RCOEM

Shri Ramdeobaba College of Engineering and Management, Nagpur

SHRI RAMDEOBABA COLLEGE OF ENGINEERING AND MANAGEMENT, NAGPUR – 440013

An Autonomous College affiliated to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra (INDIA)

PROGRAMME SCHEME

2021-2022

B. TECH. (ELECTRICAL ENGINEERING)

Salient Features of the Department

- The Department of Electrical Engineering was established in the year 1984 with a sanctioned UG intake of 60 students. The National Board of Accreditation has accredited the UG program fivetimes in succession in the year 2001, 2006, 2012, 2017 and 2020. Presently, the Electrical Engineering Department also has a post graduate program (M. Tech. in Power Electronics and Power Systems) with sanctioned intake of 12, started from 2011. Department is a Recognized Research Centre, approved by RTM Nagpur University for Doctoral program and has sixteen well-equipped laboratories.
- The department has well qualified and experienced faculty with industrial background and comprises of one Professor, three Associate Professors and nine Assistant Professors on roll. They have undertaken many consultancy projects and have been granted patent by government of India. Also, the faculty members are working on various research projects sponsored by different funding agencies including AICTE, RGSTC and UBA.
- The department has a conducive environment for the academic and overall development of students. Two student bodies are active in the department. One is the IEEE Student Joint Chapter and the other one is Electrical Engineering Students Association (EESA). They provide a platform for promoting the curricular, co-curricular and extracurricular students activities. The students of this department actively participate in sports and represent the college at various levels. Students are keenly interested in contributing for social cause and join the National Service Scheme (NSS) activities. Department organizes Seminars, Guest lectures, Value Added courses, Training programs and Product exhibitions for the students. Students get opportunity to enhance their technical skill by participating in the training program like PLC based automation, Photovoltaic Plant Design and Installation, IoT Applications etc. The curricula of both UG & PG programs is designed as per choice based creditsystem and current requirements of industry.
- There is a provision by which students can qualify and secure the award of Minor Specialization in any other discipline of their interest like Computer Science, Electronics, Mechanical etc. This is in addition to the degree belonging to core branch of Electrical Engineering. Such blend of two qualifications during the same period of four years increases the employability of students multiple times.
- To introduce the graduating students to the latest developments in the industry, the department organizes Technical Workshop cum Exhibition named “EMPOWER". This mega event was organized in the department for five times in year 2012, 2013, 2014, 2017 and 2018. Reputed companies namely ABB Limited, ARCTIC Infra Tech, GRANDSTREAM, Grundfos, Hager, Hioki, KEI Cables, L&T, Powerica, Wipro, Bergen, Biosys, HP, Rockwell Automation, Schneider, Siemens, Texas Instruments, Finolex, Highrise Transformers, TDK, Waree, Gentech, Synergy, VSP aqua mist etc. participated in the exhibition with the wide range of products to display.
- On academic front, the department results are consistently good. The department has an **E**ntrepreneur Development Cell to develop the entrepreneurial skills among the students. The department highly encourages the industry interaction. Students are permitted to avail one full semester internship in industry without any academic load in the college. So far, every year more than 80% students get placed in different companies through on-campus drive with multiple job-offers in hand even before the completion of final year of graduation. Many students have secured admission at IITs, NITs and other higher ranked institutes including foreign universities for their Masters’ education.

Department Vision

Department of Electrical Engineering endeavors to be one of the best departments in India having expertise to mould the students to cater the needs of society in the field of technology, leadership, administration, ethical and social values.

Department Mission

To provide dynamic and scholarly environement for students to achieve excellence in core electrical and multidisciplinary fields by synergetic efforts of all stake holders of the Electrical Engineering Department and inculcate the ethical and social values.

Program Educational Objectives

PEO1: Our graduates will be able to plan, design, operate and practice in electrical and energy systems.

PEO2: Our graduates will be able to work in multidisciplinary environments including IT applications and adapt themselves as per the emerging technological needs of Industry.

PEO3: Our graduates will be able to progress in their career by demonstrating in practice the technical and communication skills effectively with understanding of ethical and social values.

Program Outcomes

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals to the solution of engineering problems.

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

PO3. Design/development of solutions: Design solutions for complex engineeing problems and design system components or processes that meet the specified needs with appropriate consideration for the public safety, societal and environmental considerations.

PO4. Conduct problem investigations: Use research-based knowledge including experimentation, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Select, and apply appropriate techniques, resources, and modern engineering and IT tools for analyzing the engineering activities with an understanding of the limitations.

PO6. The engineer, industry and society: Apply contextual knowledge to assess industrial, societal and safety related issues and understand consequent relevance to the professionalengineering 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 andnorms of the engineering practice.

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

PO10.Communication: Communicate effectively on complex engineering activities such as, being able to understand and write effective reports, 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 in multidisciplinary environments.

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

Programme Specific Outcomes

PSO1: Analyze ,design and develop Electrical Engineering systems considering green energy aspects in emerging applications like Electric vehicles, renewable energy etc.

PSO2: Apply the knowledge of modern IT tools to Electrical Engineering applications.

Teaching Scheme for B.Tech. Electrical Engineering

First Year Group1: Semester-I / Group2: Semester-II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Continuous Evaluation	End Sem Exam	Total		
1.	PHT152	Oscillations, waves and Optics	3	1	0	4	40	60	100	03	BS
2.	PHP152	Oscillations, Waves and Optics Lab	0	0	3	1.5	25	25	50	–	BS
3.	MAT152/ MAT151	Differential Equations, Linear Algebra, Statistics & Probability/ Calculus	3	0/1	0	3/4	40	60	100	03	BS
4.	MAP151	Computational Mathematics Lab	0	0	2	1	25	25	50	–	BS
5.	EET151	Basic Electrical Engineering	3	1	0	4	40	60	100	03	ES
6.	EEP151	Basic Electrical Engineering Lab	0	0	2	1	25	25	50	–	ES
7.	MET151	Engineering Graphics and Design	1	0	0	1	40	60	100	03	ES
8.	MEP151	Engineering Graphics and Design Lab	0	0	4	2	50	50	100	–	ES
9.	HUT152	Constitution of India	2	0	0	0	–	–	–	–	HSS
10.	PEP151	Yoga/Sports	0	0	2	0	–	–	–	–	Other
TOTAL			12	2/3	13	17.5/18.5					

First Year Group 2: Semester - 1 / Group 1: Semester - II

Sr. No.	Code	Course	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Continuous Evaluation	End Sem Exam	Total		
1.	CHT151	Chemistry	3	1	0	4	40	60	100	03	BS
2.	CHP151	Chemistry Lab	0	0	3	1.5	25	25	50	–	BS
3.	MAT151/ MAT152	Calculus/ Differential Equations, Linear Algebra, Statistics and Probability	3	1/0	0	4/3	40	60	100	03	BS
4.	CST151	Programming for Problem Solving	4	0	0	4	40	60	100	03	ES
5.	CSP151	Programming for Problem Solving Lab	0	0	2	1	25	25	50	–	ES
6.	IDT151	Creativity, Innovation and Design Thinking	1	0	0	1	20	30	50	1.5	Other
7.	INT151	Workshop/Manufacturing Practices	1	0	0	1	20	30	50	1.5	BS
8.	INP151	Workshop/Manufacturing Practices Lab	0	0	2	1	25	25	50	–	BS
9.	HUT151	English	2	0	0	2	40	60	100	03	HSS
10.	HUP151	English Lab	0	0	2	1	25	25	50	–	HSS
TOTAL			14	2/1	9	20.5/19.5					

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Semester III

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
1.	MAT256	Electrical Engineering Mathematics	3	0	0	03	40	60	100	3	PC
2.	EET253	Data Structures and Algorithms	3	0	0	03	40	60	100	3	ES
3.	EEP253	Data Structures and Algorithms Lab	0	0	2	01	25	25	50	3	ES
4.	EET251	Network Analysis	3	1	0	04	40	60	100	3	PC
5.	EEP251	Network Analysis Lab	0	0	2	01	25	25	50	3	PC
6.	ENT259	Analog Electronic Circuits	3	0	0	03	40	60	100	3	ES
7.	ENP259	Analog Electronic Circuits Lab	0	0	2	01	25	25	50	3	ES
8.	EET252	Electrical Measurements and Instrumentation	2	1	0	03	40	60	100	3	PC
9.	EEP252	Electrical Measurements and Instrumentation Lab	0	0	2	01	25	25	50	3	Pc
10.	MBT251	Innovation and Entrepreneurship	3	0	0	03	40	60	100	3	HSS
11.	CHT251	Environmental Science	2	0	0	00	-	-	-	-	Other
		TOTAL	19	02	08	23					

Semester IV

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
1.	EET271	Signals and Systems	2	1	0	03	40	60	100	3	PC
2.	ENT260	Digital Circuits and Microprocessor	3	0	0	03	40	60	100	3	ES
3.	ENP260	Digital Circuits and Microprocessor Lab	0	0	2	01	25	25	50	3	ES
4.	EET272	Electrical Machines-I	3	1	0	04	40	60	100	3	PC
5.	EEP272	Electrical Machines-I Lab	0	0	2	01	25	25	50	3	PC
6.	EET276	Power System-I	3	0	0	03	40	60	100	3	PC
7.	EET277	Object Oriented Programming	3	0	0	03	40	60	100	3	ES
8.	EEP277	Object Oriented Programming Lab	0	0	2	01	25	25	50	3	ES
9.	EET299	Open Elective-I	3	0	0	03	40	60	100	3	OE
10.	HUT252	Indian Traditional Knowledge	2	0	0	00	-	-	-	-	HSS
		TOTAL	19	02	06	22					

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Open Elective: 1

EET299-2	Renewable Energy Systems
EET299-3	Elements of Electrical Technology

Semester V

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
1.	EET352	Electrical Machines-II	3	1	0	04	40	60	100	3	PC
2.	EEP352	Electrical Machines-II Lab	0	0	2	01	25	25	50	3	PC
3.	EET353	Microcontroller	3	0	0	03	40	60	100	3	PC
4.	EEP353	Microcontroller Lab	0	0	2	01	25	25	50	3	PC
5.	EET354	Program Elective-I	3	0	0	03	40	60	100	3	PE
6.	EET355	Power Electronics	3	1	0	04	40	60	100	3	PC
7.	EEP355	Power Electronics Lab	0	0	2	01	25	25	50	3	PC
8.	EET358	Database Management Systems	3	0	0	03	40	60	100	3	ES
9.	EEP358	Database Management Systems Lab	0	0	2	01	25	25	50	3	ES
10.	EET398	Open Elective-II	3	0	0	03	40	60	100	3	OE
11.	EEP359	Simulation Lab*	0	0	2	01	50	--	50	3	PC
		TOTAL	18	02	10	25					

* Laboratory course with internal evaluation.

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Program Elective: 1

EET354-5	Electromagnetic Fields
CET371	Engineering Mechanics and Strength of Materials
IDT351	Biology for Engineers
EET354-3	Electrical Energy Conservation and Audit
EET354-4	Industry Offered Elective-I

Open Elective: II

EET398-4	Electrical Appliances
EET398-5	Energy Storage Systems

Semester VI

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
1.	EET371	Power System–II	3	0	0	03	40	60	100	3	PC
2.	EEP371	Power System–II Lab	0	0	2	01	25	25	50	3	PC
3.	EET372	Control Systems	3	1	0	04	40	60	100	3	PC
4.	EEP372	Control Systems Lab	0	0	2	01	25	25	50	3	PC
5.	EET373	Program Elective-II	3	0	0	03	40	60	100	3	PE
6.	EET374	Program Elective-III	3	0	0	03	40	60	100	3	PE
7.	EEP374	Program Elective-III Lab	0	0	2	01	25	25	50	3	PE
8.	EET399	Open Elective-III	3	0	0	03	40	60	100	3	OE
9.	EEP378	*Mini Project	0	0	2	01	50	-	50	3	Pr
10	EEP377	Comprehensive Viva	0	0	2	01	25	25	50	3	PC
TOTAL			15	01	10	21					

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Program Elective – II and III

Program Elective	***Power System Track***	***Control, Automation and Drives Track***	***Renewable Energy & Electric Vehicle***	***Other***	
II	Power Station Practice EET373-2	Electric Drives and Control EET373-5	Non-Conventional Energy Sources EET373-6	Utilization of Electrical Energy EET373-3	Industry Offered Elective-II EET373-4
III(T)	Electrical M/C Design EET374-6	PLC and SCADA EET374-7	Photovoltaic System Engineering EET374-5		
III(L)	Electrical Workshop EEP374-8	PLC and SCADA(L) EEP374-7	Photovoltaic System Engineering(L) EEP374-5		

Open Elective: III

EET399-1	Solar Photovoltaic Systems
EET399-2	Automation with PLC

Semester VII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Continuous Evaluation	End Sem Exam	Total		
1.	EET452	Program Elective-IV	3	0	0	03	40	60	100	3	PE
2.	EEP452	Program Elective-IV Lab	0	0	2	01	25	25	50	3	PE
3.	EET456	Power System Protection	3	0	0	03	40	60	100	3	PE
4.	EEP456	Power System Protection-Lab	0	0	2	01	25	25	50	3	PE
5.	EET498	Open Elective-IV	3	0	0	03	40	60	100	3	OE
6.	HUT453	Engineering Economics and Management	3	0	0	03	40	60	100	3	HSS
7.	EEP454	Industry Internship Evaluation	0	0	2	00	50	-	50	-	Pr
8.	EEP455	Project Phase-I	0	0	6	03	100	-	100	-	Pr
		TOTAL	12	00	12	17					

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Program Elective-IV:

Program Elective	***Power System Track***	***Control, Automation and Drives Track***	***Renewable Energy & Electric Vehicle***
IV(T)	High Voltage Engineering EET452-7	Digital Signal Processing EET452-8	IoT Applications for Energy EET452-9
IV(L)	High Voltage Engineering (L) EEP452-7	Digital Signal Processing (L) EEP452-8	IoT Applications for Energy(L) EEP452-9

Open Elective: IV

EET498-1	Electric Vehicles
EET498-3	Energy Management and Audit

Semester VIII

Sr. No.	Course code	Course Name	Hours/week			Credits	Maximum marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
1.	EET472	Program Elective-V	3	0	0	03	40	60	100	3	PE
2.	EET473	Program Elective-VI	3	0	0	03	40	60	100	3	PE
3.	EEP474	Project Phase-II	0	0	16	08	100	100	200	3	Pr
TOTAL			06	00	16	14			400		
OR											
	EEP476	Full Semester Internship (Industry/ Research /TBI)	--	--	16	14	200	200	400		Pr

BS: Basic Sciences; ES: Engineering Sciences; HSS: Humanities and Social Sciences, PC: Program Core; PE: Program Electives, OE: Open Electives, Project, Int: Internships/Seminars, Other

Program Elective: V and VI

Program Elective	***Power System Track***	***Control, Automation and Drives Track***	***Renewable Energy & Electric Vehicle***	***Others***
V	Modern Electrical Grids EET472-6	Power Quality EET472-7	Advance Electrical Drives EET472-8	Industry Offered Elective-III EET472-9
VI	FACTS EET473-5	Industrial Electrical Systems EET473-2	Energy Storage & EV Charging Infrastructure EET473-6	Industry Offered Elective-IV EET473-7

Program Elective Tracks and list of courses

Sem	Program Elective No	Courses				
5	I	Electromagnetic Fields EET354-5	Engg. Mechanics and Strength of Materials CET371	Biology for Engineers IDT351	Electrical Energy Conservation and Audit EET354-3	Industry Offered Elective-I EET354-4
Sem	*Program Elective*	*Power System Track*	*Control, Automation and Drives Track*	*Renewable Energy & Electric Vehicle*	*Other*	
6	II	Power Station Practice EET373-2	Electric Drives and Control EET373-5	Non-Conventional Energy Sources EET373-6	Utilization of Electrical Energy EET373-3	Industry Offered Elective-II EET373-4
	III(T)	Electrical M/C Design EET374-6	PLC and SCADA EET374-7	Photovoltaic System Engineering EET374-5		
	III(L)	Electrical Workshop EEP374-8	PLC and SCADA(L) EEP374-7	Photovoltaic System Engineering(L) EEP374-5		
7	IV(T)	High Voltage Engineering EE452-7	Digital Signal Processing EET452-8	IoT Applications for Energy EET452-9	----------	
	IV(L)	High Voltage Engineering(L) EEP452-7	Digital Signal Processing (L) EEP452-8	IoT Applications for Energy(L) EEP452-9	----------	
8	V	Modern Electrical Grids EET472-6	Power Quality EET452-7	Advance Electrical Drives EET472-8	Industry Offered Elective-III EET472-9	
	VI	FACTS EET473-5	Industrial Electrical Systems EET473-2	Energy Storage & EV Charging Infrastructure EET473-6	Industry Offered Elective-IV EET473-7	

Honors in Distributed Energy Generation Systems

Scheme of Examination											
Sem	Course code	Course Name	Hours/week			Credits	Maximum Marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
IV	EETH42	Renewable and Distributed Energy Sources	4	0	0	04	40	60	100	3	Honors
V	EETH52	Energy Storage System	4	0	0	04	40	60	100	3	Honors
VI	EETH62	Distributed Generation and Smart grids Or Equivalent SWAYAM NPTEL course approved by the Department	4	0	0	04	40	60	100	3	Honors
VII	EETH72	Design of Power Converter for Distributed Generation System Or Equivalent SWAYAM NPTEL course approved by the Department	4	0	0	04	40	60	100	3	Honors
VIII	EETH82	Power Quality Improvement Techniques Or Equivalent SWAYAM NPTEL course approved by the Department	4	0	0	04	40	60	100	3	Honors
TOTAL			20	00	00	20					

Minors in Electric Vehicles (EV)

Semester	Course code	Course Name	Hours/week			Credits	Maximum Marks			ESE Duration (Hrs)	Category
			L	T	P		Continuous Evaluation	End Sem Exam	Total		
IV	EETM42	Basics of Electrical Engineering and EV	4	0	0	04	40	60	100	3	Minors
V	EETM52	EV Motors and their Control	4	0	0	04	40	60	100	3	Minors
VI	EETM62	EV Energy Management and Charging Infrastructure	4	0	0	04	40	60	100	3	Minors
VII	EETM72	EV Communication and Instrumentation	4	0	0	04	40	60	100	3	Minors
VIII	EETM82	EV Policies and Safety Aspects	4	0	0	04	40	60	100	3	Minors
TOTAL			20	00	00	20					

Open Elective

Scheme of Examination											
Sem	Course code	Course Name	Hours/week			Credits	Maximum Marks			ESE Duration (Hrs)	Category
			L	T	P		Conti-nuous Evaluation	End Sem Exam	Total		
IV	EET299-3	Elements of Electrical Technology	3	0	0	03	40	60	100	3	OE
	EET299-2	Renewable Energy Systems									
V	EET398-4	Electrical Appliances	3	0	0	03	40	60	100	3	OE
	EET398-5	Energy Storage Systems									
VI	EET399-1	Solar Photovoltaic Systems	3	0	0	03	40	60	100	3	OE
	EET399-2	Automation with PLC									
VII	EET498-1	Electric Vehicles	3	0	0	03	40	60	100	3	OE
	EET498-3	Energy Management and Audit									
TOTAL			12	00	00	12					

First Year Group1: Semester-I / Group2: Semester-II
Department of Electrical Engineering

Course Code : PHT152 | **Course : Oscillations, Waves, Optics**

L:3 Hrs.,T:1Hrs., P: 0Hrs., Per week | **Total Credits : 4**

Course Objectives

1. To train the student to work with oscillatory phenomena in electrical, mechanical and opticalsystems;
2. To introduce fundamental concepts and laws as relevant to electromagnetic waves and matterwaves.

