge type cyclo converters with R and RL loads. Applications.

Learning Resources:
Text Books:

1. M.D. Singh and Khanchandani,' Power Electronics' TMH, 2nd Edition.
2. P.S. Bhimbra, 'Power Electronics' Khanna publications, 3rd Edition, 2006.

Reference Books:

1. M.H. Rashid,'Power Electronics, circuits, devices and applications' Pearson'3rd edition, 2005.
2. W.C. Launder, 'Power Electronics' McGraw-Hill 3rd edition,1993.
3. Vedam Subramanyam, 'Power Electronics', New Age International (P) Limited, 2ndedition 2006.

Web Resources:

1. www.powerelectronics.com; % reference for applications
2. www.mypptsearch.com/search-ppt/High%l % Reference for design problems
3. www.ieee.org/conferences_events/confe % for additional references on latest developments
4. http://nptel.ac.in/courses/108101038/ % NPTEL course for power electronics

EE 361 – Electrical Measurements & Instrumentation Lab

Semester VI [Third Year]

L	T	P	C	Int	Ext
1	0	4	3	30	70

COURSE OBJECTIVES:

1. To know the procedures for measuring Resistance, Inductance and Capacitance of different ranges.
2. To perform experiments to measure three phase power, frequency, core losses.
3. To design experiments for calibration of energy meter.
4. To know the industrial practices of Measuring earth resistance, dielectric strength of transformer oil & Testing of underground cables
5. To provide hands on practice with various equipment during workshop practice.

Learning Outcomes:

Upon the completion of this lab the students will be able to

1. Measure various electrical engineering parameters used in engineering practice.
2. Calibrate and check the operation of energy meter.
3. Measure earth resistance.
4. Calculate core losses of magnetic material.
5. Use transformer oil testing kit.
6. Get hands on experience with equipment in workshop practice lab.

LIST OF EXPERIMENTS:

1. Calibration and testing of single - phase energy meter.
2. Kelvin's Double Bridge - Measurement of resistance - Determination of tolerance.
3. Schering Bridge - capacitance measurement and tan measurement
4. Anderson Bridge - inductance measurement.
5. Measurement of 3-phase active and reactive power in three phase circuits.
6. Measurement of frequency using CRO.
7. Measurement of strain using strain gauge.
8. Tracing of B-H curve using CRO.
9. LVDT characteristics, calibration and displacement measurement.
10. Energy meter calibration by phantom loading.
11. Frequency measurement by Wein's Bridge.
12. Measurement medium resistance using Wheatstone Bridge.
13. Measurement of dielectric strength of transformer oil by transfer oil testing kit.
14. Assembling and testing of AC regulator and 3 point starter.
15. Industrial Wiring.
16. Assembling and testing of Ceiling fan.
17. Assembling and testing of various components of fluorescent lamp.
18. Binding of insulators.
19. Substation layout & Design of UG cable.
20. Identification of terminals of DC compound motor.
21. Fault identification and location in underground cables.
22. Measurement of earth resistance by earth resistance tester & fall of potential method.

LEARNING RESOURCES:

REFERENCE BOOK: 1. Electrical & Electronic Measurement & Instruments by A.K.Shawney Dhanpat Rai & Co 17th edition 2000.

EE 362 – Power Electronics Lab
Semester VI [Third Year]

L	T	P	C	Int	Ext
0	0	3	1.5	30	70

COURSE OBJECTIVES:

1. To make the students to design triggering circuits of SCR.
2. To introduce power electronics components from which the characteristics of SCR, TRIAC, IGBT and MOSFET are obtained.
3. To perform the experiments on various converters.

COURSE OUTCOMES:

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

1. Compare and study the characteristics of various power electronic devices
2. Illustrate the operation, application and design various power electronic converters.
3. Design required drive circuits for project work.

LIST OF EXPERIMENTS:

1. Static characteristics of SCR, Triac
2. Characteristics of MOSFET & IGBT
3. Gate triggering methods for SCR's (R, R-C, UJT)
4. Characteristics of Single phase fully controlled rectifier with R, RL & RLE load (with or without feedback diode)
5. Characteristics of Voltage commutated DC chopper
6. Characteristics of single – phase AC voltage controller with R&RL loads
7. Characteristics of single - phase Cyclo-converter (Center tapped or Bridge)
8. Characteristics of single - phase full wave McMurray Bedford inverter
9. Characteristics of Single phase dual converter
10. Characteristics of Three phase fully controlled rectifier with R, RL and RLE loads
11. Speed control of Universal motor
12. Characteristics of Morgan's chopper
13. Characteristics of PWM Inverter based three phase Induction motor.
14. Speed control of induction motor using three phase AC voltage controller
15. Speed control of DC motor using 4 quadrant Chopper

Note: Minimum of ten experiments have to be performed and recorded by the candidate to attain eligibility for Semester End Examinations

LEARNING RESOURCES:

TEXT BOOKS:

1. M.H. Rashid, 'Power Electronics, circuits, devices and applications', Pearson 3rd edition, 2005
2. M.D.Singh and Khanchandani, 'Power Electronics', TMH, 2nd Edition

REFERENCE BOOKS:

1. P.S. Bhimbra, 'Power Electronics', Khanna publications, 3rd Edition 2006

EE 363 – Power Systems Lab
Semester VI [Third Year]

L	T	P	C	Int	Ext
0	0	2	1	30	70

COURSE OBJECTIVES:
1. To make the students to analyze different types of faults in power systems.
2. To create concepts towards study of existing power network for design of compensation devices.
3. To study the performance of insulators and cables by High voltage testing

COURSE OUTCOMES:
Upon successful completion of the course, the student will be able to:
1. Select and design protective devices for various equipment used in Electrical Industry.
2. Determine impedances of various rotating machines.
3. Design capacitors to improve power factor practically and be able to test HV insulators & cables
4. Determine parameters of transmission line, loading capability, compensation equipment required in practical transmission network.
5. Illustrate the grid interconnection mechanisms of renewable energy resources.

LIST OF EXPERIMENTS:
1. Characteristics of over current relay & Earth fault relay
2. Characteristics of over voltage / under voltage relay
3. Characteristics of differential relay
4. Characteristics of definite time reverse power relay
5. Characteristics of negative sequence relay
6. Sequence impedances of alternator
7. Harmonic analysis using power network analyzer
8. Characteristics of distance relays
9. Power factor correction of induction motor
10. Determination of Transmission line parameters
11. Regulation and efficiency of transmission line including Ferranti effect
12. Reactive power control by tap changing transformers
13. Sequence impedances of transformer
14. Grading of Insulators
15. Compensation of transmission line model
16. H.V. testing of Insulators
17. High voltage testing of cables
18. Grid interconnection of Renewable energy resources

REFERENCE BOOKS:
1. Nagrath&Kothari, Modern power system analysis, TMH 3rd edition
2. C.L. Wadhwa, Electrical power systems, New age International (P) Limited
3. TK Nagsarkar and Sukhija, Power system analysis, Oxford press

EESL4 – Skill Oriented Course – IV
Semester VI [Third Year]

L	T	P	C	Int	Ext
1	0	2	2	100	0

SOFT SKILLS

COURSE OBJECTIVES:

Soft Skills course prepares students to

- Raise awareness of and to develop key competencies to succeed in professional and personal life.
- Demonstrate their team working abilities; and, that they can emerge as leaders while still maintaining the group objectives.
- Prepare resume that describes their education, skills, experiences and measurable achievements with proper grammar, format and brevity and demonstrate ability to target the resume to the presenting purpose.
- Develop confidence in relationship to their interviewing skills.

COURSE OUTCOMES:

By the end of the course students will be able to:

1. Develop key competencies to succeed in professional and personal life.
2. Understand the key skills and behaviour required to facilitate group discussion
3. Produce resume with basic format and inputs to meet the company requirements.
4. Identify appropriate verbal and non-verbal communication skills/techniques for an interview including preparedness, professional attire.

COURSE CONTENT:

UNIT-1 CO1 [9]

Importance of Skills in Professional and Personal life

- Soft Skills Vs Hard Skills
- Personality Development
- Self-Grooming
- SWOT/ SWOC Analysis
- Goal Setting

UNIT-2 CO2 [12]

Communication Skills

- Presentation Skills : Mini presentations
- Group Discussions (GD Lab)
- Types of GDs -How to face GD
- Practice Sessions

UNIT-3 CO3 [6]

Resume Writing

- Email -Etiquette
- Resume Workshop

Cover Letter

Effective Resume Writing: Structure and Presentation

UNIT-4 CO4 [9]

Interview Skills

- Facing Interviews: Interview Process - Understanding Employer Expectations - PreInterview Planning
- Frequently Asked Questions (FAQs)- Opening Strategies - Answering Strategies Mock Interviews

LEARNING RESOURCES:

Reference Books:

- Mitra, B. K. (2011). Personality development and soft skills. Oxford University Press.
- Technical Communication - Principles and Practice, II Ed, OUP by Meenakshi Raman&Sangeetha Sharma,

2015.
- Strategies for Engineering Communication – Susan Stevenson and Steve Whitmore, 2002
- Group Discussion and Interview Skills by Priyadarshi Patnaik, published by FoundationBooks
- The Skills of Interviewing: A guide for Managers and Trainers – Leslie Rae
- Cambridge English for Job-Hunting by Colm Downes, published by Cambridge UniversityPress

EESL5 – Skill Oriented Course – V
Semester VII [Fourth Year]
Computer simulation of electrical systems lab

L	T	P	C	Int	Ext
1	0	2	2	100	0

COURSE OBJECTIVES:

1. To discuss about the simulation of various power electronic circuits, control system circuits and analysis of power system for short circuits and stability using different packages available.
2. To introduce control system tool box in MATLAB.
3. To simulate power system networks for load flow, short circuit analysis, relay coordination and transient stability using Mi-Power software.

COURSE OUTCOMES:

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

1. Simulate different power electronic circuits using PSPICE.
2. Simulate different control systems problems using MATLAB.
3. Determine short circuit studies and relay co-ordination of power systems usingMiPOWER.
4. Exhibit expertize in usage of modern tools.

List of Experiments:

1. Simulation of static characteristics of SCR
2. Simulation of a resonant pulse commutation circuit and buck chopper
3. Simulation of an AC voltage controller with various loads
4. Simulation of single-phase inverter with PWM control
5. Modeling of transformer
6. Transfer function analysis of a given circuit
7. State model representation of transfer functions
8. Plotting of Bode, Nyquist and root-locus plots for transfer functions
9. Short circuit studies in power systems
10. Transient stability analysis of power systems
11. Relay co-ordination in power systems
12. Simulation of two area system
13. Develop a program for Ybus by inspection
14. Develop a program for Zbus using Zbus building algorithm
15. Develop a program for Load flow analysis by Gauss - Seidel method
16. Develop a program for load flow analysis by Newton - Raphson method
17. Develop program for load flow analysis by FDLP method.

Simulation is to be carried out with the following software PSPICE/ MATLAB/ MiPower/ PSIM/ PSCAD/ EMTP.

Learning Resources:

Text Books:

1. Computer methods in Power System Analysis by Stagg, G.W. & El-Abiad TMH
2. Computer Techniques in Power System Analysis by M.A. Pai , TMH 2005
3. Power Electronics, circuits, devices and applications by M.H. Rashid Pearson 3rd edition, 2005
4. Control systems by A. Ananda Kumar, PHI

Web Resources:

1. www.wikipedia.com
2. http://nptel.iitm.ac.in

EEEL01 :: Power system protection

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To give the student an idea of zones of protection and various types of relays.
2. To make the student to gain the knowledge of various circuit breakers with their applications.
3. To create the knowledge of differential protection of various power system network elements and grounding methods
4. To make the student to understand the principle of static relays and their applications.

Course Outcomes:

Upon completion of the course, the student will be able to:
1. Describe the concepts of zones of protection and different types of relays.
2. Illustrate the principles and recommend the usage of various circuit breakers used in power system network.
3. Investigate the protection schemes of equipment in power system network.
4. Evaluate the importance of using static relays and their schemes.