Course Outcomes

After successful completion of the course students will understand and be able to work with

1. Free, damped and forced oscillations;
2. Fundamental properties of mechanical waves and their propagation across material boundaries;
3. Basics of electromagnetic waves and optical media, phenomena of interference, diffraction ofoptical waves
4. Elementary understanding of quantum behavior of electrons in solids.

Module 1: Oscillations (8L)

Quick review of simple harmonic motion, mechanical and electrical oscillators, vector and complex number (phasor) representation, superposition of many SHMs of equal amplitude and equal successive phase difference; Damped oscillations, under, critical and over-damping with stress on mechanical oscillators, problems; Forced oscillations with focus on electrical/mechanical oscillations, impedance of a electrical/mechanical circuit, forcing frequency dependence of velocity, displacement in a forced oscillator, two components of displacement, energy and power supplied bydriving force, Q factor.

Module 2: Waves - 1 (5L)

Correlated harmonic oscillations in space and time, statement and meaning of the wave equation, general solution, concept of polarization of waves- transverse and longitudinal waves; Transverse wave on a string, characteristic impedance, reflection and transmission at a string-string boundary,impedance matching, insertion ofquarter-wave element.

Module 3: Waves - 2 (5L)

Group of waves, group velocity, meaning of dispersion, causes of dispersion; Standing waves, normal modes of vibrating string, energy in modes, standing wave ratio; Longitudinal waves: sound waves in gases, statement and meaning of expressions for energy distribution and intensity.

Module 4: Wave Optics - 1 (6L)

Light as a transverse polarized electromagnetic wave in vacuum and in homogeneous isotropic dielectric, impedance |E|/|Hperp,E|, Poynting vector, energy; Reflection and refraction of em wave at dielectric-dielectric boundary, parallel and perpendicular polarizations, boundary conditions on E and H components, Fresnel equations, Brewster's angle.

Module 5: Wave Optics - 2 (6L)

Huygens' principle, superposition, interference by division of amplitude and wavefront, Young's double- slit, Newton's rings, Michelson interferometer; Single-slit Fraunhofer diffraction, Rayleigh criterion for resolution,

grating and its resolving power.

Module 6: Matter Waves (8L)

Plank's energy packets, Wave-particle duality of de Broglie, Heisenberg uncertainty relations; Wavefunction for matter waves and its interpretation, position and momentum operators, Hamiltonian operator, Schrodinger's equation; One-dimensional single particle systems: Particle in a infinite square well potential (rigid box), Finite square well potential; Quantum tunneling.

Text Book(s)

1. The Physics of Vibrations and Waves (Sixth Edition), H J Pain John-Wiley 2005.
2. Optics, Ajoy Ghatak, Tata McGraw Hill Education 2005

References

1. Online course: Oscillations and Waves by S Bharadwaj on NPTEL
2. Engineering Physics (Second Edition), Sanjay Jain and Girish Sahasrabudhe, Universities Press2016.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: PHP152 | **Course: Oscillations, Waves, Optics lab**

L: 0 Hrs. T: 0 Hrs. P: 3 Hrs. Per week | **Total Credits: 1.5**

Course Outcomes

The Physics Laboratory course will consist of experiments illustrating the principles of physics relevant to the study of science and engineering. Students will show that they have learnt laboratory skills that will enable them to properly acquire and analyze the data in physics laboratory and drawvalid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in physics and compare the results obtained with theoretical calculations.
3. Understand measurement technique, and report the results obtained through proper graph plotting and error analysis.

In addition to the demo experiments, the Lab turns will be utilized for performing the experimentsbased on the following lists as specific to Program:

1. Error analysis and graph plotting
2. Wave length, frequency and phase velocity of travelling wave.
3. Wavelength of source of light using Newton's rings
4. To study the oscillation in bifilar suspension arrangement
5. Determination of velocity of sound in liquid–standing ultrasonic waves as optical grating
6. Kundt's tube – Determination of the wavelength of sound with the cork powder method
7. Determination of velocity of sound in solid
8. Beating of ultrasonic waves
9. Investigation of Doppler effect with ultrasonic waves
10. Refractive Index of prism
11. Frequency, amplitude and phase determination using C.R.O.
12. Study of surface flatness using interference phenomena
13. To determine the resolving power of grating
14. Study of Polarizers and Analyzers
15. Study of total internal reflection using Laser source
16. Data analysis using Mathematica

Suggested References

1. Physics Lab Manual written by the Teaching Faculty of Physics Department, RCOEM. A minimumof 8 experiments are to be performed from the above list of experiments.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: MAT151 **Course: Calculus**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 04**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Calculus and multivariate analysis. 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

On successful completion of the course, the students will learn:

1. The fallouts of Mean Valve Theorems that is fundamental to application of analysis to Engineering problems, to deal with functions of several variables that are essential in most branches of engineering.
2. Basics of improper integrals, Beta and Gamma functions, Curve Tracing , tool of power series and Fourier series for learning advanced Engineering Mathematics.
3. Multivariable Integral Calculus and Vector Calculus and their applications to Engineering problems.

Syllabus

Module 1: Calculus: (7 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin's series expansions; Indeterminate forms and L'Hospital's rule; radius of curvature (Cartesian form), evolutes and involutes

Module 2: Multivariable Calculus (Differentiation) (8 hours)

Limit, continuity and partial derivatives, Eulers Theorem, chain rule, total derivative, Jacobians, Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 3 Calculus: (6 hours)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Tracing of curves (Cartesian form)

Module 4: Sequences and series: (7 hours)

Convergence of sequence and series, tests for convergence, power series, Fourier series: Half range sine and cosine series, Parseval's theorem.

Module 5: Multivariable Calculus (Integration) (7 hours)

Multiple Integration: Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by double integration Center of mass and Gravity (constant and variable densities).

Module 6: Vector Calculus (7 hours)

Vector Differentiation, Directional derivatives, total derivative, Gradient, Curl and Divergence. Vector integration , Theorems of Green, Gauss and Stokes.

Topics for self learning

Maxima and minima for function of one variable, Geometrical interpretation of Partial Differentiation(Tangent plane and Normal line) , Applications of definite integrals to evaluate perimeter, area, surface areas and volumes of revolutions.

Textbooks/References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.
6. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune - 411030 (India).

First Year Group2: Semester-I / Group1: Semester-II

Department of Electrical Engineering

Course No. MAT152 **Course: Differential Equations, Linear Algebra,Statistics and Probability**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Objective

The objective of this course is to familiarize the prospective engineers with techniques in Ordinarydifferential equation, statistics, probability and Matrices.

It aims to equip the students to deal with advanced level of mathematics and applications that wouldbe essential for their disciplines.

Course Outcomes

On successful completion of the course, the students will learn:

1. The effective mathematical tools for the solutions of ordinary differential equations that modelphysical processes.
2. The essential tool of matrices in a comprehensive manner.
3. The ideas of probability and various discrete and continuous probability distributions and thebasic ideas of statistics including measures of central tendency, correlation and regression.

Syllabus

Module 1:First order ordinary differential equations(7 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree : equationssolvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 2: Ordinary differential equations of higher orders (8 hours)

Second order linear differential equations with constant and variable coefficients, method of variationof parameters, Cauchy-Euler equation.

Module 3:Basic Statistics: (7 hours)

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

Module 4: Basic Probability: (8 hours)

Probability spaces, conditional probability, independence; Discrete random variables, Binomial distribution, Poisson distribution, Normal distribution. Relation between binomial, Poisson and Normal distributions.

Module 5: Matrices (10 hours)

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic tocanonical forms.

Topics for Self Learning

Application of Differential Equations.

Textbooks/References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Theory and Problems of probability and statistics : 2nded :J. R. Spiegal ,Schaum series
8. A text book of Applied Mathematics Volume I & II, by P. N. Wartikar and J. N. Wartikar, Pune Vidhyarthi Griha Prakashan, Pune-411030 (India).
9. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: MAP151 **Course: Computational Mathematics LabL: 0 Hr., T: 0 Hrs., P:2 Hrs., Per week** **Total Credits : 1**

Course Outcomes

The Computational Mathematics Lab course will consist of experiments demonstrating the principles of mathematics relevant to the study of science and engineering. Students will show that they havelearnt laboratory skills that will enable them to properly acquire and analyze the data in the lab and draw valid conclusions. At the end of the Course the students will learn to:

1. Develop skills to impart practical knowledge in real time.
2. Understand principle, concept, working and application of areas in mathematics and comparethe results obtained with theoretical calculations.
3. Understand basics of mathematics, and report the results obtained through proper programming.The Lab turns

will be utilized for performing the experiments based on the following list:

1. Calculus
2. Ordinary Differential Equations
3. Statistics
4. Linear Algebra

Suggested References:

1. Computational Mathematics Lab Manual written by the Teaching Faculty of Mathematics Department, RCOEM.

A minimum of 8 experiments to be performed based on the above list.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: EET151 | **Course: Basic Electrical Engineering**

L: 3 Hr., T: 1Hrs., P: 0 Hrs., Per week | **Total Credits : 4**

Course Outcomes

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

CO1: Understand and analyze basic ac and dc electric circuits and magnetic circuits

CO2: Understand working principles of electrical machines: Transformer, Induction motor, DC machinesCO3: Apply the knowledge of power converter for suitable applications

CO4: Introduce and identify the components of power systems and low-voltage electrical Installations.

Module 1: Introduction to Power system (2 hours)

Introduction to Power Generation (Thermal, Hydro, Nuclear, Wind, and Solar) with block schematic presentationonly. Single line diagram for Generation, Transmission & Distribution through different voltage levels.

Module 2: DC Circuits & Magnetic Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with DC excitation, Time-domain analysis of first order RL and RC circuits, Magnetic materials, BHcharacteristics, Basics of Magnetic circuits.

Module 3: Single Phase AC Circuits (6 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations(series and parallel), resonance.

Module 4: Three Phase AC Circuits (4 hours)

Three phase AC generation, Three phase balanced circuits, voltage, and current relations in star and delta connections. Power factor improvement.

Module 5: Transformers (6 hours)

Ideal and practical transformer, Equivalent circuit, losses in transformers, regulation, and efficiency. Auto transformer and three-phase transformer connections.

Module 6: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components, efficiency, starting of induction motor. Single- phase induction motor. Construction, working, torque-speed characteristic, and speed control of separately excited dc motor.

Module 7: Power Converters (4 hours)

Block schematic introduction to power converters and its practical applications (DC-DC, DC-AC, AC-DC, AC-AC),Types of Batteries, Important Characteristics for Batteries and battery backup.

Module 8: Electrical Installations (4 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption, energy tariff.

Text / References

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
6. Electrical Technology: B. L. Thereja, S. Chand Publications.
7. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code : EEP151 **Course: Basic Electrical Engineering Lab.**

L: 0 Hr., T: 0 Hrs., P: 2 Hrs., Per week **Total Credits : 1**

Course Outcomes

Upon completion of this course, the students shall be able to,

CO1: Co-relate, analyze and apply the fundamental principles of science and engineering tounderstand the laboratory experimental work.

CO2: Connect the electric circuit, perform the experiment, analyze the observed data and make validconclusion.

CO3: Write report based on the performed experiments (journal) with effective presentation ofdiagrams and characteristics/graphs.

CO4: Carry out survey of electrical energy consumption at home and calculate monthly energy bill asper the tariff of power Distribution Company.

List of Experiments

1. To verify Kirchhoff's laws for D.C. Circuits
2. Verification of Kirchhoff's laws to AC circuit(RLC series)
3. Verification of Kirchhoff's laws to AC circuit (RLC parallel).
4. To study speed control of D.C. shunts motor by:
   a) Armature voltage Control method.
   b) Field current/flux control method.
5. To study the balanced Three phase system for star and delta connected balanced load.
6. Improvement of power factor by using static capacitors
7. To determine regulation and efficiency of a single phase transformer by open circuit (o.c) andshort circuit (s.c.) tests.
8. To determine regulation and efficiency of a single phase transformer by direct loading test

Demonstration / Study experiment

9. To study B-H curve for different magnetic material
10. To study Buck converter
11. To study Boost converter

Demonstration of cut out sections of machines:

i. DC Machine
ii. Three phase squirrel cage induction motor
iii. Synchronous machine

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: MET151 **Course: Engineering Graphics and DesignL: 1 Hr., T: 0Hrs., P:0 Hrs., Per week** **Total Credits : 01**

Course Outcomes

The expected learning outcome is that, the students shall be able to

1. Draw and interpret technical drawing
2. Convert 2-D to 3-D drawing and vice versa.
3. Represent the various positions of planes and solids in different orientations.
4. Develop the solid surface for sheet metal working.

UNIT 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, usage of drawing instruments, Lettering and dimensioning.

UNIT 2: Orthographic Projections

Principles of Orthographic Projections -Conventions: Projections of Points and lines (line inclined to both planes) Projections of planes (inclined to both the planes), Introduction to Auxiliary Planes;

UNIT 3: Projections of Solids

Inclined to both the Planes - Auxiliary Views; Draw simple annotation, dimensioning and scale. Floorplans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UNIT 4: Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid Cone-Auxiliary Views; Development of surface 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 5: Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views of Simple Solids; Conversion of Orthographic views to Isometric Views / Projection.

Suggested Text / Reference Books

i) Bhatt N. D. Panchal V.M. & Ingle P.R., (2014) Engineering Drawing, Charotar Publishing House.

ii) Jolhe D. A. (2016) Engineering Drawing with an Introduction to Auto CAD", Tata McGraw- Hill Publishing Co. Ltd., New Delhi.

iii) Narayana K. L. & P. Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

iv) Shah M. B. & Rana B. C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.

v) Agrawal B & Agrawal C. M. (2012), Engineering Graphic, TMH Publication.

vi) Corresponding set of CAD Software Theory and User Manuals.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: MEP151 **Course: Engineering Graphics and Design LabL: 0 Hr., T: 0Hrs., P:4 Hrs., Per week** **Total Credits : 02**

Course Outcomes

Students are prepared for actual work situations through practical training in a new state of the artcomputer designed CAD laboratory using engineering software. The student will learn to :

1. Draw and interpret technical drawing
2. Plan the sheet layout for the given drawing
3. Convert 2-D to 3-D drawing and vice versa
4. Represent the various positions of planes and solids in different orientations.
5. Develop the solid surface for sheet metal working
6. Use & demonstrate drafting package.

UNIT 1: Introduction to Engineering Drawing

Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and involutes; Introduction to Scales.

UNIT 2: Orthographic Projections

Principles of Orthographic Projections -Conventions - Projections of Points and lines inclined to bothplanes; Projections of planes - Auxiliary Planes.

UNIT 3: Projections of Solids

Inclined to both the Planes Auxiliary Views; Draw simple annotation, dimensioning and scale, Floorplans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

UNIT 4: Sections and Sectional Views of Right Angular Solids

Prism Cylinder, Pyramid, Cone - Auxilary Views; 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 5: Isometric Projections

Principles of Isometric projection - Isometric Scale, Isometric Views, Conventions; Isometric Views ofSimple Solids; conversion of Orthographic views to Isometric views / Projection

UNIT 6: Overview of Computer Graphics

Demonstrating knowledge of the theory of CAD software such as (the Menu System Toolbars Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, crosshairs, Coordinate Systems), Dialog boxes and windows, Shortcut menus (Button Bars), The command Line(wherever applicable), The Status Bar, Different methods of zoom as used in CAD, select and erase objects; Isometric Views of lines, Planes, Simple and compound solids);

UNIT 7: Customization & CAD Drawing

Setting up drawing page and the printer, including scale settings, Setting up of units and Drawing limits; ISO and ANSI standards for coordinate dimensioning; Orthographic constraints, map to objects, manually and automatically, Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

UNIT 8: Annotations Layering & Other Functions

Applying dimensions to objects, applying annotations to drawings; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;orthographic projection techniques.

UNIT 9: Demonstration of a simple team design project that illustrates

Geometry and Topology of Engineered Components Creation of Engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed toplogies for engineering, Introduction to Building Information Modeling (BIM), drafting and designpackage, 3D printing.