Course Content:

UNIT – I **[Text Book- 1] 15**

Protective Relays: Introduction - basic requirement of protective relaying - zones of protection – primary and backup protection - classification of relays - attracted armature, balanced beam, induction disc, thermal relays.
Buchholz"s relay. Over current relays –inverse, very inverse, extremely inverse and IDMT relays, plug setting and time setting multipliers-problems- under voltage relays. directional and non- directional relays. negative sequence relays.
Distance relays – impedance, reactance, mho and off set mho relays. Characteristics of distance relays and comparison differential relays - circulating current and opposite voltage differential scheme

UNIT – II **[Text Book- 1&2] 15**

Switchgear: Elementary principles of arc phenomenon - arc quenching - interruption of capacitive currents and low current chopping - resistance switching - recovery and restriking voltages.
Principles of operations of various types of circuit breakers - air break – oil filled - air blast -vacuum and SF6 circuit breakers.
Rating of circuit breaker and specifications of circuit breaker- numerical problems, testing of circuit breakers.

UNIT – III **[Text Book- 1 &2] 15**

Protection of alternators, transformers and transmission lines: Differential protection for generators, transformers and transmission lines - field suppression of alternator - over current and distance protection for feeders - Translay relay.
Grounding: Neutral grounding - solid grounding - resistance and reactance grounding - Arc suppression coil. Power system earthing: Objectives – definitions - tolerable limits of body currents - soil resistivity and earth resistance.

UNIT – IV **[Text Book- 1 & Reference Book – 1] 15**

Static Relays: Introduction – basic component of static relays. Comparators – amplitude and phase comparators.
Static over current relays – instantaneous over current relay – inverse time over current relays – static differential relays.

Learning Resources:

TEXT BOOKS:

1. Power System Protection and Switchgear by B.Ram – Tata Mc-Graw Hill, 2001
2. Electrical power systems by C.L. Wadhwa, New age International (P) Limited, 2009

REFERENCE BOOKS:

1. Power system protection Static relays by T.S. MadhavaRao TMH 2nd edition 1989
2. Power system protection and switchgear by B. Ravindranath, Chander Willy Eastern Ltd 1992
3. Fundamentals of Power System Protection by Y.G. Paithankar&S.R.Bhide, PHI, 2003
4. Switchgear and protection by Sunil S. Rao,Khanna Publications,1987

Web References:

1. https://nptel.ac.in/courses/108/101/108101039/
2. www.electrical4u.com
3. www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/
4. http://www.electrical-installation.org/
5. http://electrical-engineering-portal.com/introduction-to-static-protection-relays
6. https://www.electrical4u.com/generator-protection/

EEEL02 :: Industrial Drives

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To make the students to know about different types of drives and applications in various industries.
2. To prepare them to acquire the knowledge of different speed control methods in ac and dc motors using static power semiconductor switches based control schemes.

Course Outcomes:

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

1. Categorize various drive mechanisms and their closed loop control strategies
2. Design the power electronic converters for AC to DC and DC to DC to control the speed of DC motors
3. Design power electronic converters (AC voltage controllers and VSI) to control the speed of induction motors
4. Assess the usage of power electronic converters to control the speed of synchronous motors & special motors, and illustrate the methods for energy conservation.

COURSE CONTENT:

UNIT - I **[Text Book- 1] (12)**

Introduction of Electric Drives: Electric drives, advantages of electric drive, parts of electric drives, Choice of electrical drives, Status of dc and ac drives.

Dynamics of Electric Drives: Fundamental torque equations, Speed torque conventions and multi quadrant operation, Components of load torques, Nature and classification of load torques, steady state stability.

Control of Electric Drives: Modes of operation, Speed control and drive classification closed-loop control of drives- Current limit control, torque control, speed control, PLL control, position control.

UNIT - II **[Text Book- 1] (12)**

DC motor Drives: conventional Speed control methods (theory only), methods of braking.

Rectifier fed DC Drives: Single phase fully and half controlled rectifier control of separately excited and series dc motor.(Continuous conduction) 3-Φ Controlled Rectifier fed DC Drives: - Three phase fully and half controlled rectifier control of separately excited and series dc motor, Single and three phase Dual converter control of separately excited dc motor.

Chopper fed DC Drives: Control of separately excited dc motors-Motoring (class-A), Regenerative braking (class-B), Motoring and Regenerative braking (class-C), Dynamic braking, Chopper control of series motor.

UNIT - III **[Text Book- 1] (12)**

Introduction to Induction motor drives: Three phase induction motors-analysis and performance, Operation with unbalanced source voltages and single phasing, braking, transient analysis.

Speed control from stator side: Stator voltage control by A.C. voltage controllers, Variable frequency control from voltage sources, VSI control.

Speed control from rotor side: Static rotor resistance control, slip power recovery, Variable speed constant frequency generation.

UNIT - IV **[Text Book- 1] (12)**

Synchronous motor drives: Synchronous motors, Operation from fixed frequency supply-starting, pull-in, braking, Synchronous motor variable speed drives, Self-controlled synchronous motor drives employing load commutated inverter, Self-controlled synchronous motor drives employing cycloconverter.

Special Motor drives: Permanent magnet ac motor drives, brush less dc motor drives, important features and applications of BLDC drive.

Energy Conservation in Electric Drives: Losses in Electric drive systems, measures for Energy conservation in Electric drives, use of efficient converters, use of efficient motors, use of variable speed drives, energy efficient operation of drives, using a motor of right rating.

Learning Resources:

Text Books:

1. G.K. Dubey, 'Fundamentals of Electric drives', Narosa, 2nd Edition, 2001.

Reference Books:

1. G.K. Dubey, 'Power Semiconductor controlled drives', PH, 2nd Edition1989.
2. S.B. Dewan, G.R. Selmon & Straughen, 'Power semiconductor drives' John Wiley, 2009.
3. G.K Dubey, S.R Doradla, 'Thyristorised power controllers' New Age, 1st edition, 1986.

Web Resources:

1. www.siemens.com/Sirius
2. www.minglebox.com
3. www.abb.com
4. www.drives-and-controls.co.uk
5. http://nptel.ac.in/courses/108102046

EEEL03 :: Electrical Distribution systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To provide sufficient theoretical and analytical background to understand the concepts of electric distribution system at various voltage levels.
2. To make the student to learn the distribution system.
3. Planning, design of sub transmission lines and distribution substation.
4. To develop skills for applying them in future on various engineering applications.
5. To teach the analysis and design of primary and secondary systems.
6. To give an idea on calculation of voltage drops, power losses.

Course Outcomes:

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

1. Explain the concepts of distribution system Planning and load characteristics.
2. Design simple distribution system, sub transmission lines, primary feeder and Secondary feeders.
3. Categorize the design consideration of primary & secondary distribution systems and coordination of protective devices.
4. Calculate the distribution feeder costs and identify best and optimum capacitor location.

Course Content:

UNIT – I **[Text Book – 1] [13]**

Distribution systems planning: Distribution systems planning – Factors affecting systems planning – Present distribution system planning techniques-distribution system planning models - present and future role of computers in distribution system planning, Introduction to automation-DAC & SCADA.

Load characteristics: Definitions, Coincidence Factor, Contribution Factor Loss Factor - Relationship between the Load Factor and Loss Factor, Classification of Loads (Residential, Commercial, Agricultural and Industrial) and their characteristics.

UNIT – II **[Text Book – 1] [13]**

Distribution transformers: Types of distribution transformers - Regulation and efficiency - Use of monograms for obtaining efficiency.

Deign of sub transmission lines and distribution substations: Introduction – types of sub transmission systems - distribution substation – Substation bus schemes - description and comparison of switching schemes – substation location and rating - Application of network flow techniques in rural distribution networks to determine optimum location of sub-station.

UNIT – III **[Text Book – 1] [13]**

Design considerations on primary systems: Introduction - types of feeders - voltage levels - Radial type feeders - feeders with uniformly distributed load and non-uniformly distributed loads.

Design considerations of secondary systems: Introduction - secondary voltage levels - Secondary banking - existing systems improvement.

Distribution system Protection: Basic definitions - over current protection devices - fuses, protection - coordination of protective devices - Fuse to Fuse co-ordination, Fuse to circuit breaker coordination, reclosure to circuit breaker co-ordination.

UNIT-IV **[Text Book – 1] [13]**

Voltage drop and power loss calculations: Three phase primary lines - non 3 phase primary lines - 4 wire multi grounded primary lines - copper loss - Distribution feeder costs.

Application of capacitors to distribution systems: Effect of series and shunt capacitors - Power factor correction - economic justification for capacitors - a computerized method to determine the economic power factor - Procedure to determine the best and optimum capacitor location.

Learning Resources:

Text Books:

1. Electric Power Distribution System Engineering. By Turan Gonen, MGH.

2. Electrical Distribution Systems by Dr. V. Kamaraju, Right Publishers.

Reference Books:

1. Electric Power Distribution by A.S. Pabla, TMH, 4th Ed., 1997.
2. Electrical Power Distribution Automation by Sivanagaraju & Sankar, Dhanpatrai & Sons.

Web Resources:

1. https://nptel.ac.in/courses/108/107/108107112/

https://electrical-engineering-portal.com/electrical-distribution-systems

EEEL04 :: Power system operation & control

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To make the student to understand economic load dispatch under various operational constraints and techniques to solve the problem.
2. To know the importance of quality of power, P-f, Q-V control loops, AGC.
3. To discuss the concept of reactive power and voltage control in detail.
4. To understand the importance of reactive power control in power system.
5. To understand the importance of computer applications in power system and how load particulars are with the increase in load demand.

Course Outcomes:

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

1. Describe the importance of economic operation of power systems.
2. Illustrate the operation of single area and two area AGC.
3. Design various voltage control mechanisms in distribution systems.
4. Control the voltage and reactive power in practical operating conditions.
5. Solve the Power management problems in industries and utilities with the help of latest equipment.

COURSE CONTENT:

Unit - I **[Text Book- 1] (12)**

Economic operation of power systems: Economic dispatch in thermal power station: Heat rate curves - cost curves - incremental fuel and production costs - economic distribution of load between units without consideration to line losses.

Transmission line losses as a function of plant generation - calculation of loss coefficients - optimum generation allocation between thermal plants.

Unit - II **[Text Book- 1] (12)**

Load frequency control: Importance of keeping voltage and frequency constant in a power system - Load frequency control (LFC) single area case - P-F loop: Schematic diagram of load frequency and excitation voltage regulators of a turbo-generator - mathematical modeling of generator, loads, prime mover and speed governor for LFC & corresponding block diagram representation - LFC block diagram of an isolated power system - steady state analysis - dynamic response. LFC for two area systems.

Automatic generation control (AGC) scheme - AGC in a single area and two area systems - block diagram representation.

Unit - III **[Text Book- 1] (12)**

Reactive power and voltage control: Loadability of transmission lines - sources and sinks of reactive power.

Voltage control of distribution systems: Tap changing - booster transformers -synchronous phase modifiers - induction regulators and static capacitors.

Reactive power control in synchronous generators: The role of excitation system, exciter, generator and sensor models - simplified AVR block diagram - steady state response for a step change in terminal voltage.

UNIT–IV **[Text Book – 1, 3] (12)**

Reactive power compensation of loads: Shunt compensating devices

Transmission line compensation: Series compensation - shunt compensation. StaticVAR compensators - thyristor controlled reactors (TCR) - thyristor switched capacitors(TSC) - combined TCR and TSC - schematic of all three types - STATCOM and FACTS devices.

Power System Control Centers:
Aim of control centers, functions of control centers – Planning, Monitoring and Data acquisition and System control. Setup, locations, central & civil facilities. Facilities in control room. Communication-PLCC. Emergency control

LEARNING RESOURCES:

TEXT BOOKS:

1) Modern power system analysis by D.P.Kothari&I.J.Nagrath McGraw Hill
2) Power system analysis by H.Saadat , Tata McGraw Hill, 2003
3) Power System analysis operation and control by Abhijit Chakrabarti&SunitaHalder, PHI

REFERENCE BOOKS:

1) Power system analysis by John J.Grainer and WD Stevenson Jr.,TMH 2007
2) Power system operation and control by S.Sivanagaraju& G. Sreenivasan, Pearson 2010
3) Generation, distribution and utilization of Electrical Energy by CL Wadhwa, New Age Int. publications, revised 2/E

WEB RESOURCES:

1. www.learnerstv.com/Free-Engineering
2. www.engr.usask.ca/departments/ee
3. www.elearning.vtu.ac.in/Programme12/E-Notes/PSOC/MSR.pdf
4. www.freevideolectures.com/.../Power-Systems-Operation-and-Control
5. www.unr.edu/ebme/academics/courses
6. www.cdeep.iitb.ac.in/nptel/Electrical
7. www.cramster.com/answers
8. www.power.uwaterloo

EEEL05 :: Utilization of Electrical Power

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To derive the heating and cooling curve and to study the various classes of duty and Selection of power rating.
2. To impart the knowledge on electric traction as it is one of the most important applications of Electrical Engineering.
3. To make students learn the various usage of electrical energy such as illumination, heating, welding etc.

Course Outcomes:

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

1. Choose a right and efficient drive for a particular application
2. Describe the mechanics of train movement & Calculate Specific Energy Consumption for a given run and explain the control methods of traction motors
3. Identify the usage of various types of Heating and Welding systems based on the application
4. Design Illumination systems for various applications

COURSE CONTENT:

UNIT - I **[Text Book-1] (12)**

Selection of Drive:

Factors governing selection of electric motors, Nature of electric supply, Types of drives, Types of loads, Choice of drive. Motor Power Rating: Insulating materials, Temperature rise in electrical machines, Duty cycles, Rating of machines, Choice of rating of motors, Load equalization.

UNIT - II **[Text Book-1] (12)**

ELECTRIC TRACTION:

Train movement: Typical speed-time curves, Crest speed average speed and schedule speed, Factors affecting schedule speed, Simplified speed-time curves, Mechanics of train movement, Tractive effort for propulsion of train. *Energy consumption:* Power output from the driving axles, Energy output from the driving axles, Specific energy output using simplified speed-time curve, Factors affecting specific energy consumption, Dead weight accelerating weight and adhesive weight.

Control of traction motors: Starting and speed control of DC traction motors, plain rheostatic starting (notching), Series-parallel starting, Transition methods, Drum controller, Contactor type controller.

UNIT – III **[Text Book-1] (12)**

Electric Heating:

Modes of transfer of heat, Stefan's law, Electric arc furnaces, Resistance heating, Design of heating element, Induction heating, High frequency eddy current heating, Dielectric heating, Choice of frequency.

Electric Welding:

Resistance welding, Electric arc welding, Arc welding with DC and AC, Comparison between resistance and arc welding (Excluding electronic controls)

UNIT - IV **[Text Book-1] (12)**

Illumination:

Terms used in illumination, Laws of illumination, polar curves, Photometry, Integrating sphere, measurement of illumination, Sources of light, CFL's, LED Lighting, efficient lighting. Arc lamps, Incandescent lamps, Effect of voltage variation, Gaseous discharge lamps, Fluorescent lamps, Comparison between filament and fluorescent tubes, design of lighting schemes, Factory lighting, Methods of lighting calculations, Flood lighting, Street lighting.

Learning Resources:

Text Books:

1. J.B.Gupta, "Utilization of Electrical Power and Electric Traction",S.K.Kataria & sons publications, 9th edition
2. Sunil S Rao, "Utilization, generation & conservation of electrical energy", by Khanna publishers, first edition 2005.
3. G.C.Garg, utilization of electric power and electrric traction. Khanna publishers, 2004.

Reference Books:

1. CL Wadhwa, "Generation distribution and utilization of electrical energy", New Age 2005.
2. M.L.Soni, P.V.Gupta, U. S. Bhatnagar and A Chakraborti, "A Text Book on Power System Engineering",DhanpatRai& Co. Pvt. Ltd., 2001.
3. Openshaw Taylor, "Utilization Electric Power", Orient Longman, 1986.
4. Partab H, "Art and Science of Utilization of Electrical Energy", DhanpatRai and Sons, Second edition.
5. Energy Efficiency in Electrical Utilities, BEE guide book, 2010.

Web References:
1. http://nptel.iitm.ac.in/video.php?subjectId=108105060 (Unit-V)
2. http://www.nptel.ac.in/courses/108105061/Illumination%20%20Engineering/Lesson-20/pdf/L20(NKK)(IE)%20((EE)NPTEL).pdf
3. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/
4. www.bee-india.org
5. www.irfca.org (Unit-II)

EEEL06 :: Advanced Electric Drives

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To know about different types of high-power semiconductor devices drives and applications in various industries.
2. To acquire the knowledge of different level VSI configurations and modulation schemes.
3. To control the speed of induction motor using above converters.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Identify the commonly used high-power semiconductor devices and their switching characteristics.
2. Describe the PWM schemes for the two-level voltage source inverter.
3. Illustrate the configurations and modulation schemes for cascaded H-bridge (CHB) and NPC multilevel inverters.
4. Explain the behaviour of induction Motor drives using two and multilevel VSI.

COURSE CONTENT:

UNIT-I **[Text-book1] (10)**

High-Power Semiconductor Devices

Technical Requirements and Challenges: Line-Side Requirements, Motor-Side Challenges, Switching Device Constraints, Drive System Requirements, Converter Configurations, MV Industrial Drives.

Introduction, High-Power Switching Devices: Diodes, Silicon-Controlled Rectifier (SCR), Gate Turn-Off (GTO) Thyristor, Gate-Commutated Thyristor (GCT), Insulated Gate Bipolar Transistor (IGBT), Other Switching Devices, Operation of Series-Connected Devices: Main Causes of Voltage Unbalance, Voltage Equalization for GCTs, Voltage Equalization for IGBTs.

UNIT-II **[Text-book1] (10)**

Two-Level Voltage Source Inverter

Introduction, Sinusoidal PWM: Modulation Scheme, Harmonic Content, Over-modulation, Third Harmonic Injection PWM, Space Vector Modulation: Switching States, Space Vectors, Dwell Time Calculation, Modulation Index.

UNIT-III **[Text-book1] (10)**

Multi-Level Voltage Source Inverter

Cascaded H-Bridge Multilevel Inverters

Introduction, H-Bridge Inverter: Bipolar Pulse-Width Modulation, Unipolar Pulse-Width Modulation, Multilevel Inverter Topologies: CHB Inverter with Equal dc Voltage, H-Bridges with Unequal dc Voltages, Carrier Based PWM Schemes: Phase-Shifted Multicarrier Modulation, Level-Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes.

Diode-Clamped Multilevel Inverters

Introduction, Three-Level Inverter: Converter Configuration, Switching State, Commutation, Neutral-Point Voltage Control: Causes of Neutral-Point Voltage Deviation.

UNIT-IV **[Text-book1] (10)**

Voltage Source Inverter-Fed Drives

Introduction, Two-Level VBSI-Based MV Drives: Power Converter Building Block, Two-Level VSI with Passive Front End, Neutral-Point Clamped (NPC) Inverter-Fed Drives: GCT-Based NPC Inverter Drives, IGBT-Based NPC Inverter Drives, Multilevel Cascaded H-Bridge (CHB) Inverter-Fed Drives: CHB Inverter-Fed Drives for 2300-V/4160-V Motors, NPC/H-Bridge Inverter-Fed Drives

Learning Resources:

Text Books:

1. High-power Converters and AC Drives: Bin-Wu, IEEE Press, John Wiley & Sons.
2. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.

Reference Books:

1. Electric Motor Drives: Modeling, Analysis and Control – R. Krishnan – Prentice Hall
2. Vector Control of Electric Drives: Peter Vas, Oxford Publishers

EEEL07 :: Signals and systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To provide sufficient theoretical, analytical background about signals and systems.
2. To learn about Fourier series and Fourier transformation.
3. To understand the input-output relationships for characteristics of LTI systems.
4. To study Fourier and Laplace Transform analysis for continuous-time LTI systems.
5. To study Z-Transform analysis for discrete time systems.

Course Outcomes:

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

1. Explain the mathematical descriptions, representations and classification of continuous and discrete signals and systems.
2. Use Fourier series and Fourier transform techniques for the representation of continuous-time periodic and aperiodic signals.
3. Explain the input-output relationships for characteristics of LTI systems.
4. Use Fourier and Laplace Transform analysis for continuous-time LTI systems.
5. Use Z-Transform analysis for discrete time systems.

COURSE CONTENT:

UNIT – I **(TEXT BOOKS-1, 2) (15)**

SIGNALS AND SYSTEMS: Introduction, Continuous-Time and Transformations of the independent variable, Exponential and sinusoidal signals, The unit Impulse and Unit step functions, Continuous-Time and Discrete-Time systems, Basic system properties.

SAMPLING: Introduction, Representation of a continuous-time signal by its samples, sampling theorem, Reconstruction of a signal from its samples using interpolation, Aliasing and its effects.

UNIT – II **(TEXT BOOKS-1, 2) (15)**

FOURIER SERIES: Introduction, Fourier series representation of continuous-time periodic signals, Convergence of the Fourier series, Properties of continuous-time Fourier series.

FOURIER TRANSFORMS: Introduction, Representation of aperiodic signals: The continuous Fourier transform, The Fourier transform for periodic signals, Properties of the Continuous-time Fourier transform.

UNIT – III **(TEXT BOOKS-1, 2) (15)**

LINEAR TIME INVARIANT SYSTEMS: Introduction, LTI systems, Impulse response, Transfer function of a LTI system, Convolution integral, Convolution sum, Energy and Power spectral density, Parseval's theorem, Ideal LPF, HPF and BPF characteristics, Causality.

UNIT – IV **(TEXT BOOKS-1, 2) (15)**

SIGNALS AND SYSTEMS ANALYSIS USING LAPLACE TRANSFORMS: Introduction, The Laplace transform, The region of convergence for Laplace transforms, The inverse Laplace transform, Properties of the Laplace transform, Analysis and characterization of LTI systems using the Laplace transform, The unilateral Laplace transform.

SIGNALS AND SYSTEMS ANALYSIS USING Z-TRANSFORM: Introduction, The Z- transform, The region of convergence for Z-transform, The inverse Z-transform, Properties of the Z-transform, Analysis and characterization of LTI systems using the Z-transform, The unilateral Z-Transform

Learning Resources:

TEXT BOOKS:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals & Systems", II Edition, PHI Publishers, 1996.
2. P.RameshBabu, R Ananda Natarajan, "Signals and Systems", III edition, Scitech Publishers, 2009.

REFERENCE BOOKS:

1. Simon Haykin, Barry Van Veen, "Signals & Systems", II edition, John Wiley &Sons, 2001
2. B P Lathi, "Signals, Systems and Communications", III edition BS Publications, 2003.

Web Resources:

1. http://nptel.ac.in/courses/117104074
2. http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011
3. https://nptel.ac.in/courses/108/106/108106163/

EEEL08 :: Wind and Solar Energy Systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To provide knowledge on wind and solar energy sources to meet the energy requirements.
2. To make the student to understand wind and solar power generation in detail.
3. To discuss about various factors associated with wind and solar power generation.

Course Outcomes:

After successful completion of the course, the students are able to

1. Illustrate the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Describe the basic physics of wind and solar power generation.
3. Design the power electronic interfaces for wind and solar generation.
4. Obtain solutions for the issues related to the grid-integration of solar and wind energy systems.

COURSE CONTENT:

Unit-1: Introduction to Wind Power [Text Book – 1] [15]

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit-2: Topologies of Wind Generators [Text Book – 1] [15]

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit-3: Solar Photovoltaic System [Text Book – 3] [15]

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, Solar day length, Estimation of solar energy availability. Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, Converter Control.

Unit-4: Network Integration & Solar power generation [Text Books – 2&3] [15]

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Learning resources:

Text books:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. H. Siegfried and R. Waddington, " Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.

Reference books:

1. J. A. Duffie and W. A. Beckman, " Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems", John Wiley and Sons, 2004.
3. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.