List of sheets

1. Curves (ellipse, Parabola, hyperbola, Cycloid, involute)
2. Line, Planes, Solids
3. Application of Section and development of solids
4. Orthographic Projection
5. Isometric
6. Auto CAD practice sheet 1
7. Auto CAD practice sheet 2
8. Blueprint sheet

Suggested Text/ Reference Books

i) Bhatt N.D. Panchal V.M. & Ingle P.R., (2014), Engineering drawing, Charotar Publiishing house

ii) Jolhe D.A., (2016) Engineering drawing with an Introduction to Auto CAD", Tata McGraw-Hill Publishing Co. Ltd., New Delhi.

iii) Shah M.B. & Rana B.C. (2008), Engineering drawing and Computer Graphic, Pearson Education.

iv) Agarwal B & Agarwal C.M. (2012), Engineering Graphics, TMH PUBLICATION

v) Narayana K. L. & P. Kannaiah (2008), Text Book on Engineering Drawing, Scitech Publishers.

vi) (Concesponding set of) CAD Software Theory and USER Manuals.

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: HUT152 **Course: Constitution of India**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 0**

Course outcome

1. Students will understand the role of constitution in democratic India
2. Students will be responsible students by knowing their fundamental rights and duties
3. Students will develop better understanding of democratic functions of the government of India
4. Students will form better understanding of system of governance for effective participation

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the Fundamental Rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and theStates
8. Parliamentary Form of Government in India – The constitution powers and status of the Presidentof India
9. Union Executive: structure, functions
10. Judiciary: Structure, role with special reference to PIL, writ petitions, strengthening of democracy&social justice
11. Amendment of the Constitutional Powers and Procedure
12. Emergency Provisions: National Emergency, President Rule, Financial Emergency
13. Local Self Government – Constitutional Scheme in India
14. Provisions of civil services: Characteristics, functions, merits and demerits
15. Democratic principles in industry

Book

Durga Das Basu "An Introduction to Constitution of India" 22nd Edition, LexisNexis

First Year Group1: Semester-I / Group2: Semester-II

Department of Electrical Engineering

Course Code: PEP151 **Course: Yoga / Sports**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 0**

Course outcome

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

1. Understand fundamental skills and basic rules of games offered by the Physical Education Department of RCOEM.
2. Obtained health related physical fitness.
3. Develop body-mind co-ordination through games and yoga.
4. Changed sedentary life styles towards active living.

Brief Objectives of Sports/Yoga Practical Classes:

It has long been proven that a healthy body leads to a healthy mind. With a strong belief in this, Physical Education Department at RCOEM will conduct Sports/Yoga Classes with the objective of maintaining health, fitness and wellness of students as well as create awareness about need for good health and physical fitness. The objective would also be to make the all-round development with team spirit, social values as well as to identify and develop leadership qualities in students through various sports activities. Sports activities would also be conducted with the objective to provide better interaction and recreation to the students which is an important neutralizer for stress. Additionally, the objective would be to evaluate the health related fitness of students so as to recommend and conduct specific Yoga and Sports activities. The emphasis is on participation, with healthy competition.

Programme Outline:

- **Sports**

1. Introduction to sports, offered by the department.
2. Health and safety issues related to sports; knowledge, recognition and ability to deal with injuries and illness associated with sports.
3. Practicing the fundamental skills and bringing awareness of basic rules and regulations.
4. Conduction of small recreational games and activities.

- **Yoga :** Includes various sitting, standing and lying Asanas, Suryanamaskars and Pranayamas.
- **Physical Efficiency Tests:** This includes 6 health related physical fitness tests.

Components	Name of Tests
Speed	50 mts Dash
Agility	Shuttle run
Cardiovascular Endurance	8 mins Run/Walk
Test Flexibility	Sit and Reach Test
Abdominal Strength (M) / shoulder strength (F)	Bent Knee Sit-ups (M)/ Modified Pull-ups (F)
Yogic exercises	Suryanamaskars

First Year Group 2: Semester-I / Group 1: Semester-II

Department of Electrical Engineering

Course Code: CHT151 **Course: Chemistry**

L: 3 Hrs, T: 1 Hr, P: 0 Hr., Per week **Total Credits: 4**

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand different phenomena; one has to base the description of all chemical processes at molecular levels.

The course will enable the student to:

CO1: Rationalise periodic properties such as ionization potential, electro-negativity, oxidation states and electron affinity.

CO2: Analyse microscopic chemistry in terms of atomic and molecular orbitals and to apply this knowledge for understanding the band structure of different types of solids.

CO3: Understand different types of molecular interactions, rationalise bulk properties and processes using thermodynamic considerations.

CO4: Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levelsin various spectroscopic techniques

CO5: List major chemical reactions that are used in the synthesis of molecules and to understand structural aspect of organic compounds.

CO6: Analyse impurities present in the water and suggest the methodology for its removal.

Chemistry (Concepts in Chemistry for Engineering)

(1) Periodic properties (6 Lectures)

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, Effective nuclear charge, atomic and ionic sizes, ionization energies, electron affinity, electronegativity, and polarizability, Fajan's rule, Hard soft acids and bases theory and its applications.

(2) Atomic and molecular structure (8 lectures)

Schroedinger equation. Particle in box solutions, Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Equations for atomic and molecular orbitals. Molecular Orbital Theory and Molecular orbital diagrams of different homo-nuclear and hetero-nuclear diatomic molecules. Pi-molecular orbital diagram of butadiene and benzene.

Crystal field theory and the energy level diagrams for octahedral and tetrahedral complexes of transition metalions and their magnetic properties.

Band structure of solids and the role of doping on band structures.

(3) Spectroscopic techniques and applications (8 lectures)

Electromagnetic Spectrum, Principles of spectroscopy.

Electronic spectroscopy – Basic Principles, Lambert-Beer's Law, Woodward-Fisher Rule for conjugated dienes.

Fluorescence and its applications in medicine.

Nuclear magnetic resonance – Basic Principles, Chemical Shift, Spectral interpretation of some simple compounds.

(4) Chemical Thermodynamics and Electrochemistry (8 lectures) Ionic, dipolar and van Der Waals interactions. Equations of real gases and critical phenomena.

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.The Nernst equation and applications, Corrosion – Basic principle and mechanism of corrosion.

(5) Stereochemistry and Organic Reactions (8 lectures)

Stereoisomers, configurations and symmetry & chirality, enantiomers, diastereomers, optical activity.

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction. Synthesis of a commonly used drug molecule such as Ibuprofen, Aspirin, Paracetamol, Chloroquine, etc.

(6) Water Technology (6 lectures)

Impurities in natural water, hardness and alkalinity, Disadvantages of hardness i. e. sludge and scale formation, softening of water using lime-soda, zeolite and ion-exchange method, advantages and limitations of these water softening processes, Desalination of water using Reverse Osmosis.

Suggested Text Books

(i) A Textbook of Engineering Chemistry by Dr. Rajshree Khare, S. K. Kataria and Son's Publisher.

(ii) Selected topics in Inorganic Chemistry by W. U. Malik, R. D. Madan & G. D. Tuli, S. Chand Publications.

(iii) Engineering Chemistry by A. Pahari, B. Chauhan, Firewall Media, Infinity Science Press LLC.

(iv) A Textbook of Engineering Chemistry by S. S. Dara, S. Chand Publications.

(v) Applied Chemistry by V. K. Walekar, A. V. Bharati, Tech-Max Publications.

(vi) Organic Chemistry by R. L. Madan, Mc-Graw Hill Publications.

(vii) Elementary Organic Spectroscopy, Revised Edition by Y. R. Sharma, S. Chand Publications.

(viii) Organic Chemistry – Reactions and Reagents by O. P. Agrawal, Goel Publishing House Publications.

(ix) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

Reference Books

(i) Physical Chemistry, by Robert G. Mortimer, Elsevier Academic Press Publications.

(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane, Mc-Graw Hill Publications.

(iii) Organic Chemistry by Paula Y. Bruice, Pearson India.

(iv) Physical Chemistry, Third Edition by Gilbert W. Castellan, Adison-Wesley Publishing company.

(v) Physical Chemistry, by P. W. Atkins, Oxford University Press Publications.

(vi) Chemical Principles, Eight Edition, Steven S. Zumdahl, Donald J. DeCoste, Cengage Learning Publications.

(vii) Chemistry – The Molecular Nature of Matter and Change, Fifth Edition by Martin S. Silberberg, Mc-Graw Hill Publications.

(viii) Chemistry, An Introduction to Organic, Inorganic and Physical Chemistry, Third Edition by Catherine E. Housecroft, Edwin C. Constable, Pearson Prentice Hall Publications.

(ix) Organic Chemistry, Third Edition, William Kemp, Palgrave Publications.

(x) Concise Inorganic Chemistry, Fourth Edition by J. D. Lee, Chapman and Hall Publications.

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: CHP151 **Course: Chemistry Lab**

L: 0 Hrs., T: 0 Hrs., P: 3 Hrs., Per week **Total Credits : 1.5**

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistryrelevant to the study of science and engineering.

The students will learn to:

CO1: Estimate the amount of different impurities in water/waste water samples.

CO2: Estimate rate constants of reactions and order of the reaction from concentration of reactants/products as a function of time and to validate adsorption isotherms.

CO3: Measure molecular/system properties such as surface tension, viscosity of aqueous or other industrially important liquids/mixtures etc.

CO4: Synthesize a polymer or drug molecule or nano-material.

List of Experiments for Chemistry Lab

1. Determination of Surface tension of a given liquid/mixture.
2. Determination of Viscosity of a given liquid/mixture.
3. Estimation of total, temporary and permanent hardness present in a given water sample.
4. Estimation of type and extent of alkalinities present in a given water sample.
5. Estimation of Cu and Zn in a brass sample.
6. Study of chemical oscillations or iodine clock reaction and determination of rate constant of thereaction.
7. Estimation of acid value of oil.
8. Estimation of saponification value of oil.
9. Ion Exchange column for removal of hardness.
10. Study of adsorption of acetic acid by charcoal.
11. Synthesis a polymer / drug molecule / nano-material.

Suggested Books/Reference Books

(1) A Textbook on Experiments and Calculations in Engineering Chemistry by S. S. Dara, S. Chand Publications.

(2) Advanced Practical Physical Chemistry by J. B. Yadav, Krishna's Prakashan Media (P) Limited.

(3) Collection of Interesting General Chemistry Experiments, A by A. J. Elias, Universities Press Publications.

(4) College Practical Chemistry by V. K. Ahluwalia, S. Dhingra and A. Gulati, Universities Press Publications.

(5) Advanced Practical Medicinal Chemistry by Ashutosh Kar, New Age International Publisher.

First Year Group 2: Semester-I / Group 1: Semester-II

Department of Electrical Engineering

Course Code: CST151 **Course: Programming for Problem Solving**

L: 4 Hrs.,T: 0 Hrs.,P: 0 Hrs.,Per week **Total Credits : 4**

Course Outcomes

On successful completion of course student will learn:

1. To formulate simple algorithms for arithmetic and logical problems, translate the algorithms to programs (in Clanguage), test and execute the programs and correct syntax and logical errors.
2. To implement conditional branching, iteration and recursion, to decompose a problem into functions and synthesize a complete program using divide and conquer approach.
3. To use arrays, pointers, structures and I/O operations for the formulation of algorithms and programs.
4. To apply programming to solve matrix addition, multiplication problems and searching & sorting problems.

UNIT-I: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart / Pseudocode with examples. Arithmetic expressions and precedence

UNIT-II: C Programming Language

Introduction to C language: Keywords, Constant, Variable, Data types, Operators, Types of Statements, Preprocessor Directives, Decision Control Statement-if, if-else, Nested if-else statement, Switch case, Loops and Writing and evaluation of conditionals and consequent branching.

UNIT-III: Arrays and Basic Algorithms

Arrays: 1-D, 2-D, Character arrays and Strings.

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order ofcomplexity through example programs (no formal definition required)

UNIT-IV: Functions and Recursion

User defined and Library Functions, Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion: As a different way of solving problems. Example programs, such as Finding Factorial,Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT-V: Pointers and Structures

Structures, Defining structures, Array of Structures, Introduction to pointers, Defining pointers, Pointer arithmetic, pointer operators, Use of Pointers in self-referential structures, notion of linked list (no implementation)

UNIT-VI: File handling

Streams in C, Types of Files, File Input/ Output Operations: Modes of file opening, Reading and writing the file, Closing the files, using fflush().

Text Books

1. Programming in ANSI C : E. Balguruswami McGraw Hill
2. Mastering C: K. R. Venugopal and S. R. Prasad, Tata McGraw Hill

Reference Books

1. Programming with C: Byron Gottfried, Schaums Outline Series.
2. Let Us C: Yashwant Kanetkar, BPB Publication

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: CSP151 **Course: Programming for Problem Solving Lab**

L: 0 Hrs., T:0 Hrs., P:2 Hrs., Per week **Total Credits : 1**

Course Outcomes

On successful completion of course student will be able to:

1. Understand the fundamentals of C programming and choose the loops and decision makingstatements to solve and execute the given problem.
2. Implement different Operations on arrays also design functions to solve the given problem usingC programming.
3. Understand pointers, structures, unions and apply them to develop programs.
4. Implement file Operations in C programming for a given application.

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: IDT151 **Course: Creativity Innovation and Design Thinking**
L: 1 Hrs., T: 0Hrs., P:0Hrs., Per week **Total Credits : 1**

Course Outcomes

C1: Be familiar with processes and methods of creative problem solving

C2: Enhance their creative and innovative thinking skills

C3: Practice thinking creatively and innovative design and development

Syllabus

UNIT I. **Introduction:** Making a case for creativity, Creative thinking as a skill, Valuing diversity in thinking: Thinking preferences, Creativity styles, Creativity in problem solving

UNIT 2. Pattern Breaking: Thinking differently , Lateral thinking, Mind stimulation: games, brain-twisters and puzzles, Idea-collection processes, Brainstorming/Brainwriting, The SCAMPER methods, Metaphoric thinking, Outrageous thinking , Mapping thoughts, Other (new approaches)

UNIT 3. Using Math and Science, Systematic logical thinking, Using math concepts, Eight-Dimensional (8D) Approach to Ideation: Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity, Experimentation

UNIT4. Systematic Inventive Thinking: Systematic inventive thinking: The TRIZ methodology, Decision and Evaluation: Focused thinking framework, Six thinking hats , Ethical considerations **UNIT 5. Design for Innovation:** Introduction to design for interaction, nine lessons for innovation, difference in creativity and innovation, Building blocks for innovation

UNIT 6.Intellectual Property: Introduction to intellectual property: Patents, Copyrights©, Trademarks ®, Trade Secret, Unfair Competition.

Reference Books and Text Book

1. Creative Problem Solving for Managers - Tony Proctor - Routledge Taylor & Francis Group
2. 101 Activities for Teaching creativity and Problem Solving - By Arthur B Vangundy - Pfeiffer
3. H. S. Fogler and S.E. LeBlanc, Strategies for Creative Problem Solving, Prentice Hall
4. E. Lumsdaine and M. Lumsdaine, Creative Problem Solving, McGraw Hill,
5. J. Goldenberg and D. Mazursky, Creativity in product innovation. Cambridge University Press, 2002.

Course Assignments for internal continuous assessment of 20 Marks (NO T1 and T2)

- Brain teasers (aka Puzzle Busters, to be solved individually)
- Cartoon captions (small teams)
- TRIZ, a systematic ideation method, reading (individual)
- Book readings and discussions (small teams)
- Small teams presentations on innovation: (1) innovative individual, (2) innovative company, (3) innovative movie / game, (4) sustainable innovation, (5) innovation in business, (6) innovation in art, (7) innovation in architecture, (8) innovative nation, (9) innovation in science, and (10) innovation in engineering.
- Large groups hands-on projects
- Eight-dimensional (8D) ideation method examples
- Large teams videos

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: INT151 | **Course: Workshop / Manufacturing Practices**

L: 1Hrs., T: 0Hrs., P: 0Hrs., Per week | **Total Credits:1**

Course Outcomes

1. Identify the different manufacturing process commonly employed in Industry along withprevailing safetypractices.
2. Identify the various tools and equipments to carry out different manufacturing processes accompanied bythe inspection ofthe workpart.

Syllabus

Unit-1 Fundamentals of metal cutting, single point cutting tool, fundamental mechanics of metalcutting, fitting operations, and associated measuring and marking tools

Unit-2 Introduction to pattern making for metal casting, different types of carpentry tools, measuringtools and marking tools, holding devices, different types of carpentry joints.

Unit-3 Smithy and Forging, Forging tools like chisels, hammers, types of furnaces, types of coal,Forming operations, Hot working and Cold working of metals.

Unit-4 Metal joining Process, mechanics of welding, types of welding, soldering and brazing, types of joints Unit-5 Introduction to foundries, Metal Casting, types of sand, Introduction to Molding tools &casting process. Unit-6 Introduction to Plastic Injection Molding

Suggested Text Book

1. "Elements of Workshop Technology" Hajra S.K, Choudhury A. K , Roy Nirjhar Vol. I and Vol .II,Media Promoters and Publishers Private Ltd. Mumbai.

Reference Books

1. Kalpak Jain S. and Schmid S. “Manufacturing Engineering and Technology”4th Edition, PearsonIndia Education 2008
2. Roy A. and Lindberg, “Process and Materials of Manufacture”4th Edition, Prentice Hall India1998.

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: INP151 **Course: Workshop/ManufacturingPractices Lab**

L:0Hrs.,T:0Hrs.,P:2Hrs.,Per week **Total Credits :1**

Laboratory Outcomes

On the completion of the course the students shall be able to;

1. Recognize the different manufacturing process commonly employed in the Industry
2. Make the components using required manufacturing process, inspection methods whilepracticing the requisite safety precautions

Contents

1. Fitting Practice
2. Welding and Soldering Practice
3. Pattern Making Practice
4. Metal Casting Practice
5. Smithy and Forging Practice
6. Machining Practice
7. Plastic Molding Process
8. Glass Cutting Process

Suggested Text Book

1. "Elements of Workshop Technology'" Hajra S.K, Choudhury A.K , Roy Nirjhar Vol. I and Vol .II,Media Promoters and Publishers Private Ltd Mumbai.

Reference Books

1. Kalpak Jain S. and Schmid S. "Manufacturing Engineering and Technology"4th Edition, PearsonIndia Education 2008
2. Roy A. and Lindberg, "Process and Materials of Manufacture", Prentice hall India 1998.

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: HUT151 **Course: English**

L: 2 Hrs. T: 0 Hrs. P: 0 Hrs. Per week **Total Credits: 2**

Course Objectives

The main objective of the subject is to enhance the employability skills of engineering students as wellas communication skills at work place. The sub-objectives are:

1. To develop vocabulary of students.
2. To orient students in basic writing skills.
3. To orient students in functional grammar.
4. To orient students in the process of effective writing.
5. To provide practice and improve students' oral communication skills.

Course Outcomes

1. Students will have good word power.
2. Students will acquire basic writing skills.
3. Students will understand functional grammar and its usage.
4. Students will organize and express their thoughts effectively through written communication.
5. Students will learn oral communication skills in order to handle themselves effectively in aninterview and group discussion

Syllabus

1. Vocabulary Building

1.1. The concept of Word Formation

1.2. Root words from foreign languages and their use in English

1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives

1.4. Synonyms, Antonyms and standard abbreviations

2. Basic Writing Skills

2.1 Sentence Structures

2.2 Use of phrases and clauses in sentences

2.3 Importance of proper punctuation

2.4 Creating coherence

2.5 Organizing principles of paragraphs in documents

2.6 Techniques for writing precisely

3. Identifying Common Errors in Writing

3.1 Subject-verb agreement

3.2 Noun-pronoun agreement

4. Misplaced modifiers

3.1 Articles

3.2 Redundancies

3.3 Cliches

1. Nature and Style of sensible Writing

4.1 Describing

4.2 Defining

4.3 Classifying

4.4 Providing examples or evidence

2. Writing Practices

5.1 Comprehension

5.2 Precis Writing

5.3 Essay Writing

5.4 Letter Writing

5.5 Email Writing

3. Oral Communication

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations : Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Books

1. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

First Year Group 2: Semester-I / Group 1: Semester-II
Department of Electrical Engineering

Course Code: HUP151 **Course: English Lab**

L: 0 Hrs. T: 0 Hrs. P: 2 Hrs. Per week **Total Credits: 1**

Course objective

1. To enhance competency of communication in English among learners.

Course outcomes

1. Students learn presentation and public speaking skills
2. Students learn to practice effective strategies for Personal Interview and Group Discussions
3. Students learn and effectively apply language skills – listening, speaking, reading and writing

List of Practical

1. Common Everyday Situations: Conversations and Dialogues
2. Pronunciation, Intonation , Stress, and Rhythm
3. Formal Presentations: Orientation
4. Formal Presentations : Practice Session
5. Interviews: Orientation
6. Interviews: Practice Session
7. Communication at Workplace: Group Discussion- Orientation
8. Communication at Workplace: Practice Session

B. Tech III Semester

Department of Electrical Engineering

Course Code: MAT256 **Course: Electrical Engineering Mathematics**
L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Outcomes

After studying the course, the students will be able to:

1. Understand Laplace transforms to solve engineering problems.
2. Understand the complex variables and its application.
3. Solve field problems in engineering involving PDEs.
4. Apply statistical method for analyzing experimental data and understand the basic importance of Numerical Methods to solve problems related to Engineering applications.

MODULE 1: [10Hours]

Laplace Transforms: Laplace transforms and their properties, Application for Laplace Transform to solve ordinary differential equations including simultaneous Differential Equations. Solution of one dimensional Partial differential equations by Laplace Transform method.

MODULE 2: [8Hours]

Functions of a Complex Variable: Function of a complex variable, Analytic functions, Cauchy- Riemann conditions, Conjugate functions, singularities, Cauchy's integral theorem and integral formula, Taylor's and Laurent's theorem, Residue theorem.

MODULE 3: [8Hours]

Partial Differential equations: Partial differential equation of first order first degree i.e. Lagrange's form. Linear homogeneous PDE of nth order with constant coefficient, method of separation of variables, Applications of partial differential equations.

MODULE 4: [8Hours]

Numerical Methods: Solution of algebraic and transcendental equations using method of false position and Newton-Raphson method. Solution of system of linear equations, Gauss elimination method, Gauss-Seidal method, .

Numerical solution of ordinary differential equations by Taylor's series method, Modified Euler's method, Runge-Kutta method.

MODULE 5: [8Hours]

Random Variable and Probability distribution: Expectation of Discrete Random Variables, Moments, Variance of Sum, Continuous random variables and their properties, Probability density function, probability distribution function for Discrete and continuous random variables, normal, exponential distribution.

Textbooks/References

1. S.S.Sastry, Introductory methods of numerical analysis, PHI,4th Edition,2005.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

B. Tech III Semester

Department of Electrical Engineering

Course Code: EET253 **Course: Data Structures and Algorithms**

L: 3Hrs., T: 0 Hrs., P:0 Hrs., Per week **Total Credits: 3**

Course Objectives

- To impart to students the basic concepts of data structures and algorithms.
- To familiarize students on different searching and sorting techniques.
- To prepare students to use linear (stacks, queues, linked lists) and non-linear (trees, graphs) data structures.
- To enable students to devise algorithms for solving real-world problems.

Course Outcomes:

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

CO1: Recognize different ADTs and their operations and specify their complexities.

CO2: Design and realize linear data structures (stacks, queues, linked lists) and analyze their computation complexity.

CO3: Devise different sorting (comparison based, divide-and-conquer, distributive, and tree-based) and searching (linear, binary) methods and analyze their time and space requirements.

CO4: Design traversal and path finding algorithms for Trees and Graphs

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Syllabus

MODULE– I: Data Structures and Algorithms Basics

Introduction: basic terminologies, elementary data organizations, data structure operations; abstract data types (ADT) and their characteristics.

Algorithms: definition, characteristics, analysis of an algorithm, asymptotic notations, time and space tradeoffs.

MODULE – II: Stacks and Queues

Array ADT: definition, operations and representations – row-major and column-major. Stack ADT: allowable operations, algorithms and their complexity analysis, applications of stacks – expression conversion and evaluation (algorithmic analysis), multiple stacks.

Queue ADT: allowable operations, algorithms and their complexity analysis for simple queue and circular queue, introduction to double-ended queues and priority queues.

MODULE – III: Linked Lists

Singly Linked Lists: representation in memory, algorithms of several operations: traversing, searching, insertion, deletion, reversal, ordering, etc.

MODULE – IV: Sorting and Searching

Sorting: different approaches to sorting, properties of different sorting algorithms (insertion, Shell, quick, merge, heap, counting), performance analysis and comparison.

Searching: necessity of a robust search mechanism, searching linear lists (linear search, binary search) and complexity analysis of search methods.

MODULE – V: Trees

Trees: basic tree terminologies, binary tree and operations, binary search tree [BST] and operations with time analysis of algorithms, threaded binary trees.

MODULE – VI: Graphs

Graphs: basic terminologies, representation of graphs, traversals (DFS, BFS) with complexity analysis, path finding (Dijkstra's SSSP, Floyd's APSP), and spanning tree (Prim's method) algorithms.

Text Books:

1. Ellis Horowitz, Sartaj Sahni& Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
2. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.
3. G.A.V. Pai; Data Structures and Algorithms: Concepts, Techniques and Application; First Edition; McGraw Hill; 2008.

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein; Introduction to Algorithms; Third Edition; PHI Learning; 2009.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran; Fundamentals of Computer Algorithms; Second Edition; Universities Press; 2008.
3. A. K. Sharma; Data Structures using C, Second Edition, Pearson Education, 2013.

B. Tech III Semester

Department of Electrical Engineering

Course Code: EEP253 **Course: Data Structures and Algorithms Lab**

L: 00 Hrs., T: 00 Hrs., P:02 Hrs., Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students shall be able:

1. To design different ADTs with their operations.

2. To implement linear data structures (stacks, queues, linked lists) and analyze their computation complexity.

3. To implement different sorting (comparison based, divide-and-conquer, distributive and tree-based) and searching (linear, binary) methods and analyze their time and space requirements.

4. To implement and analyze traversal and path finding algorithms for Trees and Graphs.

Experiments are based on the syllabus of course EET253.

Text Books:

1. Ellis Horowitz, Sartaj Sahni& Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press, 2008.
2. Mark Allen Weiss; Data Structures and Algorithm Analysis in C; Second Edition; Pearson Education; 2002.
3. G.A.V. Pai; Data Structures and Algorithms: Concepts, Techniques and Application; First Edition; McGraw Hill; 2008.

B. Tech III Semester

Department of Electrical Engineering

Course Code: EET251 **Course: Network Analysis**

L: 3 Hrs., T: 1 Hrs., P: 0 Hrs., Per week **Total Credits : 04**

Course Outcomes:

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

CO1: Apply the basic Mathematical tools to circuit analysis and compute the parameters of three phase circuits.

CO2: Apply the frequency analysis to circuit with different input signals.

CO3: Find the various characteristics of electrical networks

CO4: Apply the graphical approach to networks.

Course Objective:

To make Students able to apply different analytical tools on electrical networks for solving them.

Module-1: Equilibrium Equations: *[Minimum Teaching Hours:8 Hours]*
Equilibrium Equations with Nodal & Mesh Analysis on electrical networks, source transformations, Dot conventions in coupled circuits, Solutions of Mutually coupled Networks, Duality.
Three phase unbalanced circuits and power calculations.

Module-2: Network Theorems: *[Minimum Teaching Hours: 8 Hours]*
Superposition, Reciprocity, Thevenin's, Norton's. Maximum Power Transfer, Compensation, Tellegen's theorem as applied to DC & A.C. circuits.

Module-3: Laplace Transform & Applications*: [Minimum Teaching Hours: 10 Hours]*
Evaluation of initial & final condition, Concept of complex frequency, Partial fractions, Singularity functions, Waveforms Synthesis, Steady state and transient state analysis of RL, RC, RLC network with initial & final conditions using Laplace Transformation.

Module- 4: Network Functions: *[Minimum Teaching Hours: 7 Hours]*
Transient Response, Driving points and transfer functions, Poles, Zeros of network function, their properties, Time response from Pole-Zero locations on s-plane, convolution integral solution.

Module-5: Two Port Networks: *[Minimum Teaching Hours: 6 Hours]*
Network Parameters and Inter-connections, Conditions of Reciprocity and Symmetry, Inter-relations between parameter sets.

Module-6: Network Graph Theory & Resonance: *[Minimum Teaching Hours:7 Hours]*
Paths and Cycles, Connectivity, Trees, Spanning Sub-graphs, Random graphs. Formation of incidence Matrix, Cut-set Matrix, Tie-set Matrix,
Resonance in series & parallel RLC circuits.

Text Books:

1. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
2. D. Roy Choudhury, “Networks and Systems”, New Age International Publications,1998.
3. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education,2004.
5. A.Chakrabarty, “Circuit Theory (Analysis & Synthesis)”, Dhanpat Rai & Co. 2006

References:

1. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum's series, McGraw- Hill,New Delhi, 2010.
4. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
5. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
6. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015

B. Tech III Semester

Department of Electrical Engineering

Course Code: EEP251 **Course: Network Analysis Lab**

L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits : 01**

Course Outcomes:

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

1. Apply analyze and co-relate fundamental principles of Engineering with laboratory experimental work.
2. Understand and connect the circuit and perform the experiment, Analyze the observed data & make valid conclusion.
3. Understand & write Journal with effective presentation of Drawing diagrams / characteristics /Graphs
4. Match the practical and theoretical analysis results, for conceptual verification.

List of Experiments

1. Verification of Thevenin's Theorem.
2. Verification of Norton's Theorem.
3. Verification of Superposition Theorem.
4. Verification of Maximom Power Transfer Theorem.
5. Verification of Milliman's Theorem.
6. Verification of Reciprocity Theorem.
7. To Find the Voltage Transfer Ratio of a Two Port, Bridged-T Network.
8. To Find Z-Parameters of a Two Port, T -Network.
9. To Study the Resonance of RLC Series/Parallel Network & Plot the Vr Vs F Curve.
10. To Verify the Network Theorems using MATLAB Simulation.
11. To Find the Voltage Transfer Ratio using MATLAB Simulation.
12. To Find Z-Parameters T-Network using MATLAB Simulation.

B. Tech III Semester

Department of Electrical Engineering

Course Code: ENT259 **Course: Analog Electronic Circuits**

L: 3 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 03**

Course Outcomes

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

CO1: Discuss the operation and analyze the characteristics of semiconductor diodes, BJT, and MOSFET.

CO2: Design and analyze electronic circuits containing non-linear elements such as diodes, MOSFET, & BJT using the concepts of biasing, load lines, operating point and incremental analysis.

CO3: Analyze inverting and non- inverting configurations of operational amplifier with negative feedback, evaluate performance parameters of operational amplifier.

CO4: Design Op-amp circuits for linear and nonlinear applications. ADC/DAC for designing electronic circuits for desired applications

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MODULE 1: [04 Hours]
Diode Circuits: P-N junction diode, V-I characteristics of a diode; half-wave and full-wave rectifiers ,Zener diodes, clamping and clipping circuit.

MODULE 2: [08 Hours]
BJT Circuits: Structure and V-I characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuit, high-frequency equivalent circuits.

MODULE 3: [08 Hours]
MOSFET Circuits: MOSFET structure and V-I characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuit - gain, input and output impedances, trans-conductance.

MODULE 4: [07 Hours]
Feedback amplifier and Op-amp fundamentals: General Feedback amplifier Structure, Properties of Negative Feedback,: Characteristics of operational amplifier, open loop Op-amp, basic inverting and non-inverting Op-amp amplifiers with negative feedback, Op-amp parameters & their analysis.

MODULE 5: [10 Hours]
Op-amp linear and nonlinear applications: Voltage follower, summing amplifiers, integrators and differentiators, difference amplifiers & instrumentation amplifiers, Clipper, Clamper, Comparators, Schmitt trigger circuits, Sample/Hold circuits, Digital to analog converters, Analog to digital converters

MODULE 6: [06 Hours]
Oscillators and Active filters design: Precision rectifiers, oscillators: basic concept, Op-amp based sinusoidal oscillators, design of Active filters. .

Textbook

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, “Microelectronics Circuits: Theory and Applications,” Seventh Edition, Oxford University Press, 2017.
2. Sergio Franco,“Design with Operational Amplifiers and Analog Integrated Circuits,” Fourth Edition, McGraw-Hill Education, 2014.

Reference books

1. Donald Neamen, “Electronic Circuits: Analysis and Design,” Third Edition, McGraw-Hill Publication, 2006.

2. Donald Neamen, “Semiconductor Physics and Devices: Basic Principles,” Fourth edition, McGraw-Hill, 2011.

3. Jacob Millman, Christos Halkias, Chetan Parikh, “Millman's Integrated Electronics,” Second edition, McGraw Hill Education, 2017.

4: Ramakant Gayakwad, ” OP-AMPS and linear integrated circuits” 4th Edition, PHI

5 D. Roy Choudhary, Shail Jain “Linear Integrated Circuits”, 4th Edition, New Age International.

B. Tech III Semester

Department of Electrical Engineering

Course Code: ENP259 **Course: Analog Electronic Circuits Lab**

L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits : 01**

Course Outcomes:
Upon the completion of this course students will be able to:

CO1: Identify the region of operation of semiconductor diodes, MOSFET, and BJT.

CO2: Design rectifiers, Clippers and voltage regulators using diodes.

CO3: Analyze inverting and non- inverting configurations of operational amplifier.
CO4: Design basic linear and nonlinear Op-amp circuits.

Experiments are based on the syllabus of course ENT259.

Textbooks:

1. Microelectronic Circuits: Theory and Applications :Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Seventh Edition, Oxford University Press, 2017.

2. Linear Integrated Circuits: D. Roy Choudhary, Shail Jain, 4th Edition, New Age International.

B. Tech III Semester

Department of Electrical Engineering

Course Code: EET252 **Course: Electrical Measurements & Instrumentation**

L:3Hrs.,T: 1 Hrs., P:2 Hrs., Per week **Total Credits: 4**

Course Objective:

The objective of the course is to prepare the students to enable the development of skills through which the student will gain the knowledge of the basic principles of all measuring instruments and apply it for the measurement of electrical and non-electrical quantities.

Course Outcomes:

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

CO1. Identify suitable bridge for the measurement of passive electrical elements.

CO2. Discuss the operating principle and construction of different types of analog instruments.

CO3. Discuss the operating principle and construction of digital instruments for the measurement of electrical quantities

CO4. Discuss the Instrument transformers and calculate various operational parameters.

CO5: Select and compare different transducers for the measurement of various physical quantities.

Syllabus

Module-I (Teaching Hours – 9)
Measurement Systems**,** classification of different measuring Instruments, D.C bridges (Wheat stone, Kelvin and Kelvin's Double bridge) A.C bridges (Schering Bridge, Maxwell-Inductance- Capacitance Bridge, Hay's bridge, Owen's Bridge and DeSauty's Bridge),

Module-II (Teaching Hours – 9)
Analog Measurement Techniques, Principles of permanent magnet moving coil(PMMC) instrument, Moving iron (MI) instrument and Electrodynamometer type instruments. Measurement of three phase and single phase power , loading effect of instruments.

Module-III (Teaching Hours – 6)
Digital Measurement Techniques , True RMS measurement, measurement of voltage, Current, Power, Frequency and Energy.

Module-IV (Teaching Hours – 7)
Introduction to Instrument transformers and its applications.
Working principle of Special Instruments, Insulation Tester, Earth tester,

Module-V (Teaching Hours –9)
Classification of Transducers, -Electromechanical transducers, Potentiometric resistance Transducers, Inductive type transducers, Variable inductance transducer, , Piezoelectric transducer, Strain gauges, Linear variable differential transformer, Capacitive type transducer, resistance strain gauge, Digital transducers,

Module-VI (Teaching Hours –7)
Measurement of temperature, measurement of flow, measurement of motion and measurement of pressure.

Text books:

1. A Course in Electrical and Electronics Measurements and Instrumentation: 11ed., Sawhaney A. K., Dhanpat Rai & Sons, Delhi 1994.
2. Electrical Measurements and Measuring Instruments: 3ed., Golding, E. W., Widdis, F. C.,Wheeler's Student Edition, 1994.
3. Electrical Measurements and Instrumentation: U. A. Bakshi, A.V. Bakshi, Technical Publications,2009.
4. Electrical and Electronic Measurements and Instrumentation : R.K. Rajput.
5. Instrumentation Measurement and Analysis : B C Nakra, K K Chaudhary

Reference Book :

1. Electronic Measurements and Instrumentation: 3 ed., Cooper, W.D., Helfrick, A.D., Prentice-Hall of India,New Delhi 1991.