Web Resources:

1. https://www.elprocus.com/solar-energy-system
2. https://sesindiana.com

3. www.greenrhinoenergy.com

EEEL09 :: Electrical Machine Design

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To design main dimensions & cooling systems of transformers.
2. To design main dimensions of rotating Electrical Machines.

Course Outcomes: After completion of the course the student will be able to

1. Design main dimensions of transformer, cooling systems
2. Design main dimensions of DC machine & field circuit.
3. Design main dimensions of Induction motor & rotor.
4. Design main dimensions of Synchronous Machine & field circuit.

Course Content:

UNIT-I **[Text Book – 1] [15]**

D.C.Machines: E.M.F generated from full pitch - fractional pitch with and without distributed windings - distribution factor. Design of main dimensions from output equation - Design of Armature windings - Design of field system - Design of inter pole and commutator.

UNIT-II **[Text Book – 1] [15]**

Transformers: Derivation of output equation - volt per turn importance and calculation of main dimensions for three phase and single phase transformers - window dimensions - Yoke design and coil design - Design of tank with tubes.

UNIT-III **[Text Book – 1] [17]**

Induction Motor: Derivation of output equation - calculation of main dimensions – Stator design - number of slots - shape and area of slots - Rotor design for squirrel cage and slip ring types.

UNIT-IV **[Text Book – 1] [13]**

Synchronous Machines: Derivation of output equation - Calculations of Main Dimensions for salient pole and cylindrical rotor alternators - Stator design - number of stator slots and slot dimensions - Pole design for salient pole generators - pole winding calculations. Design of rotor for cylindrical rotor alternator - Design of rotor windings.

Learning Resources:

Text Books:

1. A Course in Electrical machine Design by A.K. Sawhney, Dhanpatrai& Sons,
2. Performance and Design of AC Machines by M.G. Say CBS

Reference Books:

1. CEDT Manual on design and technology on low power transformers and inductors by IISC, Bangalore.
2. Design of Electrical Machines by V.N.MittleStandard Publishers Distributors 2009
3. Performance and Design of AC Machines by A.E. Clayton
4. Principles Of Electrical Machine Design by R.K. Agarwal, S.K. Kataria&Sons,2010

Web References:

1. http://www.faadooengineers.com/threads/9454-Electrical-Machine-Design-full-notes-e-books-pdf-all-units
2. http://nptel.iitm.ac.in

EEEL10 :: HVDC Transmission Systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To revise the basic concepts of HVDC links, compare EHV AC and HVDC systems.
2. To analyse HVDC converters.
3. To discuss various HVDC system control methods.
4. To describe various faults and protection methods for HVDC systems.
5. To study about harmonics and methods used to eliminate them in HVDC systems.

Course Outcomes:

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

1. Describe the importance of HVDC Links; compare EHV AC and HVDC systems.
2. Analyse converter configurations used in HVDC transmission.
3. Explain the details of converters and HVDC system control mechanisms.
4. Identify converter faults and design protection schemes.
5. Illustrate the existence of harmonics in HVDC system and design filter circuits to eliminate harmonics.

COURSE CONTENT:

Unit –I: **[Text Book-1] (15)**

DC POWER TRANSMISSION TECHNOLOGY

Introduction –Comparison of Ac and DC Transmission: Economics of power transmission, Technical performance, Reliability-application of DC Transmission.

Description of DC Transmission: Types of DC links, Converter station-Planning for HVDC Transmission-Modern trends in HVDC Technology-Some operating problems-HVDC Transmission based on Voltage Source Converters

Unit- II: **[Text Book 2] (15)**

ANALYSIS OF HVDC CONVERTERS

Converter circuits: six-pulse converter circuits-choice of best circuit for HVDC converters-Twelve pulse converter.

Analysis of Graetz circuit: Analysis with Grid control but no overlap-Analysis with Grid control and with overlap less than 60^0-Analysis of Grid control and with overlap greater than 60^0 –Complete characteristics of Rectifier–Inversion.

Unit-III: **[Text Book1] (15)**

CONVERTER AND HVDC SYSTEM CONTROL

Principles of DC link control -converter control characteristics: Basic characteristics, modification of the control characteristics-system control hierarchy-Firing angle control: Individual Phase control-Equidistant pulse control- current and extinction angle control. Starting and stopping of DC link: Energization and de-energization of a bridge - power control –reactive power control-sub synchronous Damping control.

Unit-IV: **[Text Book1& 2] (15)**

CONVERTER FAULTS AND PROTECTION

Introduction-Converter faults: Commutation failure-Arc through-Misfire-Bypass valves- short circuit on a Rectifier- Arc back currents. Disturbances on AC side, Disturbances on DC side, Protection against over currents, Protection against over voltages-Surge arresters.

HARMONICS AND FILTERS

Generation of harmonics - Characteristic and Uncharacteristic harmonics - adverse effects of harmonics - calculation of voltage and current harmonics. Types of filters, Design of Single tuned filters, Design of High pass filters, Active Filters.

Learning Resources:

Text Books:

1. K.R. Padiyar, „HVDC power transmissions systems: Technology and system interactions" New age International (P) Ltd,2 edition, 2012.
2. E.W.Kimbark, „Direct Current transmission", John Wiley,1971.

Reference Books:

1. HVDC Transmission: Power Conversion Applications in Power Systems, Chan-Ki Kim, Vijay K. Sood, et. al.2009,Wiley-IEEE Press.
2. S. Rao, „EHVAC and HVDC transmission engineering and practice", Khanna Publishsers, 3rd edition.
3. HVDC Transmission by S K Kamakshaiah, V Kamaraju, TMH Publishers, 2011.

Web Resources:

1. https://nptel.ac.in/courses/108/104/108104013/
2. https://www.sciencedirect.com/topics/engineering/hvdc-power-transmission
3. https://www.power-technology.com/features/featurethe-worlds-longest-power-transmission-lines-4167964/
4. http://edisontechcenter.org/HVDC.html

EEEL11 :: Power Quality

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To make the student to understand about various Power quality problems
2. To make them familiar with Power Quality considerations in Industry.

COURSE OUTCOMES:

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

1. Illustrate the importance the severity of power quality problems in power system.
2. Identify different types interruptions, origin of interruptions, predictions and precautions.
3. Analyze voltage sag problems and suggest preventive techniques.
4. Explain Power Quality considerations in Industrial Power Systems.

COURSE CONTENT:

UNIT-I [Text book-2] [15]

INTRODUCTION: Introduction of the Power Quality (PQ) problem, General Classes of Power Quality Problems, Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms.

UNIT-II [Text book-1] [15]

LONG INTERRUPTIONS: Interruptions – Definition –causes of Long Interruptions – Origin of Interruptions – Limits for the Interruption frequency – Limits for the interruption duration – costs of Interruption.

SHORT INTERRUPTIONS: definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, mitigation methods of interruptions.

UNIT III [Text book-1] [15]

VOLTAGE SAG CHARACTERIZATION: Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, voltage sag calculation in non-radial systems, meshed systems, and voltage sag duration. Three phase unbalance, phase angle jumps, load influence on voltage sags, mitigation methods of voltage sag.

UNIT-IV [Text book-1] [15]

POWER QUALITY CONSIDERATIONS IN INDUSTRIAL POWER SYSTEMS: Computers, consumer electronics, adjustable speed AC drives and its operation. Mitigation of AC Drives, adjustable speed DC drives and its operation, mitigation methods of DC drives.

LEARNING RESOURCES:

TEXT BOOKS:

1. Understanding Power Quality Problems by Math H J Bollen. IEEE Press.
2. Electrical Power Systems Quality: Roger C. Dugan, MF McGranaghan, Surya Santoso and HW Beaty, TMH, 2/E

REFERENCE BOOKS:

1. Power Quality: Problems and Mitigation Techniques Bhim Singh et. al. John Wiley & Sons, 16-Feb-2015
2. Handbook of power quality by Angelo Baggini , John Wiley 2008.
3. Power Quality by C. Sankaran - CRC PRESS.
4. Power System Harmonics, Jos Arrillaga, Neville R. Watson, John Wiley & Sons, 2003.
5. Power Quality VAR Compensation in Power Systems, R. SastryVedam Mulukutla S. Sarma, CRC Press.
6. G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).
7. Angelo Baggini 'Handbook of Power Quality' – Wiley.

EEEL12 :: Flexible AC Transmission Systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To understand the need for reactive power compensation and system stability in AC transmission system.
2. To become familiar with operation of various FACTS controllers and their impact on AC transmission system.

COURSE OUTCOMES:

Upon successful completion of the course, the student will be able to:
1. Describe the importance of FACTS controllers in transmission system to enhance the system performance, control strategies for different types of converters for static compensation.
2. List different types of shunt compensators and their objectives, types and will be able to compare transient and dynamic stability performance of different controllers.
3. Describe the objectives of series compensators and importance of static voltage and phase angle regulators towards active, reactive power flow control.
4. Explain the concepts of UPFC and IPFC, control strategies for controlling P and Q.

COURSE CONTENT:

UNIT-I [Text Book- 1] (12)

FACTS Concept and General system Considerations:
Flow of power in an AC System-power flow and Dynamic stability Considerations of a Transmission Interconnection-Relative importance of Controllable Parameters-Basic Types of FACTS Controllers.
Converters for Static Compensation - Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM) - GTO Inverters - Multi-Pulse Converters and Interface Magnetics-Transformer Connections for 6 and 12 pulse operation.

UNIT-II [Text Book- 1&2] (12)

Static Shunt Compensators: SVC and STATCOM - Operation and Control of TSC, TCR, STATCOM - Comparison between SVC and STATCOM - STATCOM for transient and dynamic stability enhancement.

UNIT-III [Text Book-1] (12)

Static Series Compensation: GCSC, TSSC, TCSC and SSSC -Operation and Control - External System Control for series Compensators - SSR and its damping - Static Voltage and Phase Angle Regulators - TCVR and TCPAR - Operation and Control.

UNIT-IV [Text Book-1] (12)

UPFC and IPFC: The unified Power Flow Controller - Operation - Comparison with other FACTS devices - control of P and Q – Dynamic Performance - Special Purpose FACTS controllers - Interline Power flow Controller - Operation and Control.

LEARINING RESOURCES:

TEXTBOOKS:

1. Hingorani N. G. and Gyugyi L., 'Understanding FACTS', IEEE Press, Standard Publishers Distributors, 2001.
2. Mohan Mathur.R., Rajiv. K.Varma, 'Thyristor – Based Facts Controllers for Electrical Transmission Systems', IEEE press and John Wiley & Sons, 2000.

REFERENCE BOOKS:

1. PadiyarKR, 'FACTS Controllers in power transmission and distribution', New Age International Publications, 2001.
2. M.H. Rashid, 'Power Electronics, circuits, devices and applications' Pearson 3rd edition, 2005.
3. Miller T. J. E., 'Reactive Power Control in Electric Systems,' Wiley-Interscience, 1982.

WEB REFERENCES:

1. http://www.eetindia.co.in/VIDEO_DETAILS_700001240.html
2.http://nptel.iitm.ac.in
3.www.ece.unb.ca/sharaf/downloads/ppt/ppt_046.ppt

EEEL13 :: High Voltage Engineering

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To give fair knowledge about break down mechanism in gases.
2. To provide sufficient theoretical and analytical background to understand the concepts of generation of high DC, AC and impulse voltages.
3. To impart the knowledge on how the high voltages and currents are measured by using different measurement techniques
4. To brief testing methods of various high voltage electrical apparatus.

COURSE OUTCOMES:

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

1. Describe the concepts of break down mechanism in gases and generation of high DC voltages.
2. List generating methods of high DC,AC, Impulse voltages and currents.
3. Illustrate various methods to measure the different high voltages and currents in high voltage laboratory and inthe field.
4. Explain various methods of testing different high voltage equipment that are used in power system network.

COURSE CONTENT:

UNIT-I [Text Book-1] (15)

Break down mechanism in gases Gases as insulating media –ionization processes-Townsend's current growth equation-Towsend's criterion for break down.Break down in electro negative gases-time lags for breakdown-Stramer theory of break down in gases-Paschen's law-break down in non-uniform fields and corona discharges.

Generation of High D.C Voltages: principle of voltage doubler circuit – voltage multiplier circuits Cockcroft-Walton cascade arrangement and its mathematical analysis– Van de Graff generators- regulation of d.c voltages.

UNIT-II [Text Book-1&2](15)

Generation of High A.C Voltages cascade connection of transformers - resonant transformers- Tesla coil-numericalproblems.

Generation of Impulse Voltages: Standard specifications - standard wave shapes for testing - properties of double exponential wave shapes - approximate estimate of wave shape control resistors - Multistage impulse generator - Energy of impulse generator.

Generation of Impulse Currents: Standard specifications - analysis of impulse current generator- Generation of Rectangular current Pulses-Tripping and control of impulse Generators.

UNIT-III [Text Book-1] (16)

Measurement of High DC, AC Voltages and Impulse voltages: General concepts of High voltage measurements – series ammeter-potential dividers and generating voltmeters for the measurement of DC voltages Resistive, Inductive and Capacitive voltage dividers for high AC voltage and impulse voltage measurement. Use of fibre optic for the measurement of AC current-various shunts used for measuring DC current, and impulse currents.

UNIT-IV [Text Book-1&2](14)

Measurement of DC resistivity, measurement of dielectric constant and loss factor-partial

discharge measurements

High Voltage Testing Techniques: Testing of insulators – Bushings - isolators and CB's -

Testing of transformers, surge diverters and cables.

LEARNING RESOURCES:

TEXT BOOKS:

1. M.S. Naidu &V. Kamaraju- "High Voltage Engineering", Tata McGraw-Hill Education Pvt. Ltd,5thedition,2013.
2. CL Wadhwa-"High voltage engineering",New age International,Third edition,2010.

REFERENCE BOOKS:

1. Kuffel, E, Zaengl W.S, KuffelJ- "High Voltage Engineering fundamentals" ,Publishedby A.Wheaton&

COLtd.2nd edition,2000.
2. Ravindra Arora & Wolfgang Mosch ,"High Voltage Insulation Engineering", New Age International (P) Limited, 1st Edition, 1995.
3. Rakesh Das Begamudre-"Extra High Voltage AC transmission Engineering"New Age International, 4th Edition (reprint)– 2011.
4. Adolf J.Schwab-."High Voltage measurement techniques",M.I.TPressCambridge, Massachusetts,1972.

WEB REFERENCES:

1. http://www.generalcable-fr.com/Portals/france/pdf/en/2101_HVleaflet.pdf

2.http://www.energy.siemens.com/hq/pool/hq/energytopics/power%20engineering%20guide/PEG_70_KAP_03.pdf

3. http://www.elect.mrt.ac.lk/pdf_notes.htm
4. http://nptel.ac.in/courses/108104048/ui/TOC.htm
5. https://lecturenotes.in/subject/180/high-voltage-engineering-hve

EEEL14 :: Electrical Energy Conservation and Auditing

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To facilitate the students with the knowledge on energy audit of industries, buildings and organisation of energy management with proper controllers.
2. To enable the students to have a fair knowledge about power factor improvement methods and economical aspects of the industrial electrical equipment.

COURSE OUTCOMES:

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

1. List various methods of energy auditing of industries, buildings along with the conservation schemes.
2. Describe the detailed energy management schemes and controlling methods.
3. Examine the conservation concepts of variable speed, variable duty cycle systems and unbalanced voltage systems with compensating methods.
4. Illustrate the operation of energy instruments, economic analysis and aspects of the apparatus with different techniques.

COURSE CONTENT:

UNIT-I: [Text Book1] (15)

BASIC PRINCIPLES OF ENERGY AUDIT

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams, load profiles, Energy conservation schemes-

Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT-II: [Text Book1] (15)

ENERGY MANAGEMENT Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting

Energy manger, Qualities and functions, language, Questionnaire – check list for top management.

UNIT-III: [Text Book1] (15)

ENERGY EFFICIENT MOTORS Energy efficient motors , factors affecting efficiency, loss distribution , constructional details ,characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

POWER FACTOR IMPROVEMENT,

Power factor – methods of improvement, location of capacitors, Pf with non linear loads, effect of harmonics on power factor, power factor motor controllers

UNIT-IV: [Text Book1] (15)

LIGHTING AND ENERGY INSTRUMENTS

Good lighting system design and practice, lighting control ,lighting energy audit - Energy Instruments-wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers ,application of PLC's.

ECONOMIC ASPECTS AND ANALYSIS Economics Analysis-Depreciation Methods, time value of money, rate of return , present worthmethod , replacement analysis, life cycle costing analysis

Energy efficient motors- calculation of simple payback method, net present worth method- Power factor correction, lighting -Applications of life cycle costing analysis, return on investment.

LEARNING RESOURCES:

TEXT BOOKS:

1. W.R. Murphy and G. Mckay Butter worth, Energy management,Heinemann publications.
2. Paul o' Callaghan, Energy management, Mc-graw Hill Book company-1st edition, 1998

REFERENCE BOOKS:

1. John .C. Andreas, Marcel Dekker, Energy efficient electric motors,Inc Ltd-2ndedition, 1995-
2. W.C.Turner, Energy management hand book, John wiley and sons
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO

WEB RESOURCES:

1. http://www.enernoc.com/our-resources/term-pages/what-is-an-energy-audit
2. http://energy.gov/energysaver/professional-home-energy-audits
3. http://www.cpri.in/about-us/departmentsunits/energy-efficiency-and-renewable-energy-division-ered/energy-audit-services.

EEEL15 :: Power System Dynamics and Control

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To remember the dynamic characteristics of power system equipment,
2. To recognize dynamic performance of power systems.
3. To model different power system components for the study of stability.
4. To illustrate the system stability

Course Outcomes:

Upon the completion of the subject, the student will be able to

1. Choose the fundamental dynamic behavior and controls to perform basic stability analysis of power system network.
2. Comprehend concepts in modeling and simulating the dynamic phenomena of power systems Interpret results of system stability studies.
3. Analyze theory and practice of modeling main power system components, such as synchronous machines, excitation systems and governors
4. Illustrate Small signal analysis for the study of system stability.

COURSE CONTENT:

UNIT- I **[Text Book1] [15]**

Basic Concepts: Power system stability states of operation and system security – system dynamics – problems system model analysis of steady State stability and transient stability – simplified representation of Excitation control.

UNIT- II **[Text Book1] [15]**

Modeling of Synchronous Machine: Synchronous machine – park's Transformation-analysis of steady state performance per – unit quantities-Equivalent circuits of synchronous machine determination of parameters of equivalent circuits.

UNIT- III **[Text Book1] [15]**

Excitation System: Excitation system modeling-excitation systems block Diagram – system representation by state equations- Dynamics of a synchronous generator connected to infinite bus – system model Synchronous machine model-stator equations rotor equations – Synchronous machine model with field circuit – one equivalent damper winding on q axis – calculation of Initial conditions.

UNIT- IV **[Text Book1] [15]**

Analysis of Single Machine System: Small signal analysis with block diagram – Representation Characteristic equation and application of Routh Hurwitz criterion- synchronizing and damping torque analysis-small signal model – State equations.

TEXT BOOKS:

1. K. R. PADIYAR," Power system dynamics, stability and control "- B.S. Publications.
2. P.M. Anderson and A. A. Fouad, "Power system control and stability", IEEE Press

REFERENCE BOOKS:

1. R. Ramanujam, "Power Systems Dynamics"- PHI Publications.
2. P.Sauer & M.A.Pai, Power System Dynamics & Stability, Prentice Hall, 1997.

Web Resources:

1. https://nptel.ac.in/courses/108/101/108101004/
2. https://easyengineering.net/power-system-dynamics-stability-and-control-by-padiyar/
3. https://www.iitp.ac.in/~siva/2021/ee549/index.html

EEEL 16 :: Line-Commutated and Active PWM Rectifiers

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To provide sufficient knowledge on power electronic converters
2. To provide sufficient knowledge on modulation techniques of converters and multi-level inverters

COURSE OUTCOMES:

Upon completion of the course, students will demonstrate the ability to

1. Analyse controlled rectifier circuits.
2. Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse
a. configurations.
3. Understand the operation of PWM rectifiers – operation in rectification and regeneration
a. modes and lagging, leading and unity power factor mode.

COURSE CONTENT:

Unit-1 [Text Book1] [10]

Thyristor rectifiers with passive filtering

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.

Unit-2 [Text Book1] [10]

Multi-Pulse converter 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.

Unit-3 [Text Book1] [10]

Single-phase ac-dc single-switch boost converter

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.

Unit-4 [Text Book1] [10]

Ac-dc bidirectional boost converter & Isolated 1-ϕ ac-dc fly back converter

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. Dc-dc fly back 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.

TEXT BOOKS:

1. Principles of Thyristorised Converters - G. De-Oxford & IBH Publishing Co -1988-First edition.
2. Principles of Power Electronics -J.G. Kassakian,M. F. Schlecht and G. C. Verghese-Addison-Wesley,1991-Second edition.

REFERENCE BOOKS:

1. Power Electronics: Essentials and Applications- L-. Umanand -Wiley India, 2009-First edition.
2.Power Electronics: Converters, Applications and Design- N. Mohan and T. M. Undeland -John Wiley &Sons, 2007-Second edition.
3.Fundamentals of Power Electronics-. R. W. Erickson and D. Maksimovic -Springer Science & Business Media, 2001

WEB REFERENCES:

1. www.powerelectronics.com; % reference for applications
2. http://nptel.ac.in/courses/108101038/; % NPTEL course for power electronics

EEEL 17 :: Industrial Electrical Systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. The objective of the Industrial Electrical System program is to equip with the skills and knowledge.
2. To successfully carry out basic service and maintenance of Industrial Electrical Systems in a safe and environmentally sound manner.

COURSE OUTCOMES:

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

1. Illustrate various components of industrial electrical systems
2. Design electrical wiring systems for residential & commercial applications and their Illumination systems.
3. Select and analyze of various electrical protective & operating devices controlling.
4. Choose proper electrical system components for industrial electrical systems
5. Illustrate the concepts of different apparatus in industrial electrical systems automation.

COURSE CONTENT:

Unit-I:

Electrical System Components

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit-II:

Residential and Commercial Electrical & Illumination Systems

Types of residential and commercial wiring systems, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation.

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems.

Unit-III:

Industrial Electrical Systems

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Unit-IV:

Industrial Electrical System Automation

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

LEARNING RESOURCES:

TEXT BOOKS:

1. Industrial Electrical Systems – I, Dr. Deepak S. Bankar, Edition – 2018.
2. S. L. Uppal and G. C. Garg, " Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
3. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
4. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.

REFERENCE BOOKS:

1. Residential, Commercial and Industrial Electrical Systems, Hemant Joshi, TMH-2008

2. **Industrial Safety, Health and Environment Management Systems,** R. K. Jain, Sunil S. Rao, Khanna Publications – 2000.

WEB RESOURCES:

1. *https://www.essltd.ie*
2. *https://www.accessengineeringlibrary.com*
3. *www.intermountainelectronics.com*

EEEL18 :: Smart Electric grids

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To provide the students a systems perspective of modern electricity markets and a systems approach to address various issues faced by the electricity sector.
2. To provide the students an in-depth knowledge of how electricity markets operate from short-term system dispatch to long-term asset investments.
3. To present the student a vision of how Smart Grid will transform the current electricity grid to a reliable and sustainable modern energy system.

Course Outcomes:

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

1. Describe the structure of an electricity market in either regulated or deregulated market conditions.
2. Discuss about how (wholesale) electricity is priced in a transmission network.
3. Evaluate the trade-off between economics and reliability of an electric power system.
4. Illustrate the impacts of renewable resources to the grid and the various issues associated with integrating such resources to the grid.
5. Demonstrate the principles of Smart Grid, technology enabling, and demand participation, edge computing for Smart Grid.

COURSE CONTENT:

UNIT–I **[Text Book 1] 15**

INTRODUCTION: Introduction to smart grid- Electricity network-Local energy networks- Electric transportation- Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid.