B. Tech III Semester

Department of Electrical Engineering

Course Code: EEP252 Course: Electrical Measurement and Instrumentation Lab

L: 0 Hrs, T: 0 Hr, P: 2 Hrs. Per week Total Credits: 01

Course Outcomes

Upon the completion of this course, students shall be able to,

1. Apply analyze and co-relate fundamental principles of science & Engineering with laboratory experimental work/simulation work/Programming work
2. Understand the circuit diagram and connect the circuit properly. Perform the experiment, Analyze the observed data and make valid conclusion.
3. Write journal with effective presentation of diagram, characteristics and waveforms.
4. Measure resistance, inductance, capacitance, Active power, reactive power, apparent power, power factor, motion, pressure, flow and temperature.

List of Experiment:

Part-A: Based on Electrical Measurements
Part-B: Based on Instrumentation

Part-A: Based on Electrical Measurements

1. Measurement of Resistance
   i. Medium Resistance using Wheatstone Bridge Method
   ii. Low Resistance using Kelvin's Double Bridge method

3. Measurement of Capacitance using
   i. De-Sauty's Bridge and Modified De_Sauty's Bridge
   ii. Schering Bridge

4. Measurement of Inductance using
   i. Hay's Bridge
   ii. Maxwell's Bridge

5. Measurement of reactive power by one wattmeter method

6. Measurement of three phase power using two wattmeter method.

7. Measurement of Energy using Digital Energy meter

Part B: Based on Instrumentation

8. Pressure measurement using Piezo Resistive sensor

9. Flow measurement using Rotameter

10. Temperature measurement using Thermocouple
11. Study of Linear Variable Differential Transformer (L.V.D.T.)

Text books:

1. A Course in Electrical and Electronics Measurements and Instrumentation: 11ed., Sawhaney A. K., Dhanpat Rai & Sons, Delhi 1994.
2. Electrical Measurements and Measuring Instruments: 3ed., Golding, E. W., Widdis, F. C.Wheeler's Student Edition, 1994.
3. Electrical Measurements and Instrumentation: U. A. Bakshi, A.V. Bakshi, Technical Publications,2009.
4. Electrical and Electronic Measurements and Instrumentation: R.K. Rajput.

Reference Book:

1. Electronic Measurements and Instrumentation: 3 ed., Cooper, W.D., Helfrick, A.D., Prentice-Hall of India,New Delhi 1991.

B. Tech III Semester

Department of Electrical Engineering

Course Code: MBT251 **Course: Innovation and Entrepreneurship**

L: 03 Hrs., P: 00 Hrs., Per week **Total Credits : 03**

Course Outcomes:

After attending the course students should be able to:

1. Understand the logic and mechanics of a business enterprise
2. Develop an understanding of the entrepreneurial process from the conceptual stage to becoming an established business
3. Develop an understanding of business functions essential for the success of technology enterprises.
4. Develop a scalable, repeatable & profitable business model
5. Create Business Plan.
6. To use techniques and tools of innovation for bringing out innovation in products, services, and business.

Module I: Overview, Idea Generation / Evaluation: Startups and businesses, Types & stages of start-up, Idea generation strategies, Startup life cycle, Boot-strap financing, angels/VCs – elevator pitch, incubators and, business accelerators, entrepreneurs mindset, General environment Analysis for identifying opportunities.

Module II & III: Business model canvas: Components of business model and canvas, Value proposition and Differentiation, Customer Segmentation, Customer relationships, Channels, Key Partnerships, Key Activities, Key Resources, Revenue streams, Cost Structure, Value proposition and Differentiation,

Module IV: Customer Discovery: The need for Customer feedback, Product Market Fit, The Customer Discovery Process, Customer Discovery and Validation

Viable Product (MVP) & agile engineering: Definition of MVP, Planning an agile engineering team for quick change in business model (pivot), Start-up team & communication method,

Module V: Business Narrative and Go-ahead Decision Process: Developing the Business Narrative after Validating the BMC, The Go-Ahead Decision Process,
Business plan: Components of Business plan, Problem and Need, Scenario presentation, Sizing Market potential, TAS, Go-To-Market strategies, and Cost Modelling
Team and Technology: Ideal Team composition, Technology, and Solution

Module VI: Tools for Innovation and Business Plan: *Design Thinking, Competitor Analysis, Cash flow, and project financing*

Readings:

Textbook:

The Start-up Owner's Manual: The Step-by-Step Guide for Building a Great Company, by Steve Blank & Bob Dorf. (Available in Kindle also)

Reference Books:

1. The Art of War, Sun-Tzu (Sun Tzu: The Art of War... free epub book at http://www.epubbooks.com/book/692/the-art-of-war)
2. Hope is not a Strategy, Rick Page
3. Innovation and Entrepreneurship, Peter Drucker
4. Biographies of Andy Grove, Bill Gates, Larry Ellison, Googl Founders, etc
5. Straight from the Gut and Winning, Jack Welch
6. How to Drive Your Competition Crazy, Guy Kawasaki
7. Crossing the Chasm, Geoffrey Moore
8. Differentiate or Die, Jack Trout

B. Tech III Semester

Department of Electrical Engineering

Course Code: CHT251 **Course: Environmental Science**

L: 02 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits : 02**

Course Outcomes

On successful completion of the course, the students:

1. Will get sufficient knowledge regarding different types of environmental pollutions, their causes, detrimental effects on environment and effective control measures.
2. Will realize the need to change an individual'soutlook, so as to perceive our environmental issues correctly, using practical approach based on observations and self learning.
3. Will become conversant with recent waste management techniques such as E-wastes, its recycling and management.
4. Will gain knowledge about the modes for sustainable development, importance of green energy and processes.
5. Will be able to identify and analyze environmental problems as well as risks associated with these problems and greener efforts to be adopted, to protect the environment from getting polluted.

Syllabus

Principle of contaminant behaviour and recent trends in environmental pollution control I- Air

pollution and its control techniques:(4 lectures)

Contaminant behaviour in the environment, Air pollution due to SOx, NOx, photochemical smog, Indoor air pollution.

Natural pathways for degradation:Carbon cycle, Sulphur cycle, Nitrogen cycle, Oxygen cycle.

Factors responsible for altering the composition of atmosphere (deforestation, burning of fossil fuels, industrial and vehicular emissions, CFCs).

Techniques to control Air pollution, ambient air quality and continuous air quality monitoring, Control measures at source, Kyoto Protocol, Carbon Credits.

II- Noise pollution and its control techniques: (2 lectures)

Introduction to noise pollution and its causes

Noise pollution control: Recent advances in noise pollution control and benefits.

III- Soil pollution and its control techniques: (5 lectures)

Soil pollution: Soil around us, Soil water characteristics, soil pollution.

Solid waste management: Composting, vermiculture, landfills, hazardous waste treatment, bioremediation technologies, conventional techniques (land farming, constructed wetlands), and phytoremediation.

Degradation of xenobiotics in environment: Petroleum hydrocarbons, pesticides, heavy metals

IV- Water pollution and its control techniques: (8 lectures)

Major sources of water pollution:Eutrophication, acid mine drains, pesticides and fertilizers, dyeing and tanning, marine pollution, microplastics

Techniques to control water pollution: Conventional waste water treatment-types of sewage, sewerage system, alternative systems, primary, secondary and tertiary processes including aerobic and anaerobic techniques, safe disposal.

Case studies

Treatment schemes for waste water from dairy, textile, power plants, pharmaceutical industries, and agro based industries such as rice mills

V- E-wastes (2 lectures)

Introduction, types of e-wastes, environmental impact, e-waste recycling, e-waste management rules.

VI- Environmental Sustainability: Role of Green technology (5 lectures)

Concept of green technologies, categories, goals and significance, sustainability

Green energy, green chemistry, challenges to green technology, advantage and disadvantages of green processes, Eco mark certification- its importance and implementation

VII- Different government initiatives (2 lectures)

National ambient air quality standard 2009, Swacch bharat abhiyan, National afforestation program and Act- 2016, National river conservation plan, Formation of National Green Tribunal

Books Suggested

1) Benny Joseph, Environmental Studies, Mc Graw Hill Education (India) Private Limited
2) B. K. Sharma, Environmental Chemistry, Goel Publishing House, Meerut
3) PAarneVesilind, J. Jeffrey Peirce and Ruth F. Weiner, Environmental Pollution and Control, Butterworth -Heinemann
4) D. D. Mishra, S. S. Dara,A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd. Sultan Chand & Company
5) Shree Nath Singh, Microbial Degradation of Xenobiotics, Springer-Verlag Berlin Heidelberg
6) P.T. Anastas& J.C. Warner, Green Chemistry: Theory & practice, Oxford University Press
7) P.Thangavel & Sridevi, Environemental Sustainability: Role of Green technologies, Springer publications

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET271 **Course: Signals and Systems**

L: 02 Hrs.,T: 01 Hrs., P: 00 Hrs., Per week **Total Credits: 3**

Course Objectives

The objective of the course is to prepare the students to analyze the various signals in real life application in time domain and frequency domain. The course will prepare students to intermediate level of fluency with signals and systems in both continuous time and discrete time, in preparation for more advanced subjects in digital signal processing

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Course Outcomes:

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

CO1: Classify different types of signals and systems.
CO2: Analyze the differential equations in time domain.
CO3: Apply Fourier transform to continuous-time and discrete-time signals
CO4: Apply z transform to discrete signals and systems
CO5: Illustrate the sampling process and its various applications

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Syllabus

Module-I: Introduction to signals and systems (Teaching Hours – 8)
Signals and systems as seen in everyday life, and in various branches of engineering and science. Different types and properties of signal and systems. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals.

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Module-II: Behaviour of continuous and discrete-time LTI systems (Teaching Hours – 7)
Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response

Module-III: Fourier Transform (Teaching Hours - 10)
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT), the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).

Module-IV: **Z Transform** (Teaching Hours - 7)
The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis, various properties of z transforms.

Module-V: Sampling and Reconstruction (Teaching Hours - 6)
The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books:

1. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.AICTE Model Curriculum for Undergraduate degree in Electrical Engineering (Engineering & Technology)

Reference Books:

1. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall, 2009.
2. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

B. Tech IV Semester

Department of Electrical Engineering

Course Code: ENT260 **Course: Digital Circuits and Microprocessor**

L: 03Hrs.,T: 00 Hrs., P: 00 Hrs. , Per week **Total Credits: 3**

Course Outcomes:

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

CO1: Discuss the working of various combinational circuits for different applications.

CO2: Identify the different sequential components used in combinational circuits.

CO3: Design and verify functionality of various combinational and sequential circuits.

CO4: Describe the architectural features of 8085 microprocessor and their usage.

CO5: Organize instructions to implement assembly language programs using 8085 microprocessor instruction set.

CO6: Comprehend and incorporate the concepts of Subroutines and Interrupts of 8085 microprocessor in simplifying assembly language programs.

Syllabus:

Module: 1 [06 Hours]

Logic Simplification: Number system, Binary Arithmetic, Boolean algebra and De Morgan's Theorem, Logic Gates, SOP & POS forms, Logic Optimization Technique, Karnaugh maps.

Module 2: [06 Hours]

Combinational logic Design: Comparators, Multiplexers, Demultiplexer, Encoder, Decoder, Arithmetic Circuit Design.

Module 3: [09 Lectures]

Sequential Logic Design: Latches Flip flop – S-R, J-K, D, T and Master-Slave JK FF, Counters, Shift registers.

Module 4: [06 Hours]

Microprocessor Introduction: Introduction of Intel's 8085A: Architecture, description. Flag structure, concept of PSW, Addressing modes, Timing diagrams.

Module 5: [09 Hours]

Programming: Instruction Set Stack and Subroutine, Simple and Nested subroutines, Push-Pop, Call-Return instructions, Stack manipulation, (simple programming).

Module 6: [06 Hours]

Interrupts: Interrupt concept& structure in 8085, Interrupt Service Routines (ISR), advanced instructions of Programming of 8085A.

Text books:-

1. Fundamentals of Digital Circuits, A. Kumar, Prentice Hall India, 2016.
2. Modern Digital Electronics, R. P. Jain, McGraw Hill Education, 2009.
3. Microprocessor, Architecture, Programming and Applications with 8085, Ramesh S.Gaonkar, 5th Edition, Penram International Publications.

Reference books:-

1. Digital logic and Computer design, M. M. Mano, Pearson Education India, 2016.
2. Digital Electronic Principles, By Malvino PHI, 3 Edition.

B. Tech IV Semester

Department of Electrical Engineering

Course Code: ENP260 **Course: Digital Circuits and Microprocessor Lab**

L:00 Hrs.,T: 00 Hrs., P:02 Hrs. , Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students shall be able to,

1. Design and optimize different of Combinational and sequential circuits.
2. Understand the instruction set of 8085 and write and debug Assembly language programs on microprocessor 8085.

Experiments are based on the syllabus of course ENT260

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET272 **Course: Electrical Machines-I**
L: 03 Hrs., T: 01 Hrs., P: 00Hrs., Per week **Total Credits:4**

Course Objectives

The objective of the course is to acquire the practical knowledge of construction, working and operation of transformer, Induction Motor and DC machines and also introduce the procedure for testing of machines.

Course Outcomes

Upon the completion of this course students will be able to:

CO1: Discuss the construction, operation and speed control of DC Motor and analyse its performance.
CO2: Discuss the construction and operation of a Transformer and analyse the performance parameters.
CO3: Discuss the various ratings and connections of Three phase Transformer, it's parallel operation and calculate the load sharing.
CO4: Discuss the construction and operation of a Three Phase Induction Motor and evaluate it's performance.
CO5: Understand the concepts of starting, speed control and braking of three-phase induction motor and analyses the Torque-speed characteristics.
CO6: Discuss the construction, operation and characteristics of single-phase ac motors.

Module 1: DC Machines (08 Hours)

Basic principle & operation of DC generators and DC motors (separately excited, shunt and series), Induced emf equation, Characteristics of DC motors, speed control of DC motors, Losses & Efficiency, Application of DC motor.

Module2: Transformer (08 Hours)

Brief review of single-phase transformer, construction of 3-phase transformer, classification of three phase transformer on the basis of core construction and winding, comparison between 3-phase transformer and a bank of three 1-phase transformers, Difference between power transformer and distribution transformer, OC & SC test on three phase transformers, calculation of regulation and efficiency, Accessories of oil immersed transformer (numerical excluded), introduction to dry type transformer, methods of cooling.
Auto-transformer: Construction, comparison with two winding transformers, VA conducted magnetically and electrically.

Module 3: Transformer (Cont…..) (08 Hours)

Calculation of all-day efficiency, Polarity test, various connections of 3-phase transformer with vector groups, clock notation of 3-phase transformer, three phase to two phase conversion (qualitative analysis), temperature rise test, concept of Inrush current, Tap changer (on load and off load).
Parallel operation of transformer: Conditions for parallel operation and load sharing between parallel connected transformer.

Module 4: Three phase Induction Machine (08 Hours)

Construction,3-phase winding, production of rotating magnetic field, slip, equivalent circuit, phasor diagram, torque equation, power flow, torque-slip characteristic in all three modes of operation (motor, generator and braking), No load and blocked rotor tests**,** Double cage Induction motor, calculation of equivalent circuit parameters, losses and efficiency.

Module 5: Starting, speed control and braking of 3-phase Induction Motor (08 Hours)

Starting methods of 3-phase Induction Motor: DOL starting, Rotor Resistor starting, Auto-transformer starting, Star-Delta starting.

Speed control Methods: By change in input voltage, input frequency, V/F method, rotor resistance control and consequent pole changing technique. Effect of change in input voltage, input frequency, both with constant V/F ratio and rotor resistance on torque-slip characteristics.

Braking methods: Plugging, Regenerative braking, DC and AC braking.

Module 6: Single phase AC Motors (08 Hours)

Single Phase induction motor, Double revolving field theory and development of equivalent circuit. Methods of starting using auxiliary winding, capacitor start-run type, capacitor start induction run type, applications.

Introduction to universal motor and shaded pole motor: constructional features and performance characteristics, application.

Text Books:

1. Electrical Machines: Dr. P.S. Bimbhra
2. Electrical Machines: Ashfaq Hussain
3. A Text Book of Electrical Technology: B. L. Theraja (Vol. II)
4. Electric Power Transformer Engineering by Charles W. Johnson,3rd Edition,2012 CRC Press

Reference Books:

1. Performance & Design of A.C. Machine: M. G. Say
2. Electrical Machines: I.S. Nagrath & Dr. D.P. Kothari
3. Laboratory Courses in Electrical Engineering: Tarnekar, Kharbanda, Bodkhe & Naik

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EEP272 **Course: Electrical Machines-I Lab**
L: 00 Hrs., T: 00 Hrs., P:02 Hrs., Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students shall be able to,

1. Understand and correlate the theoretical knowledge of DC machines, three phase induction machines and transformer with laboratory experiments.
2. Select the instruments and apparatus of appropriate rating with recognition of machine ratings and connect the circuit to perform the experiment.
3. Perform the experiment, take readings, analyze the measured data and make valid conclusions.
4. Write effective report with neat and labelled presentation of diagrams, observations, correct calculations and graphs.

Experiments are based on the syllabus of course EET272

Text Books

1. Laboratory Courses in Electrical Engineering: S. G. Tarnekar, P. K. Kharbanda, S. B. Bodkhe, S. D. Naik, D. J. Dahigaonkar, S. Chand Publishing, New Delhi.
2. Electrical Machines: Ashfaq Hussain, Dhanpat Rai & Co. (P) Limited.
3. Electrical Machines: Dr. P.S. Bimbhra
4. A Text Book of Electrical Technology: B. L. Theraja (Vol. II)

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET276 **Course: Power System-I**
L: 03 Hrs, T: 00 Hr, P: 00 Hrs. Per week **Total Credits: 03**

Course Objectives

To familiarize students with basic structure of Power System and introduce them to different electrical and mechanical aspects related to Power System transmission and distribution.