SMART GRID TO EVOLVE A PERFECT POWER SYSTEM: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power Systems- Distributed power systems- Fully integrated power system-Nodes of innovation.

DC DISTRIBUTION AND SMART GRID: AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood-Potential future work and research.

UNIT–II **[Text Books 1,2] 15**

INTELLIGRID ARCHITECTURE FOR THE SMARTGRID: Introduction- Launching intelligrid-Intelligrid today- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies.

DYNAMIC ENERGY SYSTEMS CONCEPT: Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems- Integrated communications architecture-Energy management-Role of technology in demand response-

Current limitations to dynamic energy management-Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices- Key characteristics of advanced whole building control systems-Key characteristics of dynamic energy management system.

UNIT–III **[Text Books 1,2] 15**

ENERGY PORT AS PART OF THE SMART GRID: Concept of energy -Port, generic features of the energy port.

POLICIES AND PROGRAMS TO ENCOURAGE END – USE ENERGY EFFICIENCY: Policies and programs in action -multinational - national-state-city and corporate levels.

MARKET IMPLEMENTATION: Framework-factors influencing customer acceptance and response - program planning-monitoring and evaluation.

UNIT–IV **[Text Book 3] 15**

EDGE COMPUTING FOR SMART GRID: AN OVERVIEW ON ARCHITECTURES AND SOLUTIONS:

Introduction- IoT Applications, Requirements, and Architecture- Smart Grid, Information Processing in Smart Grid, Edge Computing in Internet of Things, Edge Computing Model for Smart Grid, Current Art in Edge Computing and Smart Grid, Case study

LEARNING RESOURCES:

TEXT BOOKS:

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response" - CRC Press, 2009.
2. James Momoh, "Smart Grid :Fundamentals of Design and Analysis"-Wiley, IEEE Press,2012.
3. Dimitrios Soudris, Elias Kosmatopoulos, "IoT for Smart Grids Design Challenges and Paradigms", Springer International Publishing, 2018.

REFERENCE BOOKS:

1. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press
5. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, AkihikoYokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012
6. Gellings, C.W., Wikler, G., and Ghosh, D., "Assessment of U.S. Electric End-Use Energy Efficiency Potential," The Electricity Journal, Vol. 19, Issue 9, November 2006.

WEB RESOURCES:

1. http://smartgrid.ieee.org/
2. https://nptel.ac.in/courses/108/107/108107113/
3.http://www.iitk.ac.in/ime/anoops/for15/ppts/Day2%20IITK/Smart%20Grid%20Concept%20&%20Deployment-%20Dr.%20Saikat%20Chakrabarty.pdf
4. http://large.stanford.edu/courses/2015/ph240/xu1/docs/epri-1016905.pdf .
5. https://www.keystone.org/wp-content/uploads/2015/08/05-2003-Keystone-Dialogue-on Global-Climate-Change.pdf
6. http://www.indiasmartgrid.org/_.

EEEL 19 :: Digital Control Systems

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To understand the concepts of digital control systems and assemble various components associated with it.
2. The theory of z–transformations and application for the mathematical analysis of digital control systems.
3. To represent the discrete–time systems in state–space model and evaluation of state transition matrix.
4. To examine the stability of the system using different tests and study the design of state feedback control by "the pole placement method."

COURSE OUTCOMES:

1. The students learn the advantages of discrete time control systems and the "know how" of various associated accessories.
2. The learner understand z–transformations and their role in the mathematical analysis of different systems (like Laplace transforms in analog systems).
3. The stability criterion for digital systems and methods adopted for testing the same are explained.
4. Finally, the conventional and state space methods of design are also introduced.

COURSE CONTENT:

UNIT – I: [Text book-1] (15)

Signal processing and z–transformations

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT – II: [Text book-1] (15)

Stability analysis

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

UNIT-III: [Text book-1] (15)

Design of discrete–time control systems by conventional methods

Transient and steady state specifications – Design using frequency response in the w–plane for lag and lead compensators – Root locus technique in the z–plane.

UNIT–IV: [Text book-2] (15)

State space analysis and design

State space representation of discrete time systems – State transition matrix and methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests(without proof). Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

TEXT BOOKS:

1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition.

REFERENCE BOOKS:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.
2. Digital Control Systems – by P.N. Paraskevopoulos, Prentice Hall, 1996.

EEEL 20 :: Control Systems Design

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To design different control systems for different applications as per given specifications
2. To discuss basic aspects of design and compensation of linear control systems using Bode plots.
3. To analyse and design feedback control systems with P,PI,PID Controllers
4. To give an idea on state space analysis, and state feedback controllers design.

COURSE OUTCOMES

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

1. Able to design Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
2. Control systems for various applications can be designed using time-domain and frequency domain analysis.
3. Design simple control systems and modify the parameters to meet specific requirements
4. Connect the course content to real time applications in various electrical and electronics engineering applications.

COURSE CONTENT

UNIT – I **[Text book-1] (15)**

Compensators design

Introduction to design using compensators, Lag, Lead, Lag-Lead compensators, design of compensators – using Root locus and Bode plot.

UNIT–II **[Text book-1] (15)**

Controllers design

PI,PD and PID controllers design in both time domain and frequency domain.

UNIT – III **[Text book-2] (15)**

State Space Analysis of LTI Systems

Concepts of state, state variables and state model, state space representation of transfer function, Diagonalization- Solving the time invariant state equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

UNIT – IV **[Text book-1] (15)**

State feedback controllers Design: Feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

LEARNING RESOURCES:

TEXT BOOKS:

1. Goodwin, G.C. Graebe, S.F. and M.E. Salgado, "Control stem Design", Prentice Hall of India, 2001.
2. Modern Control Engineering by Ogata. K – Prentice Hall – 1997.

REFERENCE BOOKS:

1. Friedland, B "Advanced Control System Design", Prentice Hall Int., 1966.
2. Modern control systems, Richard C. Dorf and Robert H. Bishop, 11th Edition, Pearson Edu, India, 2009.

EEEL21 :: Digital Signal Processing

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To provide sufficient theoretical, analytical background about digital signals and systems.
2. Make the student to learn about Z- transform& Fourier transformation.
3. To understand the differences between DFT& FFT Transforms.
4. Make the student to design analog and digital IIR filters & FIR filters.
5. To study the realization of digital filters.

COURSE OUTCOMES:

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

1. Get familiarity with discrete time signal processing and characterization of random signals filter design techniques.
2. Learn how to calculate the discrete Fourier series, Fourier transform for discrete time systems and discrete Fourier transform using FFT algorithms.
3. Learn the theory of modern digital signal processing and digital filter design, including window's techniques involving digital filter design.
4. Connect the course content to real time applications in various electrical and electronics engineering applications.
5. Expertise the fundamental principles, techniques of digital signal processing for understanding, designing new digital signal processing systems and for continued learning.

COURSE CONTENT:

UNIT – I (TEXT BOOK-1 & 2) (15)

DISCRETE TIME SIGNALS AND SYSTEMS: Introduction to digital signal processing - Advantages and applications – Classification of signals-discrete time signals, representation. LTI system: Stability and causality.

Z-TRANSFORMS: Z-transforms - Region of convergence - Z-transform properties - Relation between Z-transform and Fourier transform of a sequence - Inverse Z transform using Partial fraction method, Cauchy's integration theorem - Solution of difference equations using one sided Z-transform.

UNIT – II (TEXT BOOK-1 & 2) (15)

DFS & DFT: Discrete Fourier Series - Properties of DFS - Discrete Fourier Transform - Properties of DFT - Linear convolution using DFT.

FFT: Computations for evaluating DFT - Decimation in time FFT algorithm - Decimation in frequency FFT algorithm - Computation of inverse DFT.

UNIT – III (TEXT BOOK-1 & 2) (15)

IIR FILTER DESIGN TECHNIQUES: Introduction - Properties of IIR filters - Design of Analog Butterworth and Chebyshev filters, Design of Digital Butterworth and Chebyshevfilters using bilinear transformation - Impulse invariance transformation methods. Design of digital filters using frequency transformation method.

UNIT – IV (TEXT BOOK-1 & 2) (15)

FIR FILTER DESIGN TECHNIQUES: Introduction - Characteristics of linear phase FIR filters - Frequency response. Designing FIR filters using Fourier series method, windowing methods: Rectangular window - Bartlett triangular window - Hanning window - Hamming window - Blackman window - Comparison of IIR and FIR filters.

REALISATION OF DIGITAL FILTERS: IIR Filters: Direct – Canonic – Cascade – Parallel realizations. FIR Filters: Direct, Cascade and linear phase realizations.

Learning Resources:

TEXT BOOKS:

1. John G.Proakis, Dimitris G Manolakis, "Digital Signal Processing: Principles, Algorithms andApplications", Pearson Education / PHI, 2015.

2. P. Ramesh Babu, "Digital Signal Processing", 6th Edition, Scitech Publications, 2015.

REFERENCE BOOKS:

1. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2015.
2. Johnny R. Johnson, "Introduction to Digital Signal Processing", PHI, 2009.

Web Resources:

1. https://nptel.ac.in/courses/117/102/117102060/
2. http://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/video-lectures/
3. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur#

EEEL 22 :: Computer Architecture

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To understand the basic organization of modern computer systems and interpret how computer programs are organized, stored, and executed at the machine level.
2. To understand the input/output mechanisms used to connect computers to their external environments.
3. Understand the concepts of microprocessors, their principles and practices.
4. To expose to the concept of pipelining.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to

1. Organize a modern computer system and be able to relate it to real examples.
2. Connect computers to their external environments by using input/output mechanisms.
3. Write efficient programs in assembly language of the 8086 family of microprocessors.
4. Describe compiler techniques.

COURSE CONTENT:

Unit I: [TEXT BOOK-1] [15]

Introduction to computer organization

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic.

Memory organization

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit II: [TEXT BOOK-1] [15]

Input – output Organization

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit III: [TEXT BOOK-1] [15]

16 and 32 microprocessors

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction setof 80x86, I/O addressing in 80x86.

Unit IV: [TEXT BOOK-1] [15]

Pipelining

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

Different Architectures

VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming.

TEXT BOOKS:

1. Computer System Architecture, M. Morris Mano, Prentice Hall of India Pvt. Ltd., Third Edition, Sept. 2008.
2. Computer Architecture and Organization, William Stallings, PHI Pvt. Ltd., Eastern Economy Edition, Sixth Edition, 2003.

REFERENCE BOOKS:

1. J. L. Hennessy and D. A. Patterson, "Computer Architecture A QuantitativeApproach", Morgan Kauffman, 2011.
2. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.

WEB RESOURCES:

1. http://www.cs.iit.edu/~virgil/cs470/Book/
2. http://www.ddegjust.ac.in/studymaterial/msc-cs/ms-07.pdf
3. https://www.aminotes.com/2018/11/computer-organisation-and-architecture_16.html

EEEL 23 :: Electromagnetic waves

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. To Provide solution to real life plane wave problems for various boundary conditions.
2. To Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
3. To Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
4. To Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Solve real life plane wave problems for various boundary conditions.
2. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
3. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.

COURSE CONTENT:

Unit I: [Text Book-1] [15]

Maxwell's Equations

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Displacement Current Density, Maxwell's Equations in Different Final Forms, Conditions at a Boundary Surface: Dielectric – Dielectric.

Unit II: [Text Book-1] [15]

Plane Waves at media interface

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Unit III: [Text Book-1] [15]

Transmission Lines

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless transmission line, Distortion - Condition for Distortionlessness and Minimum Attenuation, Illustrative Problems.

Unit IV: Waveguides [Text Book-1] [15]

Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Text Books

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
2. M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.

REFERENCE BOOKS:

1. D. K. Cheng, " Field and Wave Electromagnetics", Addison-Wesley, 1989.
2. C. A. Balanis, " Advanced Engineering Electromagnetics", John Wiley &Sons, 2012.

WEB RESOURCES:

1. https://scholar.harvard.edu/files/david-morin/files/waves_electromagnetic.pdf
2. http://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
3. http://freevideolectures.com/Course/2340/Electromagnetic-Fields#

EEEL 24 :: Computational Electromagnetics

L	T	P	C	Int	Ext
3	-	-	3	30	70

Course Objectives:

1. Understand conventional design methodology to study electromagnetic fields.
2. Apply various methods to solve electromagnetic field related problems.
3. Use numerical methods to study accuracy and stability.
4. Discuss numerical methods for efficient finite element computation.

Course Outcomes:

At the end of this course, students will able to

1. Understand design methodology to study electromagnetic fields.
2. Implement various methods to solve electromagnetic field related problems.
3. Apply numerical methods to study accuracy and stability.
4. Use numerical methods for efficient finite element computation.

UNIT I: [Text Book-1] [15]

INTRODUCTION TO COMPUTATIONAL METHODS

Conventional design methodology, Computer aided design aspects, advantages. Review of basic fundamentals of electrostatics and electromagnetics, development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic diffusion-transients and time-harmonic.

UNIT II: [Text Book-1] [15]

ANALYTICAL METHODS

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

UNIT III: [Text Book-1] [15]

FINITE DIFFERENCE METHOD

Finite difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions; Finite Difference Time-Domain (FDTD) method- Uniqueness and convergence.

UNIT IV: [Text Book-1] [15]

FINITE ELEMENT METHOD

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

LEARNING RESOURCES:

Text Books:

1.Analytical and Computational Methods in Electromagnetics, By R.Garg, ArtechHousePublication

2. Computational Methods for Electromagnetics and Microwaves,By R.C Booton, Jr, , John Wiley & Sons

Reference Books

1. P. P. Silvester and R. L. Ferrari " Finite Element for Electrical Engineers" , Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

Web Resources:

1. https://ece.iisc.ac.in/~dipanjan/E8_202/E8-202.html
2. *https://onlinecourses.nptel.ac.in/noc21_ee91/preview*
3. *https://my.ece.utah.edu/~ece6340/*

EEEL25 :: Power system Deregulation

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To provide in-depth understanding of operation of deregulated electricity market systems.
2. To examine typical issues in electricity markets and how these are handled world-wide in various markets.
3. To enable students to analyze various types of electricity market operational and control issues using new mathematical models.

COURSE OUTCOMES:

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

1. Illustrate the operation of deregulated electricity market systems
2. Explain different electricity market mechanisms
3. Understand typical issues in electricity markets
4. Analyze various types of electricity market operational and control issues using new mathematical models.

COURSE CONTENT:

UNIT I [Text Book-1](15)

DEREGULATION OF ELECTRIC UTILITIES: Introduction – Traditional central utility model, reform motivations, separation of ownership and operation

Competition and direct access in the electricity market, independent system operator (ISO), retail electric providers, different experiences.

COMPETITIVE WHOLESALE ELECTRICITY MARKETS:

Introduction, ISO, wholesale electricity market characteristics, market model, challenges, trading arrangements

UNIT II [Text Book-1] (15)

TRANSMISSION OPEN ACCESS:

The pool and bilateral trades, multi lateral trades.

TRANSMISSION COST ALLOCATION METHODS: Introduction - Postage Stamp Rate Method - Contract Path Method - MW-Mile Method

Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods

UNIT III [Text Book-1] (15)

MARKET POWER: Introduction - Different types of market Power – Mitigation of Market Power – Examples

ANCILLARY SERVICES MANAGEMENT: Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

UNIT IV [Text Book-1] (15)

AVAILABLE TRANSFER CAPABILITY (ATC): Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow

Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

LEARNING RESOURCES:

TEXT BOOKS:

1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd., England, 2001.

REFERENCE BOOKS:

1. Kankar Bhattacharya, Operation of Restructured Power System, Math H.J. Boller and Jaap E.DaalderKulwer Academic Publishers, 2001.

2. Marcel Dekker, Restructured Electrical Power Systems, Inc., 2001.
3. Geoffrey Rothwell, Tomas Gomez, Electricity Economics: Regulation and Deregulation, Wiley-IEEE Press.
4. J.W. Marangon Lima and E.J. de Oliveira, 'The long-term impact of transmission pricing', IEEE Transactjons on Power Systems, Vol. 13, No.4, November 1998

WEB RESOURCES:

1. http://www.nptel.ac.in/courses/108101005/BTM consult Aps,
2. http://www.btm.dk/Articles/fed-global/fed-global.html

EEEL26 :: AI Tools techniques and applications

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To cater the knowledge of Neural Networks and Fuzzy Logic Control and use these for controlling real time systems.
2. The goal of this course is to give a good basic understanding of Neural Networks and Fuzzy Logic and their applications to power system.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to:
1. Use concepts of feed forward and feedback neural networks for given application
2. Illustrate the concept of fuzziness involved in various systems.
3. Design hybrid fuzzy neural networks
4. Apply hybrid systems and neural and fuzzy applications to power system.

COURSE CONTENT:

UNIT – I [Text Book 1] (12)

Artificial Neural Network: Concept – evolution – basic models – Notation and terminology – training Supervised learning Network: Introduction – Perceptron networks –Back propagation network – radial basis network

Associative Memory Networks: Training algorithms for pattern association – Auto associative memory network – Bidirectional associative memory – Hopfield networks – Iterative auto associative memory networks

UNIT- II [Text Book 1] (12)

Fuzzy logic: Classical sets – fuzzy sets – classical relations – fuzzy relations – tolerance and equivalence relations – Membership functions Fuzzification and Defuzzification: Fuzzification – Membership value assignments – Defuzzification – Fuzzy arithmetic – Fuzzy measures – Fuzzy rule base and approximate reasoning – fuzzy decision making.

UNIT – III [Text Book 1] (12)

Hybrid fuzzy neural networks: Hybrid system – fuzzy logic in learning algorithms - fuzzy neurons - Neural networks as pre-processors, post processors, tuners FNN architecture based on back propagation .

UNIT –IV [Text Book 1] (12)

Neural network applications: Process identification, control, fault diagnosis and load forecasting. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

LEARNING RESOURCES:

TEXT BOOKS:

1. Rajasekharan and Pai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications – PHI Publication.
2. Chennakesava R Alavala,Fuzzy logic and Neural networks: Basic concepts and applications by New Age International (P) Ltd., 2008

REFERENCE BOOKS:

1. James A Freeman and Davis Skapura, Neural Networks –Pearson Education, 2002.
2. Simon Hakins ,Neural Networks –Pearson Education
3. C.Eliasmith and CH.Anderson,Neural Engineering - PHI
4. Bart Kosko,Neural Networks and Fuzzy Logic System, PHI Publications.
5. S.N.Sivanandam, S.N.Deepa, Principles of soft computing - John Wiley India – 2007

WEB RESOURCES:

1. http://users.abo.fi/rfuller/nfs.html
2. http://www.rejinpaul.com/2012/04/ic2403-neural-networks-and-fuzzy-logic.html
3. www.neptel.iim.ac.in
4. http://en.wikipedia.org/wiki/Artificial_neural_network
5. http://machine-learning.martinsewell.com/ann/ 6. http://neurosci.wikidot.com/artificial-neural-network

EEOL1 :: RENEWABLE ENERGY SOURCES

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To discuss about depletion rate of conventional energy resources and importance of renewable energy sources.
2. To describe alternate viable energy sources to meet the energy requirements.
3. To discuss about solar energy, wind energy, tidal energy and geothermal energy as alternate sources.
4. To teach about biogas production process, usage of digester for power generation.

COURSE OUTCOMES:

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

1. Illustrate the national scene of energy production, utilization, consumption and energy storage systems.
2. Describe the basics of solar energy, generation of electricity from solar energy & photovoltaic's.
3. Assess wind energy potential, wind turbines and wind generators.
4. Outline the details of ocean energy, temperature differences & principles, extraction of energy from waves, geothermal, biogas.

COURSE CONTENT:

UNIT - I **[Text Book- 1](8)**

Principle of Renewable Energy: Comparison of Renewable and Conventional energy sources - Ultimate energy sources - natural energy currents on earth - primary supply to end use - Spaghetti & Pie diagrams - Energy planning - Energy Efficiency and Management.

UNIT - II **[Text Book- 2](12)**

Solar Radiation: Extra terrestrial solar radiation - terrestrial solar radiation - solar thermal conversion-Solar Thermal Central Receiver system - Photovoltaic energy conversion - solar cell. (only theoretical analysis)

UNIT – III **[Text Book- 2](12)**

Wind energy: Planetary and local winds - Vertical axis and Horizontal axis wind mills - principles of wind power - maximum power – actual power - wind turbine operation.
(only theoretical analysis)

UNIT - IV **[Text Book- 2](12)**

Energy from Oceans: Ocean temperature differences - principles of OTEC plant operations - wave energy - devices for energy extraction - tides - Simple single pool tidal system.
Geothermal Energy: Origin and types - Bio fuels - classification – Direct combustion for heat and electricity generator - anaerobic digestion for biogas - biogas digester - power generation.
(only theoretical analysis)

LEARNING RESOURCES

TEXT BOOKS:

1. John Twidell & Toney Weir "Renewable Energy Sources" E&F.N. Spon
2. G.D.Rai"Non-Conventional Energy Sources"Khanna Publishers.

REFERENCE BOOKS:

1. EL-Wakil"Power Plant Technology" McGraw-Hill Publications.
2. Abbasi&Abbasi"Renewable Energy Sources" Their impact on global warming and pollution by – PHI.

WEB RESOURCES:

1. https://www.eia.gov/energyexplained/renewable-sources/
2. https://www.justenergy.com/blog/7-types-of-renewable-energy-the-future-of-energy/
3. https://www.studentenergy.org/topics/renewable-energy

EEOL2 :: Utilization of Electrical Energy

L	T	P	C	Int	Ext
3	-	-	3	30	70

COURSE OBJECTIVES:

1. To know about the different types of lamps & lighting schemes.
2. To know about the different types electric heating methods.
3. To know the design heating elements such as furnaces and ovens.
4. To know to utilize the electrical energy for production of heat and welding process.
5. To provide specific knowledge on Principles and characteristics of storage batteries.

COURSE OUTCOMES:

After successful completion of the course, the students are able to
1. Categorize different types of lamps & lighting schemes.
2. Investigate the mechanisms of electrical heating.
3. Design heating elements such as furnaces and ovens.
4. Illustrate the types and requirements of welding.
5. Outline the types, principles, applications and characteristics of storage batteries.

Course Content:

UNIT I Text Book - 1 (12)

Illumination: Introduction- terms used in illumination-laws of illumination - Square law methods of calculation.
Gas discharge lamps - Fluorescent lamps - Arc lamps - Filament lamps - Comparison between filament and fluorescent lamps.

Lighting schemes & Introduction to Electric heating : Factory lighting - flood lighting and street lighting-design of lighting schemes-introduction to Compact Fluorescent Lamps.
Introduction-Modes of heat transfer - Stefan's law - Classification of electric heating methods

UNIT II Text Book - 1 (12)

Electric Heating element Design and types of furnaces : Design of heating element - Construction and working of different types of induction furnaces -resistance furnace - arc furnaces.
Dielectric heating, Dipole formation, generation of dielectric heat and applications.

UNIT III Text Book - 1 (12)

Welding : Introduction- Types of welding - resistance and arc welding -Characteristics of Carbon and metallic arc welding - comparison, welding equipment.
Requirements of good weld, comparisons of A.C and D.C weld (Excluding electronic controls)

UNIT IV Text Book - 1 (12)

Storage batteries : Types of cells. Lead acid cell, Nickel Iron cell, Chemical changes during charging and discharging. Applications - rating - classification-dry cell and wet cells.
Methods of charging & common troubles : Charging and discharging of lead acid cells, methods of charging lead acid batteries - over discharging common troubles with lead acid batteries and remedies - Nickel cadmium batteries.

LEARNING RESOURCES:

TEXT BOOK(s):

1. J.B. Gupta - Utilization Electric Power and Electric Traction, Katson books publishers, Tenth Edition, 2012.
2. Utilization, generation & conservation of electrical energy by Sunil S Rao, Khanna publishers, Sixth Edition, 2005.