Course outcomes

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

CO1: Discuss Per Unit System and calculate various components of power system.

CO2: Calculate different electrical parameters of transmission line.

CO3: Model different types of transmission line and determine their performance

CO4: Explain and analyse different types of distribution system and underground cables.

CO5: Discuss and analyse mechanical aspects of transmission system.

Syllabus

Module-I (Teaching Hours - 6)

Basic Concepts: – Evolution of Power Systems and Present-Day Scenario. Structure of a power system, Transmission and Distribution Systems, Single line diagram, overhead and underground system, AC and DC transmission, Introduction to per-unit system and per-unit calculations.

Module- II (Teaching Hours - 8)

Transmission Line Parameters: - Transmission line parameters, Electric and Magnetic Fields around conductors, Capacitance and Inductance calculations for symmetrical and unsymmetrical conductor spacing, Transposition of line, Skin and Proximity effect, bundled conductors, Corona.

Module- III (Teaching Hours - 10)

Performance of Transmission Line: - Sinusoidal Steady state representation of Lines: Short, medium and long lines. Performance of transmission line and voltage regulation, Real and reactive power flow in transmission line, Surge Impedance Loading.

Module- IV (Teaching Hours - 8)

Distribution System and Cables: - Types of distribution system and its topologies, Feeders, distributors and service mains, Quantitative analysis of DC and AC distributor. Types of Cables, Capacitance of single-phase and three-phase Cable, Grading of Cable.

Module- V (Teaching Hours - 8)

Mechanical Design of Transmission Line: - Line Supports, Types of towers, Sag Calculation, Effect of Wind and Ice loading, Insulators: Types, Voltage distribution in insulator string, improvement of string efficiency.

Text Books:

1. Electric Power Systems: *C.L.Wadhwa, Wiley Eastern Ltd, New Delhi.*
2. Modern Power System Analysis: *D. P. Kothari and I. J. Nagrath, McGraw Hill Education, 2003.*
3. Principles of Power System: *V.K.Mehta, S.Chand ,2005*

Reference Books:

1. Power System Analysis: *J. Grainger and W. D. Stevenson, McGraw Hill Education,1994.*
2. Electric Energy Systems Theory: *O. I. Elgerd, McGraw Hill Education, 1995.*
3. Power System Analysis: *R. Bergen and V. Vittal, Pearson Education Inc., 1999.*
4. Electric Power Systems: *M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, Wiley, 2012.*

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET277 **Course: Object Oriented Programming**

L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

The objective of the course is to prepare the students:

1. To enable the development of skills through which the student will gain expertise in writing programs using object oriented programming features.
2. Learn to apply concepts of File handling, exception handling.
3. To develop various programs on Generics, Collections and multithreading

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Course Outcomes

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

CO1: Discuss and analysis of different features object oriented programming.

CO2: Develop basic programs for given problems.

CO3: Discuss the File handling and exception handling and develop programs using concept Of error handling

CO4: Discuss Generics, Collections and multithreading and develop programs using these concepts.

Syllabus

Module-I (Teaching Hours – 7)

Features of Object Oriented Programming languages like data encapsulation, inheritance, polymorphism and late binding. Introduction to class and Methods, Access control of members of a class, instantiating a class, Constructors, Garbage Collection, finalize() Method.

Module-II (Teaching Hours – 7)

Concept of inheritance, methods of derivation, use of super keyword and final keyword in inheritance, run time polymorphism. Abstract classes and methods, interface, implementation of interface, creating packages, importing packages, static and non-static members.

Module-III (Teaching Hours - 8)

Exceptions, types of exception, use of try catch block, handling multiple exceptions, using finally, throw and throws clause, user defined exceptions, Generics, generic class with two type parameter, bounded generics, Collection classes: Arrays, Vectors, Array list, Linked list, Hash set, Queues, Trees.

Module-IV (Teaching Hours - 8)

Introduction to streams, byte streams, character streams, file handling in Java, Serialization Multithreading: Java Thread models, creating thread using runnable interface and extending Thread, thread priorities, Thread Synchronization, Inter-thread communications.

Text Books:

1. JAVA The Complete Reference*: Herbert Schildt;*; Seventh Edition, Tata McGraw- Hill Publishing Company Limited 2007.
2. A programmer's Guide to Java SCJP Certification: A Comprehensive Primer: *Khalid A. Mughal and Rolf W.Rasmussen,* Third Edition.
3. Java Fundamentals: A Comprehensive Introduction:*HerbertSchildt and Dale Skrien*; Tata McGraw-Hill Education Private Ltd., 2013.

Reference Books:

1. Core JAVA Volume-II Advanced Features: *Cay S. Horstmann and Gary Cornell;* Eighth Edition; Prentice Hall, Sun Microsystems Press, 2008.
2. Java Programming: A Practical Approach: *C Xavier;* Tata McGraw- Hill Education Private Ltd., 2011.

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EEP277 **Course: Object Oriented Programming Lab**

L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Outcomes

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

1. Develop programs using object-based programming techniques using objects and classes.
2. Develop programs using Specialized Java programming concepts like File handling, Multithreading, and Exception handling.
3. Develop programs using concepts like Streams, Generic and Collection classes.

Syllabus

Minimum 8 practicals based on but not limited to the following topics:
Classes and Objects, Inheritance, Overloading, Polymorphism, Collections, Generics, File Handling

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET299-3 **Course: Elements of Electrical Technology**
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Outcomes:

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

CO1: Discuss the various power generation sources.
CO2: Analyze the basic ac and dc electric circuits
CO3: Apply the basic mathematical tools for circuit analysis.
CO4: Classify various types of switchgear unit as per applications.
CO5: Understand tariff tables and use for electricity bill calculations.

Syllabus

Module I: Introduction to Power Generation: (Teaching Hours- 6)
Introduction to Thermal, Nuclear, Solar, Wind, Hydro and Bio mass based power generation
Introduction to Transmission & Distribution through different voltage levels using single line diagram.

Module II: Introduction to Electric Circuits (Teaching Hours-8)
DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with DC excitation. AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Three phase AC generation, Power factor improvement.

Module III: Basics of Network Analysis (Teaching Hours-8)
Introduction to mesh and Nodal Analysis to electrical circuits, Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer

Module IV: Electrical Installation and Safety (Teaching Hours-8)
Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.
Illumination system Simple numerical to determine number of lamps to attain a given average lux level in an area.

Module V: Tariff (Teaching Hours-8)
Objectives of Tariffs, General tariff for, flat demand rate, straight meter rate, block meter rate, two part tariff, power factor dependent tariff, KVA based tariff, three part tariff, spot (time differentiated) pricing. Elementary calculations for energy consumption.

.**Text Books:**

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.

Reference Books:

1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.
3. Electrical Technology: B. L. Thereja, S. Chand Publications.
4. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.
5. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
6. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi,2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

B. Tech IV Semester

Department of Electrical Engineering

Course Code: EET299-2 **Course: Renewable Energy Systems**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Outcomes:
1. Understanding renewable energy sources.
2. Gain knowledge of working principle of various solar energy systems.
3. Gain knowledge of working of wind power system.
4. Capability to work with energy systems like Hydel, Tidal, Biomass, Geothermal, Wave, Ocean.

MODULE-I: (05 Hrs)
Global and National Energy Scenario: Over view of conventional & renewable energy sources, need, potential & development of renewable energy sources, Global and Indian Energy scenario, Energy for sustainable development, Global climate change.

MODULE–II: (10 Hrs)
Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Solar-Electrical Power Generation, general Solar Photo Voltaic (SVP) system, Different configurations, Stand-Alone and Grid Connected SPV systems, Applications of Solar Energy.

MODULE–III: (06 Hrs)
Wind Energy: Wind Energy Conversion, Potential, Nature of the wind, Wind Data and Energy Estimation, Site selection, Types of wind turbines, Wind farms, Wind-Electric Generation and Control., offshore wind energy – Hybrid systems, wind energy potential and installation in India.

MODULE -IV: (06 Hrs)
Hydel and Tidal Power Systems: Basic working principle, Classification of hydel systems: Large, small, micro systems – measurement of head and flow, Energy equation, Types of turbines, Numerical problems. Tidal power, Basics, Kinetic energy equation, Numerical problems, Indian scenario.

MODULE- V: (06 Hrs)
Bio-Mass, Geothermal: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects–Indian scenario.
Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

MODULE- VI: (05 Hrs)
Wave & Ocean Energy
Wave power – Basics Technology – Kinetic energy equation.
Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles.

Text Books

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH,New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013.
3. Non-Conventional Energy Sources /G.D. Rai, Khanna Publishers

Reference Books

1. Renewable Energy- Edited by Godfrey Boyle-oxford University, press, 3rd edition, 2013.
2. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific,Si'pore.
3. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
4. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
5. Non-conventional energy source –B.H. Khan- TMH-2nd edition.

B. Tech IV Semester

Department of Electrical Engineering

Course Code: HUT252 **Course: Indian Traditional Knowledge**
L: 02 Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 00**

Course outcome:

Students will have increased ability to understand the importance and application of:

CO1: Indian Knowledge system and its scientific approach

CO2: Indian philosophical tradition

CO3: Indian artistic tradition

CO4: Traditional knowledge and protection of nature

CO5: The legality and its importance for the protection of Indian traditional knowledge

MODULE 1: [07 Hours]

Basic Structure of Indian Traditional Knowledge: Vedas, Upavedas, Vedang, Upadang, scientific approach

MODULE 2: [05 Hours]

Ecology and Indian Traditional Knowledge: Meaning, role, case studies

MODULE 3: [07 Hours]

Intellectual Property Rights and Indian traditional Knowledge: Meaning, role in protection of Indian traditional knowledge, cases studies

MODULE 4: [07 Hours]

Indian Philosophical traditions: Nyay, Sankaya, Yog, Mimansa, Jainism, Buddhism, Sikhism, and other approaches

MODULE 5: [04 Hours]

Indian Artistic Traditions: Chitrakala, Murtikala, Vastukala, Sangeet, Sthpatya, NrityaevamSahitya, case studies

Reference Material

1. RR Gaur, Rajeev Sangal, GP Bagaria, Human Values and Professional Ethics (Excel Books, New Delhi, 2010)
2. V. Sivaramakrishanan (ed.), Cultural Heritage of India – Course material, BharatiyaVidyaBhavan, Mumbai, 5th Edition, 2014
3. Swami Jitatmanand, Modern Physics and Vedant, BharatiyaVidyaBhavan
4. Swami Jitatmanand, Holistic Science and Vedant, BharatiyaVidyaBhavan
5. S.C. Chatterjee and D.M. Datta, An introduction to Indian Philosophy, University of Calcutta, 1984
6. Pramod Chandra, Indian Arts, Howard University Press, 1984
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987.

B. Tech IV Semester

Department of Electrical Engineering
Honours in Distributed Energy Generation Systems

ourse Code: EETH42 **Course: Renewable and Distributed Energy Sources**

L: 4 Hrs., T: 0 Hrs., P: 0 Hrs., Per week **Total Credits : 04**

Course Outcomes

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

CO1: Discuss about renewable and non-renewable sources of energy
CO2: Discuss about the power generation using solar photovoltaic system.
CO3: Discuss about the wind energy and wind energy conversion system.
CO4: Discuss about the different renewable energy sources like hydel, Tidal, Biomass, Geothermal and Ocean energy
CO5: Discuss about the concept of distributed generation.

Module 1: Introduction (4 Hours)
Conventional power generation: advantages and disadvantages, Energy crises, Non - conventional energy (NCE) resources, Potential and scope

Module 2: Solar Photovoltaic System (10 Hours)
Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar-Electrical Power Generation, general Solar Photo Voltaic (SVP) system, Different configurations, SPV system components and their characteristics, Stand-Alone and Grid Connected SPV systems, other Miscellaneous Applications of Solar Energy.

Module 3: Wind Energy: (10 Hours)
Wind Energy Conversion, Potential, Nature of the wind, Wind Data and Energy Estimation, Site selection, Types of wind turbines, Wind farms, Wind Generation and Control., classification of wind, characteristics, offshore wind energy – Hybrid systems, wind energy potential and installation in India.

Module 4: Hydel-Power: (08 Hours)
Water power estimates, use of hydrographs, hydraulic turbine, characteristics and part load performance, design of wheels, draft tubes and penstocks, plant layouts,

Module 5: Other Energy Sources (06 Hours)
Brief idea of other sources viz., tidal, geothermal, gas-based, etc,

Module 6: Introduction to Distributed Generation (06 Hours)
Concept of distributed generations, topologies, selection of sources, Advantages, issues in DG implementations. Requirements of hybrid/combined use of different renewable and distributed sources, need of energy storage

Text Books:

1. Solar Photovoltaics Fundamentals, Technologies and Applications by Chetan Sing Solanki, Eastern Economy Edition : Third Edition.
2. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers
3. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition, 2013.

Reference Books:

1. Renewable Energy- Edited by Godfrey Boyle-oxford University, press, 3rd edition, 2013.
2. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
3. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
4. Non-conventional energy source –B.H. Khan- TMH-2nd edition.
5. Integrated energy systems modeling--Karlsson, Kenneth Bernard; Skytte, Klaus Morthorst; Published in: DTU International Energy Report 2015.

B. Tech IV Semester

Department of Electrical Engineering
Minors in Electric Vehicles

Course Code: EETM42 **Course: Basics of Electrical Engineering and EV**
L: 04 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 04**

Course Objectives

The objective of this course is to make the students familiar with basic ac and dc circuits, motors, architecture of electric and hybrid electric vehicles, vehicle dynamics, various topologies used in electric and hybrid electric vehicles.

Course Outcomes

Upon the completion of this course students will be able to:

CO1: Analyze the basics of ac and dc circuits.
CO2: Discuss the construction and operation of transformer, induction motor and DC Motor.
CO3: Compare electric vehicle with conventional vehicle and its impact on energy supplies.
CO4: Discuss the dynamics of vehicle.
CO5: Discuss the architecture and various topologies of EV and HEVs.

Syllabus

Module 1– Introduction to Electric Circuits (8 hours)
Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with DC excitation, Basics of Magnetic circuits.

Module–II Single Phase AC Circuits (8 hours)
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits.

Module–III Introduction to Electric Machines (8 hours)
Construction and working principle of transformer, induction motor and DC motor.

Module–IV Overview of Electric Vehicle (06)
History of modern transportation, environmental impact and need of EV, comparison with IC engine, general layout of EV and its component, Electric vehicle Market, impact of modern drive trains on energy supplies.

Module–V Vehicle Dynamics (10)
Introduction, tractive efforts: linear and angular acceleration, aerodynamic drag, rolling resistance and uphill resistance. Power and torque to accelerate, dynamic equation, drive cycle and energy used.

Module–IV Drive train of EV and HEVs (08)

Basic concept of EVs and HEVs, classification, various drive-train topologies and power flow control.

Text Books:

1. Electrical Technology: B. L. Theraja, S. Chand Publications.
2. Basic Electrical Engineering: S. B. Bodkhe, N. M. Deshkar, P. P. H. Pvt. Ltd.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. Electric Circuits" James W. Nilsson, Susan Riedel, 9th edition, Prentice hall, 2011
5. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and
5. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals," CRC Press, 2021
6. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003.

Reference Books:

1. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
2. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
3. Electric and Hybrid Vehicles: T. Denton, Routledge, 2016
4. Ali Emadi, "Handbook of Automotive Power Electronics and Drives", CRC publishers, 2012.

B. Tech V Semester

Department of Electrical Engineering

Course Code: EET352 **Course: Electrical Machine-II**
L: 03 Hrs., T: 01 Hrs., P: 00 Hrs., Per week **Total Credits: 04**

Course Outcomes:

Upon the completion of this course, students shall be able to,

CO1. **Explain** the construction and operation of synchronous machines, **discuss** harmonics in generated EMF and **calculate** the winding constants for minimization of harmonics. (*09 hours*)

CO2. **Analyze** the steady-state behavior of synchronous generator with the help of phasor diagram and power angle curve and **determine** the voltage regulation and other unknown quantities at given operating condition. (*08 hours*)

CO3. **Analyze** the steady-state behavior of synchronous motor with the help of phasor diagram and power angle curve and **assess** the performance at given operating condition. (*08 hours*)

CO4. **Explain** synchronization and parallel operation of alternators and **analyze** the effect of change in input or output conditions. (*09 hours*)

CO5. **Analyze** the behavior of a synchronous generator during sudden 3-phase short circuit fault and unbalanced operating conditions. (*09 hours*)

CO6. **Explain** the construction, working principle and applications of various special purpose motors. (*07 hours*)

Syllabus:

Synchronous Machines (09 hours)
Introduction, construction of cylindrical and salient pole rotor machines, armature winding and field winding, MMF of armature and field windings, induced EMF equation and reduction of harmonics.

Synchronous Generator (08 hours)
Steady state operation of cylindrical and salient pole rotor synchronous generator, phasor diagram, phasor equations, OC and SC test, calculation of percentage regulation using EMF/ synchronous impedance method. Losses and efficiency.

Synchronous Motor (08 hours)
Principle of operation of synchronous motor, steady state operation of cylindrical rotor and salient pole synchronous motor, phasor equations and phasor diagram, Losses and efficiency.

Parallel operation (09 hours)
Synchronous Machines on Infinite Bus, synchronization of alternator with infinite bus, parallel operation, load sharing, power angle characteristic, steady state stability limit, SCR, role of damper windings, V curve and inverted V curves for synchronous motors and generators.

Performance during transient and unbalanced conditions (09 hours)
Sudden three phase short circuit and various component of short circuit current, transient and sub-transient

reactance and their measurement, equivalent circuit diagram under steady-state, transient, sub-transient state. Unbalance operation of synchronous machine and measurement of positive, negative and zero sequence reactance, Measurement of Xd and Xq by slip test.

Introduction to Special Machines (07 hours)

Reluctance motor, hysteresis motor, permanent magnet motor, repulsion motor, universal motor, stepper motor and Linear Induction Motor.