REFERENCE BOOK(s):

1. Partab H - Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Sons, New Delhi, Second Edition, 2009.
2. R.K.Rajput - Utilization of Electric Power, Laxmi publications Private Limited, Second Edition, 2013.
3. G.C.Garg - Utilization of Electric Power and Traction, Kanna publishers, Ninth Edition, 2014.

WEB RESOURCES:

1. http://nptel.iitm.ac.in/video.php?subjectId=108105060
2. http://web.mit.edu/lien hard/www/ahttv201.pdf
3. http://www.comp-as.com/pdf/Article03.pdf
4. www.srmuniv.ac.in/downloads/welding.doc

EEMC1 :: ENVIRONMENTAL SCIENCE

[MANDATORY NON-CREDIT COURSE – ACTIVITY BASED]

Semester I [FIRST Year]

L	T	P	C	Int	Ext
2	0	0	-	100	-

COURSE OBJECTIVES:

1. Understand that humans are an integral part of environment and hence their activities reflect on the environment
2. Realize and appreciate the importance of ancient practices and their importance in the present times
3. Appreciate the contribution of individuals for the upkeep of environmental standards, in turn help the humans live better.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Evaluate the implications of human activities and thereby promote eco friendly technologies
2. Promote awareness among the members of the society for a sustainable environment
3. Include and give priority to environmental protection in all developmental projects

A. AWARENESS ACTIVITIES – SMALL GROUP MEETINGS

I. Source of water for human consumption/activities:
   - a. collection of information pertaining to water resources and consumption in Andhra Pradesh
   - b. Water resource on campus: General/Laboratory use and
   - c. Drinking water – understand the background and adopt judicious management.
   - d. Recycled water for Gardening – Particularly Lawns.
   - e. Cut down wastage of electricity in class rooms/labs/hostels etc. by avoiding misuse.

II. After the group meetings and exposure to the local issues and healthy practices, students motivated to make:
   a. Posters b. Slogans/One liners for promoting awareness

III. Lectures from Experts (at least 2 in the course duration)

IV. A walk in the neighbourhood to promote a chosen theme on environmental consciousness.

B. ACTUAL ACTIVITIES

1. Plantation on Campus and on the sides of approach road.
2. Distribution of saplings to the local colony dwellers and encourage plantation.
3. Development of Kitchen garden on campus – Cultivation of atleast leafy vegetables and creepers like cucumber etc. for use in college canteen/hostels etc.
4. Adoption of "NO PLASTICS" on campus.
5. Field trip to gain knowledge of biodiversity, water shed, mining, pollution and other local issues.
6. Preparation of working models for energy generation/transformation etc.

C. THEORY SYLLABUS FOR ASSESSMENT

Part-I

1. Introduction to Environmental Studies, Scope and Importance.

2. Natural resources Renewable and Non-Renewable; Definition and importance of the following resources in detail: a. Forest b. Water c. Land d. Energy

3. Sustainable development - Concept and Measures.

4. Biodiversity - Definition, Types of Biodiversity, Values and threats to Biodiversity, Conservation of biodiversity, IUCN classification: Endangered, Threatened, Vulnerable, Rare species;
Endemic and Exotic species.
5. Climate change - Global warming, Ozone depletion and Acid rain.

Part-II

6. Water shed, water shed management in detail.
7. Solid wastes and Solid waste management.
8. Environmental Legislation, Environmental acts - Wild life protection act, Water act, Forest conservation act, Air act and Environmental protection act.
9. Case studies: Chernobyl nuclear disaster, Bhopal gas tragedy, Narmada bachao andolan,
Silent valley, Story of Tuvalu, Story of Ganga.
10.Earth summit and Kyoto protocol; Measures at individual level for conservation of natural resources and sustainable development.

Text Books:

1. Anubha Kaushik and C.P.Kaushik - Environmental Studies, 3rd Edition, New Age International Publishers, New Delhi., 2012.
2. R. Rajagopalan - Environmental studies from crisis to cure, 3rd Edition, Oxford University press, 2012.

ASSESSMENT

1. Two assessments each o f 30 marks will be done in the semester. The split up of eachassessment is as follows:
a. Two internal theory examinations will be conducted for 18 marks each.
b. Evaluation of the prepared activity sheets and working models will be done for 7M (continual evaluation) twice in the semester in line with the theory examination.
c. 5 Marks for attendance.
Note: Weightages for a, b & c will be taken as per the assessment guidelines of the R-20 curriculum and projected to 100 marks.

EEMC2 :: CONSTITUTION OF INDIA
Semester II [FIRST Year]

L	T	P	C	Int	Ext
2	0	0	-	100	-

COURSE OBJECTIVES:
To provide basic information about Indian Constitution.

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Understand the significance of many provisions of the Constitution as well as to gain insight into their back ground. They will also understand number of fundamental rights subject to limitations in the light of leading cases.
2. Study guidelines for the State as well as for the Citizens to be followed by the State in the matter of administration as well as in making the laws. It also includes fundamental duties of the Indian Citizens in Part IV A (Article 51A).
3. Understand administration of a State, the doctrine of Separation of Powers.
4. Know how the State is administered at the State level and also the powers and functions of High Court.
5. Understand special provisions relating to Women empowerment and also children. For the stability and security of the Nation, Emergency Provision are Justified.
6. Understand election commission as an independent body with enormous powers and functions to be followed both at the Union and State level. Amendments are necessary, only major few amendments have been included.

UNIT I [CO:1] (10)

Preamble to the Constitution of India Domicile and Citizenship. Fundamental rights under Part III, Leading Cases. Relevance of Directive Principles of State Policy under Part-IV, IV-A Fundamental duties.

UNIT II [CO:2,3] (10)

Union Executive - President, Vice-President, Prime Minister, Union Legislature - Parliament and Union Judiciary - Supreme Court of India. State Executive - Governors, Chief Minister, State Legislature and High Court.

UNIT III [CO:3,5] (10)

Special Constitutional Provisions for Scheduled Casters and Tribes, Women and Children and Backward Classes, Emergency Provisions.

UNIT IV [CO:6] (10)

Electoral process, Centre State Relations (Amendment Procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments).

LEARNING RESOURCES:

TEXT BOOK:
Durga Das Basu: "Introduction to the Constitution of India" (student edition) Prentice - Hall EEE, 19th/20th Edition, 2001.

REFERENCE BOOK(s):
1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. Brij Kishore Sharma, "Introduction to the Constitution of India", PHI, Learning Pvt.Ltd., New Delhi, 2011.

EEMC3 :: ETHICS & HUMAN VALUES
Semester III [Second Year]

L	T	P	C	Int	Ext
2	0	0	-	100	-

COURSE OBJECTIVES:

1. To create awareness to specific set of morals, values and ethics the professional must know and abide by, including work ethics, integrity and commitment etc.
2. To realize the importance of moral autonomy, professional ideals and Ethical theories
3. To study safety/risk aspects ,welfare of the public and about employee rights
4. Know about the global issues and code of ethics of professional bodies

COURSE OUTCOMES:

After successful completion of the course, the students are able to

1. Have basic understanding of how a prospective engineer should behave in his chosen field and society.
2. Realize the importance of moral autonomy, professional ideals and Ethical theories.
3. Know about the safety/ risk , welfare of the public and employee rights
4. Gain exposure to global issues and codes of some professional bodies

UNIT I [CO:1] (15)

Human Values : Morals, Values And Ethics - Integrity- Work Ethics- Service Learning - Civic Virtue- Respect For Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-Operation - Commitment - Empathy - Self-Confidence - Character - Spirituality.

UNIT II [CO:2] (15)

Engineering Ethics: Senses Of Engineering Ethics- Variety of Moral Issues - Types of Inquiry - Moral Dilemmas - Moral Autonomy - Kohlberg's Theory - Gillian-s Theory - Consensus and Controversy Professions and Professionalism: The nature and characteristics of Professions, Professionalism, the foundation and norms of Professional ethics, the need for separate code of conduct for Professionals, Professional Rights, Theories about Right Action, Uses of Ethical Theories. Case studies like The Space Shuttle Challenger, Bhopal gas tragedy, Chernobyl disaster etc.

UNIT III [CO:3] (15)

Engineering as Social Experimentation: Engineering As Experimentation - Engineers As Responsible Experimenters Safety, Responsibilities and Rights: Safety and Risk - Assessment of Safety And Risk - Risk Benefit Analysis And Reducing Risk.Collegiality And Loyalty - Respect For Authority -Collective Bargaining - Confidentiality - Conflicts Of Interest - Occupational Crime - Employee Rights - Intellectual Property Rights (IPR)- Discrimination.

UNIT IV [CO:4] (15)

Multinational Corporations - Environmental Ethics - Computer Ethics - Business ethics - Engineers As Managers - Consulting Engineers - Engineers As Expert Witnesses and Advisors - Codes Of Ethics - Sample Code Of Ethics Like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management Etc.,

LEARNING RESOURCES:
TEXT BOOK(s):

1. Mike martin and Ronald Schinzinger, "Ethics in Engineering" McGraw-Hill, New York 1996
2. Govindarajan M, Natarajan S, Senthil Kumar V.S., "Engineering Ethics", PHI, New Delhi, 2004
3. Bayles.M.D, Professional ethics, California, Wardsworth publishing company,1981
4. Koehn.D, The ground of Professional Ethics, Routledge,1995

REFERENCE BOOK(s):

1. Charles D,Fleddermann, "Engineering Ethics", Pearson / PHI, New Jersey 2004 (Indian Reprint)
2. Charles E Harris, Michael S.Protchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases" Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, "Ethics and the conduct of business" Pearson, New Delhi, 2003.
4. Edmund G.Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers" Oxford University Press, Oxford, 2001.

EEMC4 :: DESIGN THINKING & PRODUCT INNOVATION

Semester IV [Second Year]

L	T	P	C	Int	Ext
2	0	0	-	100	-

COURSE OBJECTIVES:

1. Identify the design thinking processes and methods.
2. Plan research activities to gather and empathize from a user's viewpoint.
3. Ideate techniques to help arrive at the best solution and evaluation.
4. Identify design thinking approaches for business challenges.

COURSE OUTCOMES:

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

1. Interpret the concepts of Design thinking.
2. Investigate a problem to determine its root cause.
3. Take part in group thinking and experiment with different solutions.
4. Develop innovative thinking and creative problem solving.

UNIT – I [CO1]

Introduction to Design Thinking – Origin of Design Thinking, Features & Principles of Design Thinking, Applications of Design Thinking, Role of Research in Design Thinking. [8periods]

UNIT – II [CO 2]

Modules of Design Thinking – Inspiration – methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity. [8periods]

UNIT – III [CO 3]

Modules of Design Thinking– Ideation & Implementation – methods &tools used in Experiment, Engage and Evolve phases of Design Thinking, Case study-activity. [8periods]

UNIT – IV [CO 4]

Design Thinking applied in Business & Strategic Innovation – Ten Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization, Creative Culture, Strategy & Organization – Design Thinking approaches. [8periods]

LEARNING RESOURCES:

TEXT BOOKS:

1. "Design Thinking for Entrepreneurs and Small Businesses" by Beverly Rudkin Ingle, Apress. [UNIT -1]
2. "Change by design", Tim Brown, Harper Collins, 2009 [UNIT -1]
3. "Design Thinking- The Guide Book" – Facilitated by the Royal Civil service Commission, Bhutan.[UNIT –II & III]
4. Idris Mootee, "Design Thinking for Strategic Innovation", John Wiley & Sons (2013).[UNIT -IV]

REFERENCE BOOKS:

1. "Design Thinking Business Innovation", Rio de Janeiro – 2012 1st edition, MJV press.
2. "Design Thinking- Understanding How Designers Think and Work" by Nigel Cross, Berg publishers.

WEB REFERENCES:

- IDEO: Design Thinking for Educators toolkit https://designthinkingforeducators.com/.
- https://dschool.stanford.edu/resources/a-virtual-crash-course-in-design-thinking
- https://dschool-old.stanford.edu/groups/designresources/wiki/4dbb2/ (wallet Project)