Textbooks:

1. Electrical Machinery: P.S. Bhimbra, Khanna Publishers, 2009.
2. Electrical Machines: P.K.Mukherjee, S.Chakravorti, Dhanpat Rai Pub., New Delhi, 2010.
3. Electrical Machines, Drives, and Power Systems: T. Wildi, Pearson Edu. Asia, 2001.
4. Electrical Machinery: I. J. Nagrath and D. P. Kothari, Tata McGraw-Hill Education, 2004.
5. Electrical Machines: Ashfaq Hussain, Dhanpat Rai Pub., New Delhi, 2015.

Reference Books:

1. A Text book of Electrical Technology Vol. II: B. L. Theraja and A. K. Theraja, 2015.
2. Electric Machinery: A. E. Fitzgerald and C. Kingsley, McGraw Hill Education, 2013.
3. Performance and Design of AC machines: M. G. Say, CBS Publishers, 2002.
4. NPTEL lectures/courses on related topics

B. Tech V Semester

Department of Electrical Engineering

Course Code: EEP352 **Course: Electrical Machine-II Lab**
L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students shall be able to,

5. Understand and correlate the theoretical knowledge of synchronous machines with laboratory experiments.
6. Select the instruments and apparatus of appropriate rating with recognition of machine ratings and connect the circuit to perform the experiment.
7. Perform the experiment, take readings, analyze the measured data and make valid conclusions.
8. Write effective report with neat and labelled presentation of diagrams, observations, correct calculations and graphs.

Experiments are based on the syllabus of course EET352

Text Books

5. Laboratory Courses in Electrical Engineering: S. G. Tarnekar, P. K. Kharbanda, S. B. Bodkhe, S. D. Naik, D. J. Dahigaonkar, S. Chand Publishing, New Delhi.
6. Electrical Machines: Ashfaq Hussain, Dhanpat Rai & Co. (P) Limited

B. Tech V Semester

Department of Electrical Engineering

Course Code: EET353 **Course: Microcontroller**
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

Objective of this course is to prepare the students to use Microcontroller as a tool for designing and development of electrical and electronic systems.

Course Outcomes

On completion of this course, students will be able to:

1. Understand the architecture and organisation of microcontroller.
2. Use assembly language and Embedded C for microcontroller programming.
3. Carry out initialization of microcontroller peripherals.
4. Implement interfacing of I/O devices.
5. Design simple applications using microcontroller.

Unit I

Introduction to Microcontrollers: Microprocessor and Microcontroller, Overview of microcontroller applications and major families; Microcontroller architecture.

Unit II

Instruction Set Introduction: Addressing modes and Instruction set of a proprietary microcontroller; Microcontroller hardware connection; Interfacing with parallel I/O ports.

Unit III

Peripheral Programming: Timer programming, Analog to digital Conversion, Interfacing of I/O devices; Interrupt programming, working with memories: SRAM, EEPROM, Flash.

Unit IV

Serial Communication: Serial communication using USART, Introduction to I2C Bus

Unit V

Embedded C Programming: C language programming of microcontroller using open source /proprietary software packages in Integrated Development Environment.

Unit VI

Application Development: Introduction to various interactive applications using microcontroller and peripherals, LCD interfacing.

*Proprietary Microcontroller to be announced at the beginning of the course (ATMEL AVR or Microchip or Texas)

Text Books

1. The AVR microcontroller and embedded systems using assembly and C: Muhammad Ali Mazdi, Sarmad Naimi and Sepher Naimi 2011, Prentice Hall.
2. Embedded C Programming and the Atmel AVR, Second Edition Richard Barnett: Larry O'Cull and Sarah Cox, Delmar, Cengage Learning
3. Go Embedded, Second Edition Asang Dani: Yeshwant Kanetkar, B.P.B. Publication.

Reference Books

1. Programming And Customizing The AVR Microcontroller: Dhananjay Gadre, Tata McGraw-Hill Education
2. Product Datasheets

B. Tech V Semester

Department of Electrical Engineering

Course Code: EEP353 **Course: Microcontroller Lab**
L: 00 Hrs., T: 00 Hrs., P:02 Hrs., Per week **Total Credits: 01**

Course Objectives

The objectives of this laboratory course are to prepare students for Microcontroller programming, introduce the open source/proprietary development environment and make them acquainted with microcontroller development board.

Course Outcomes

At the completion of this course, students will be able to:

1. Use open source or proprietary development environment and microcontroller development board for Microcontroller programming. Implement control algorithm using suitable programming language.
2. Set up the circuit on microcontroller development board for testing of program.
3. Debug the program to make it working.
4. Design small application based on microcontroller

Reference Books / Resources

1. Product Datasheets
2. Laboratory manual
3. Open source development tool guide

B. Tech V Semester

Department of Electrical Engineering

Course Code: EET354 - 3 **Course: Electrical Energy Conservation and Audit**
L: 03 Hrs, T: 00 Hr, P: 00 Hrs. Per week **Total Credits: 03**

Course Objectives

The objective of the course is to prepare the students:

1. To make aware with the current energy scenario and importance of energy audit.
2. To introduce with energy saving opportunities in different electrical and industrial systems.
3. To make understand the various effects on environment due to electricity generation with the different protocols at international level.

Course Outcomes

Upon the completion of this course, students will be able to,

1. Explain the basics of energy with material and energy balance.
2. Illustrate the role of ESCO and analyze the different financial options of investment.
3. Recognize the energy saving opportunities in induction motors.
4. Evaluate the performance of Compressed Air System and Heating, Ventilation & Air Conditioning (HVAC)
5. Review energy saving opportunities in Pumps, Pumping System and Cooling Towers.
6. Correlate the energy and its effect on environment.

Module I: (08 Hours)

Energy Scenario : Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Energy Conservation Act-2001 and its features.

Energy Audit: Definition, need, types of energy audit, energy audit instruments.

Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module II: **(06 Hours)**

Financial Management : Investment-need, appraisal and criteria, financial analysis techniques - simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs).

Module III: (06 Hours)

Electric Motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Energy efficient motors, soft starters with energy saver, variable speed drives. Different IS Codes related to induction motor efficiency and energy consumption.

Module IV: (07 Hours)

Compressed Air System and (HVAC):

Types of air compressors, compressor efficiency, efficient compressor operation, Heating, ventilation, air conditioning and Refrigeration System:

Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities, pressure drop calculation.

Module V: (07 Hours)

Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Energy conservation in boiler feed water pump, pumping systems for municipal drinking water, and sewerage, agriculture pump sets. **Cooling Tower:** Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.

Module VI: (06 Hours)

Energy, Environment and Climate Change: Energy and environment, air pollution, climate change United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM, Prototype Carbon Fund (PCF). Energy conservation in Buildings and Energy Conservation Building Codes (ECBC): About Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, Heating, ventilation, air conditioning (HVAC), fenestrations, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies.

Text Books:

1. Archie, W Culp. Principles of Energy Conservation: McGraw Hill, 1991.
2. P. O'Callaghan: Energy Management: McGraw Hill Book Company, 1993.
3. Handbook of Energy Engineering: Thuman A and Mehta D Paul, the Fairmount Press.Reference

Reference Books / References:

1. Handbook on Energy Audits and Management: Amit Kumar Tyagi.
2. Energy Efficient Buildings: Majumder Milli, TERI.
3. Energy Management: Paul O' Callagh, McGraw Hill.
4. Bureau of Energy Efficiency Study material for Energy Managers and Auditors Examination: Paper I to IV.

B. Tech. V Semester
Department of Electrical Engineering

Course Code: EET354-5 **Course: Electromagnetic Fields**
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits : 03**

Course Outcomes

Upon the completion of this course, the students will be able to

CO 1: Apply knowledge of with vector and scalars conversion for different coordinate system like conversion of Cartesian to Cylindrical, Spherical coordinate system and vice versa.

CO 2: Apply Coulomb's law, Gauss law, Divergence theorem to electric field intensity due to the field of 'n' point charges, volume charge and a line charge.

CO 3: Apply the concepts of potential difference and potential of a point charge to current, current density, dielectrics and capacitances and metallic conductors employing Poisson's and Laplace equations.

CO 4: Apply Biot Savorts law, Ampere's circuital law and Stroke's theorem to study steady magnetic fields and forces and to the behavior of magnetic materials.

CO 5: Correlate the basic principles of electromagnetic waves in building time varying and steady state Maxwell's equations.

MODULE 1: [06 Hours]

Vector Analysis: Idea of Vector & Scalars, Vector Algebra, Vector addition, vector subtraction, Dot product, Scalar product in Cartesian coordinate system, conversion of variables from Cartesian to cylindrical, Cartesian to spherical and vice versa.

MODULE 2: [06 Hours]

Coulomb's law, Electrical field intensity and electric flux density: Coulomb's law, electric field intensity, field of 'n' point charges, field due to continuous volume charge distribution, field of line charge, field of sheet charges concept of flux density.

MODULE 3: [08 Hours]

Gauss's law, Energy and Potential of charge system: Gauss's law, Application of Gauss's law, divergence theorem, definition of potential difference and potential, potential of a point charges, potential field of system of charge, potential gradient.

MODULE 4: [10 Hours]

Conductors, Dielectric and Capacitance and Poisson's and Laplace's Equations: Current and current density, Boundary conditions, conductor properties and, Nature of Dielectric materials, Capacitance of parallel plate capacitor, Poissons and Laplace equations.

MODULE 5: [10 Hours]

The Steady Magnetic Field and Magnetic Forces: Biot Savarts law, Ampere's Circuital Law, Strokes theorem, Magnetic flux density, Scalar and Vector Magnetic potentials, force on moving charge, nature of Magnetic materials.

MODULE 6: [02 Hours]

Maxwell's equations, Elementary ideas of Electromagnetic waves and their propagation.

Text Books

1. Engineering Electromagnetic:3rd Ed., Mc-Graw Hill, W. H. Hayt
2. Fundamental of Applied Electromagnetics: Fawwaz Ulaby, Umberto Ravaioli, 7th edition, Pearson Publisher, 2015
3. Electromagnetism: Theory and Applications, Pramanik, Ashutosh, 2nd edition, Prentice Hall India, 2008

Reference Books

Electromagnetic (Schaum's Outline Series): Joseph A. Administer, Vishnu Priye, 2nd edition

B. Tech V Semester
Department of Electrical Engineering

Course Code: CET371 Course: Engineering Mechanics and Strength of Materials
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs.,Per week Total Credits : 03

Course Objectives

1. The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.

2. This capacity requires the ability to visualize physical configurations in terms of real materials, actual constraints of and the practical limitations which govern the behavior of mechanics.

Course Outcomes

After Completion of the syllabus, the students should be able to:

1. Apply basic knowledge of forces, moment and couples to create free body diagrams and solve equilibrium problems
2. Apply knowledge of friction, simple machine, centroid and moment of Inertia to analyze the problems of engineering.
3. Understand the behavior of the material under different stress strain conditions.
4. Apply knowledge to analyze concept of deflection, bending moment and shear force diagram in beams

MODULE 1: [06 Hours]

Introduction to Engineering Mechanics: Force Systems, Basic concepts, System of Forces, Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra.

MODULE 2: [08 Hours]

Equilibrium & Friction: Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems; Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies.

MODULE 3: [06 Hours]

Centroid and Moment of Inertia: Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections.

MODULE 4: [06 Hours]

Particle dynamics: Kinematics and Kinetics of particles, rectilinear motion, curvilinear motion, Alembert's principle and its application in connected system of particles, Impulse Momentum, Collision of bodies, Work Energy Method.

MODULE 5: [06 Hours]

Simple Stresses and Strains: Concept of stress and strain, stress strain behavior of ductile and brittle material in uniaxial state of stress elastic, plastic and strain hardened zones stress-strain relations, elastic constants, relation between elastic constants and volumetric stress and strain of body.

MODULE 6: [08 Hours]

Concept of free body diagrams, types of loads, determination of axial force, shear force and bending moment at a section. SF and BM diagrams in beams. Relation between load and shear force and bending moment. Torsional Motion: Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Text Books

1. Engineering Mechanics: F.L.Singer (Harper & Row Publication) New Delhi, 1994.
2. Fundamentals of Engineering Mechanics: A.K.Sharma, Sai Publication,2015
3. Engineering Mechanics: Basudeb Bhattacharya, (Oxford University Press) New Delhi, 2008
4. Strength of material : F.L.Singer , Harper & Row, New York,2015
5. Strength of Materials : R. K.Rajput, S Chand ,2015
6. S.S.Bhavikatti, Strength of Materials, 3rdEdition,VikasPublishingHouse,2008

Reference Books

7. Engineering Mechanics: Timoshenko & Young, Tata McGraw Hill New Delhi, 2007
8. Engineering Mechanics: Bear Johnston, Tata McGraw Hill New Delhi. 2007
9. Engineering Mechanics (Statics and Dynamics): I.H.Shames, and Rao J.V First Edition, Pearson Publication, New Delhi, 2003.
10. Mechanics of Materials “Beer,Johnston, Dewolf, Tata McGra Hill New Delhi, 2008.

B. Tech V Semester
Department of Electrical Engineering

Course Code: IDT351 **Course: Biology for Engineers**
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs.,Per week **Total Credits : 03**

Course Objectives

The objective of this course is:

1. To make engineering students aware about Biology as the basic science that facilitate understanding of complex living human machine and its response.
2. To impart knowledge about the common processes in human life science (like respiration, exchange of energy by human cell etc.) and engineering as biologically inspired technologies like bioenergetics, bioprocesses, biomaterials etc.
3. To introduce study of technical topics such as Biosensors, transducers, amplifiers and signal processing, Magnetic resonance imaging, with an objective of appreciating engineering principles in biological systems used for diagnostic tools.

Course Outcomes

Upon the completion of this course students will be able to

1. Understand the basics of biology regarding the life structures and process.
2. Comprehend Biomolecules and Enzymes as basic building block of all forms of life
3. Understand the principles of energy transaction in living systems.
4. Identify DNA as a genetic material in the molecular basis of information transfer
5. Realize generation of bioelectric signals and understand fundaments of Biosensors and devices.

Unit-I

Engineering perspective and analogies of Biological Sciences, Fundamental differences between science and Engineering- case studies; Hierarchy and classification of life forms, Levels of organization of life- cell, tissues, organs, system and organism, Anatomy and physiology.

Unit-II

Biomolecules and Enzymes : Biomolecules as basic building block of all forms of life, structure and function of carbohydrates, proteins and Amino acids, Lipids, Nucleic acids, Vitamins and Minerals, Enzymology- Introduction, classification and mechanism of action.

Unit-III

Metabolism /Bioenergetics: Fundamental principles of energy transactions (Thermodynamics) as applied to biology, Entropy changes in biological systems, free energy, equilibrium, process of synthesis and breakdown of glucose in human body.

Unit-IV

Genetics: Introduction to Genetics, genetic codes, Expression and Transmission of genetic Information, concept of DNA cloning, single gene disorders in humans.

Unit-V

Bioelectric signals and devices: Resting and action potential, propagation of bioelectric signals, various bioelectric signals- ECG, EEG, EMG. Human nervous system as complex electric network.

Unit-VI

Biosensors: Introduction to Biosensors, transducers, amplifiers.

Overview of Bio Imaging-Brief introduction to medical imaging and different medical Imaging modalities; Electro Physiological Signal Analysis. Diagnostic Devices- Overview of Radiography, Nuclear Medical Imaging, Magnetic Resonance Imaging, Ultrasound Imaging. Therapeutic Devices-Overview of Diagnostic application of LASERs, High frequency heat therapy, Automatic Drug delivery Systems.

Text Book

1. Biology: A Global Approach: Campbell, N.A.;Reece, J.B;Urry,Lisa; Cain,M,L; Wasserman, S.A.; Minorsky, P.V.; Jackson, R.B.Pearson Education Ltd.
2. Eggins BR. (1006) Biosensors: An Introduction. John Wiley & Sons Publishers.
3. Biology for Engineers, SOHONI SINGH, Vayu Education, ISBN 9789383758265
4. Biology for Engineers ,Wiley India, Wiley Editorial, ISBN 9788126576340

Reference Books

1. Molecular Cell Biology. W.H.Freeman.: Lodish H, Berk A, Zipursky SL, et al. (2000)
2. Principles of Biochemistry.: Lehninger, A.L., Nelson, D.L., & Cox, M.M (2000). Newyork; Worth Publishers
3. Genes VII: Lewin B.(2000). Oxford University Press.th
4. Medical Instrumentation Application and Design :John G. Webster, ,4 edition, Wiley India,2015
5. Biology for Engineers by G. K. Suraish kumar, Oxford University Press, 1st Ed.

B. Tech. V Semester
Department of Electrical Engineering

Course Code: EET355 **Course: Power Electronics**
L: 03 hrs; T: 01 Hrs; P=00 Hrs, per week **Total Credits: 04**

Course Objectives

The objective of the course is to prepare the students:

1. To study and understand modern power semiconductor devices.
2. To learn various important topologies of power converter circuits, their operation and applications.

Course Outcomes

After the completion of this course, student will be able to,

1. Identify static & dynamic characteristics, ratings and specifications of basic power electronic switches with necessity triggering mechanism.
2. Select and compare different static controllable switches depending upon requirement and nature of power electronic controller
3. Design and analyze the different types of AC-DC converters with their performance parameters, output waveforms and applicability depending on nature of load.
4. Design and analyze the DC-DC converters with their performance parameters, output waveforms, applicability depending on nature of load.
5. Design and analyze the operation of DC-AC converters with their performance parameters, output waveforms as per nature of load using different PWM techniques.

Syllabus

Unit 1: (12 Hours)
Power switching devices: – Concept of Power Electronics, Scope and Applications, Types of Power Converters, , SCR and its characteristics, Ratings, and Gate Drive Circuits, Switching and Conduction Losses, Thyristor protection, Series and Parallel connections of SCRs. Basic Operation of TRAIC and its Characteristics.
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Unit 2: (8 Hours)
Static Controllable Switches: - Principles of Operation and V-I Characteristic of Power MOSFET, Insulated Gate Bipolar Transistor (IGBT) and Gate turn off thyristor(GTO), Ratings

Unit 3: (12 Hours)
AC to DC Converters: - Working of Single Phase, Three Phase Bridge Converters with R, RL and RLE – Load, Effect of Source Inductance in Converters, Power Factor Improvement,

Unit 4: (8 Hours)
DC-DC Converters: - Introduction, Basic Principles of Step-Down and Step-Up Operation, Chopper Classification, CCM, DCM Modes of Operation, Application of Choppers, Introduction to Forward and Flyback Converters, Ripple factor.

Unit 5: (8 Hours)
DC-AC Converters: - Single Phase and Three Phase Bridge Inverters, Output Voltage Control, Harmonics in Output Voltage Waveform, Harmonics Attenuation by Filters, Harmonic Reduction by PWM techniques, Working of Current Source Inverters, Applications of Inverters

Text Books:

1. Power Electronics: *M. Rashid, Pearson Education India, 2004.*
2. Power Electronics: Converters, Applications and Design: *N. Mohan and T. M. Undeland,2012, John Willey, 3rd edition.*
3. Industrial Power Electronics: *Deodatta Shingare, First Edition, Electrotech Publication Pune, 2009*
4. Power Electronics: *M.D. Singh, K.B. Khanchandani, Tata McGraw Hill.*

Reference Books:

1. Power Electronics: *C.Y. Lander., Third Edition, 1993, McGraw Hill International*.
2. Principles of Power Electronics: *Joseph Vithyathil, First Edition, 2010,Tata McGraw Hill.*
3. Fundamentals of Power Electronics: *R. W. Erickson and D. Maksimovic, Springer Science & Business Media, 2007.*
4. Power Electronics: *L. Umanand, Essentials and Applications", Wiley India, 2009.*

B. Tech. V Semester
Department of Electrical Engineering

Course Code: EEP355 **Course: Power Electronics Lab**
L: 00 hrs; T: 00 Hrs; P=02 Hrs, per week **Total Credits: 01**

Course Outcomes

After completion of this course, students should be able to

1. Apply, analyze and co-relate fundamental principles of science & Engineering with laboratory experimental work
2. Analyze characteristics of different types of power electronics switches
3. Analyze the operation of rectifiers, choppers and inverters
4. Design SIMULINK circuit for verification of various power electronics circuit behavior using Software.
5. Analyze and prepare the technical report on the experiments carried out.

Experiments are based on various switching devices and power converters.

B. Tech. V Semester
Department of Electrical Engineering

Course Code: EET358 **Course: Database Management Systems**
L: 03 hrs; T: 00 Hrs; P=00 Hrs, per week **Total Credits: 03**

Course Objectives

1. To describe how to design, manipulate and manage databases.
2. To Develop preliminary understandings and skills for designing a database information system.
3. To understand the concepts of SQL, implement database systems in real world.

Course Outcomes

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

1. Recognize the context, phases and techniques for designing and building database information systems in business.
2. Design and implement a database schema, database objects for a given problem-domain, organize database entities, understand the principles of storage structures and apply various Normalization techniques.
3. Apply the concurrency control and recovery techniques to build application for real world problem and understand query processing techniques involved in query optimization.

Syllabus

Module -I (Teaching Hours -8)

Introduction to DBMS, Conventional File Processing System, Components of DBMS, Advantages and Disadvantages, Three-level Architecture for DBMS, Abstraction, Data Integration and Data Independence.
SQL: Overview of SQL, DDL, integrity constraints, DML, set operations, null values, aggregate functions, sub-queries.

Module -II (Teaching Hours -7)

Intermediate SQL: Joins, Views, Indexes
Relational Database Design: First Normal Form, Pitfalls in Relational database design, Functional Dependency, decomposition, Second Normal Form, Third Normal Form, BCNF.

Module -III (Teaching Hours -8)

Concept of Transaction, Transaction state, Serializability, lock based protocols.
Deadlock Detection and Recovery, Log based Recovery, Recovery with concurrent transactions.
PL-SQL: Data Types, Variables, Constants, Operators, Conditions, Loops, Strings, Array, Functions.

Module -IV (Teaching Hours -7)

Query Processing and Optimization:
Query Processing: Overview, Measures of Query Cost, Selection Operation, Join Operation.
Query Optimization: Overview, Transformation of Relational Expressions, Cost- Based Optimization.

Text Books:

1. Database Systems Concepts: *Silberschatz, Korth, Sudarshan, 6th Edition, McGraw-Hill*.
2. An Introduction to Database Systems: *Bipin C. Desai, Galgotia.*
3. SQL & PL/SQL using Oracle: *Ivan Bayross, BPB Publications.*

Reference Books:

1. Fundamental of Database Systems: *Elmasri, Navathe, Somayajulu, Gupta*
Pearson Publications
2. Database Management System: *Raghu Ramkrishan, Johannes, McGraw Hill*
3. An Introduction to Database Systems: *C.J.Date, Narosa*

B. Tech V Semester
Department of Electrical Engineering

Course Code: EEP358 **Course: Database Management Systems Lab**
L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Objectives

1. To give a good formal foundation on the relational model of data.
2. To present SQL and procedural interfaces to SQL comprehensively.
3. To introduce the concepts and techniques relating to query processing by SQL Implementations.

Course Outcomes

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

1. Design and implement a database schema, database objects for a given problem domain.
2. Declare and enforce business rules on a database using RDBMS.
3. Normalize a database, populate and query a database using SQL DML/DDL commands.

Syllabus

Minimum 4 practicals and assignments based on but not limited to the following topics:

- **SQL:** Overview of SQL, DDL, integrity constraints, DML, set operations, null values, aggregate functions, sub-queries.
- **Intermediate SQL:** Joins, Views, Indexes

B. Tech V Semester
Department of Electrical Engineering

Course Code: EEP398-4 **Course: Electrical Appliances**
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Outcomes:

Upon the completion of this course, students shall be able to,

CO1. Explain the concept of Energy Efficiency of Electrical appliances & types of power supply unit used in these appliances

CO2. Explain the different electrical power supply backup equipment like battery, Inverter, UPS, & photovoltaic system.

CO3. Explain the working principle & application of different electrical motors.

CO4. Explain the working principle of appliances used for heating & cooling purpose.

CO5. Explain the construction & working principle of electrical domestic appliances and LED lights.

Syllabus

Module 1 (04 Hours)

Electrical Engineering fundamentals and IE codes**:** Basics of DC & AC systems, voltage-current-power relationships, AC DC sources for appliances, Star rating, Energy efficiency in electrical appliances, importance of IS codes, IE codes.

Module 2 (06 Hours)

AC/DC motors: Single Phase Motors (FHP), DC Motors, BLDC Motors, Universal Motors.

Module 3 (08 Hours)

HVAC Appliances: Construction, Working principle, ratings/ specifications, control of

a) **Resistance heating:** Water heaters, Room Heater, Tea/ Coffee Maker, Oven, Toasters, Iron

b) **Non Resistive heating**: Induction heaters, Microwave oven

c) **Cooling Appliances:** Fans, Desert Coolers, Air conditioner, Refrigerator

Module 4 (08 Hours)

Power supply Equipment: Battery and battery chargers, switch mode power supply, inverter, uninterrupted power supply (UPS), photovoltaic power system.

Module 5 (06 Hours)

Consumer appliances: Construction, working principle, ratings/ specifications, control of mixer, grinder, juicer, vacuum cleaner, air purifier, washing machines, weighing scale, elevator.

Module 6 (04 Hours)

Illumination: Construction, working principle, ratings/ specifications, control of LED lights.

Textbooks:

1) Consumer Electronics by S P Bali, Pearson Education
2) Handbook of Repair & Maintenance of domestic electronics appliances: BPB Publications

Other Resources: Literature available through e-resources

B. Tech V Semester

Department of Electrical Engineering

Course Code: EEP398-5 **Course: Energy Storage System**
L: 03 Hrs., T:00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objective: To discuss the theory and applications of different energy storage devices

Course Outcomes:

After the completion of this course, student will be able to,

CO1. Analyze the characteristics of energy from various sources that need for storage system.

CO2. Calculate SoC, SoH, SoE estimation of battery depends upon properties.

CO3. Compare different types of lithium ion battery as per applications in EV and to calculate SoC, SoH estimation.

CO4. Identify, formulate, and solve problems related to fuel cell technology keeping in mind economic viability.

CO5. Analyze different hybrid storage system as per applications in EV

Syllabus

Unit1 (06 Hour)

Introduction: Energy availability, Demand and storage, Need for energy storage, Different types of energy storage, Comparison of energy storage technologies.

Unit2 (08 Hour)

Battery technology: Overview, Battery definitions, terms and terminology, types and their properties, SoC, SoH, SoE estimation techniques.

Unit 3 (07 Hour)

Lithium ion battery: Introduction, Components, functions, advantages and disadvantages, Safety, Lifetime, Types to lithium ion battery & their comparison, applications in EV, SoC, SoH, SoE estimation techniques.

Unit 4 (07 Hour r)

Fuel Cells: Introduction to fuel cells, components of fuel cells, Types of fuel cells, working principle of fuel cell, performance characteristics of fuel cells, efficiency of fuel cell, fuel cell stack, fuel cell cars and buses.

Unit 5 (08 Hour)

Supercapacitor: Construction, working principle, types, advantages and disadvantages, SoC, SoH estimation techniques, application in electric vehicle.

Introduction to Advanced Flywheel, Introduction to Hybrid Energy storage systems: configurations and applications

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Text Books

1. A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN – 13:9789380090122), 2011.
2. Rahn C. D. and Wang C., Battery Systems Engineering, First Edition, Wiley (2013)

3. Narayan R. and Viswanathan B., Chemical and Electrochemical Energy System, Universities Press (1998)
4. Lithium-Ion Batteries Basics and Applications by Reiner Korthauer, Springer.
5. Lithium-ion Batteries Fundamentals and Applications. by Wu, Yuping, CRC Press, Taylor and Francis.
6. O'hayre, S.W. Cha, W.G. Colella, F.B. Prinz, Fuel Cell Fundamentals, 3rd edition, Wiley publisher.
7. R. P. Deshpande, Ultracapacitors: Future of Energy Storage, McGraw-Hill Education, 2014
8. Genta, G, Kinetic Energy Storage: Theory and Practice of *Advanced Flywheel* Systems eBook

B. Tech V Semester

Department of Electrical Engineering

Course Code: EEP359 **Course: Simulation Lab**
L: 00Hrs. P: 02Hrs., Per week **Total Credits: 01**

Course Objectives:

1. The course will prepare students to develop simulation of electrical systems using MATLAB, P-Sim, E-TAP , Power World Simulator and Open source software.
2. The course will prepare the students to develop program in M-file in MATLAB.
3. The course will prepare the students to compare the simulation results with theoretical results.

Course Outcomes:

After the completion of this course, student will be able to,

CO1. Design and simulate the Electrical Machine/ Power System/Power Electronics circuit using MATLAB Simulink / P-Sim / ETAP Softwares / Power World Simulator/ Open source software

CO2. Analyze the results of simulated circuit/system.

CO3. Write MATLAB programme in M-file for given complex electrical engineering based numerical problems.

CO4. Analyze and compare the results with theoretical calculations.

Contents:

The practical is based on electrical engineering applications using following softwares.

1. MATLAB/ Simulink
2. ETAP Power Station,
3. P-Sim
4. Power World Simulator
5. Open source software

Reference Books:

1. Industrial Power Electronics: Deodatta Shingare, First Edition, Electrotech Publication Pune, 2009
2. Hadi Saadat, "Power System Stability", TMH, New Delhi, 2010.
3. S.G. Tarnekar, P.K. Kharbanda, S. B. Bodkhe, S. D. Naik, D.J. Dahigaonkar "A Textbook of Laboratory Courses in Electrical Engineering", S. Chand & Co., New Delhi, 2009.
4. MATLAB Manual from MATHWORKS Inc.
5. Manual, ETAP Software
6. Manual, P-Sim software

B. Tech V Semester

Department of Electrical Engineering
Honors in Distributed Energy Generation Systems

Course Code: EETH52 **Course: Energy Storage System**
L: 04 Hrs., T:00 Hrs., P: 0 Hrs., Per week **Total Credits: 04**

Course Objective: To discuss the theory and applications of different energy storage devices
Course Outcomes:

After the completion of this course, student will be able to,

CO1. Analyze the characteristics of energy from various sources that need for storage system.

CO2. Calculate SoC, SoH, SoE estimation of battery depends upon properties.

CO3. Compare different types of lithium ion battery as per applications in EV and to calculate SoC, SoH estimation.

CO4. Identify, formulate, and solve problems related to fuel cell technology keeping in mind economic viability.

CO5. Analyze different hybrid storage system as per applications in EV

Syllabus

Unit1 (06 Hour)

Introduction: Energy availability, Demand and storage, Need for energy storage, Different types of energy storage, Comparison of energy storage technologies.

Unit2 (10 Hour)

Battery technology: Overview, Battery definitions, terms and terminology, Battery connections and Numerical Problems, types and their properties, SoC, SoH, SoE estimation techniques

Unit 3 (08 Hour)

Lithium ion battery: Introduction, Components, functions, advantages and disadvantages, Safety, Lifetime, Types to lithium ion battery & their comparison, applications in EV, SoC, SoH, SoE estimation techniques.

Unit 4 (10 Hour)

Fuel Cells: Introduction to fuel cells, components of fuel cells, Types of fuel cells, working principle of fuel cell, performance characteristics of fuel cells, efficiency of fuel cell, fuel cell stack, fuel cell cars and buses, Numerical Problems

Unit 5 (08 Hour)

Supercapacitor: Construction, working principle, types, advantages and disadvantages, SoC, SoH estimation techniques, application in electric vehicle.

Introduction to Advanced Flywheel, Introduction to Hybrid Energy storage systems: configurations and applications

.

Text Books

1. A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN – 13:9789380090122), 2011.
2. Rahn C. D. and Wang C., Battery Systems Engineering, First Edition, Wiley (2013)
3. Narayan R. and Viswanathan B., Chemical and Electrochemical Energy System, Universities Press (1998)
4. Lithium-Ion Batteries Basics and Applications by Reiner Korthauer, Springer.
5. Lithium-ion Batteries Fundamentals and Applications. by Wu, Yuping, CRC Press, Taylor and Francis.
6. O'hayre, S.W. Cha, W.G. Colella, F.B. Prinz, Fuel Cell Fundamentals, 3rd edition, Wiley publisher.
7. R. P. Deshpande, Ultracapacitors: Future of Energy Storage, McGraw-Hill Education, 2014
8. Genta, G, Kinetic Energy Storage: Theory and Practice of *Advanced Flywheel* Systems eBook

B. Tech V Semester

Department of Electrical Engineering
Minors in Electric Vehicles

Course Code: EETM52 | **Course: EV Motors and their Control**
L: 04 Hrs., T:0 Hrs., P: 0 Hrs., Per week | **Total Credits: 04**

Course Outcomes

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

CO1: Explain the vehicle resistances and major requirements of EV from an electric motor.
CO2: Discuss the construction, working and characteristics of a dc series motor and explain its speed control and reversal.
CO3: Discuss the construction, working and characteristics of a 3-phase induction motor and explain its speed control, reversal and braking.
CO4: Differentiate PMSM and BLDC motor drive and discuss their construction and working.
CO5: Discuss the construction, working and characteristics of a SRM drive.

Syllabus

Module-I: Basics of Electric Vehicle (EV) (Teaching Hours – 8)
Types of electric traction services; general description of vehicle movement; Vehicle resistance: rolling resistance, aerodynamic drag, grading resistance; dynamic equation of electric vehicle; speed versus vehicle resistance characteristics (or speed versus torque) of traction load; standard characteristics of an electric motor used in EV and HEV, major requirements of electric propulsion from an electric motor used in EV and HEV; types of motors used in EV and HEV.

Module-II: DC Motor (Teaching Hours – 8)
Types of dc motor; construction and operating principle of dc motor; concept of back emf and its equation; voltage equation; torque equation; dc series motor characteristics, losses and efficiency; starting, speed control, and reversal of dc series motor.

Module-III: Three-Phase Induction Motor (Teaching Hours - 8)
Construction and operating principle of 3-phase induction motor; synchronous speed and slip; torque equation; stating torque, maximum torque and slip at maximum torque; torque-speed characteristics, power flow; losses; relation between power and torque; reversal, speed control by V/f method; regenerative braking.

Module-IV: Permanent Magnet AC Motor (Teaching Hours - 8)
Construction of Permanent Magnet Synchronous Motor (PMSM), types of rotor; operating principle; difference between PMSM and Brushless dc Motor (BLDC); properties of permanent magnet (PM) materials used in PMSM: alnico, ferrites, rare-earth type; PMSM torque generation; BLDC motor torque generation; Hall sensors and Inverters for BLDC Motor.

Module-V: Switched Reluctance Motor (Teaching Hours - 8)
Construction of SRM; concept of reluctance torque; working of the basic SRM drive; idealized inductance, current and torque profile of SRM; torque-speed characteristic of SRM; comparison between dc motor, induction motor, PMSM and SRM for EV application.

Textbooks:

1. Mehrdad Ehsani, Yimin Gao et. al., "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles," CRC Press, Special Indian Edition, 3rd Ed., 2019.
2. Kwang Hee Nam, "AC Motor Control and Electric Vehicle Applications," CRC Press, Special Indian Edition, 2013.
3. B. L. Theraja, A. K. Theraja, "A Textbook of Electrical Technology Vol.-II," S. Chand & Co. Pvt. Ltd., 2015.

References:

1. Mounir Zeraoulia, et.al., "Electric Motor Drive Selection Issues for HEV Propulsion Systems: A Comparative Study," *IEEE Trans. on Vehicular Technology*, Vol. 55, No. 6, November 2006.
2. Zhi Yang, Fei Shang, Ian P. Brown, Mahesh Krishnamurthy, "Comparative Study of Interior Permanent Magnet, Induction and Switched reluctance Motor Drives for EV and HEV Applications," *IEEE Trans. on Transportation Electrification*, Vol. 1, Issue 3, November 2015.

B. Tech VI Semester

Department of Electrical Engineering

Course Code: EET371 **Course:** Power System-II
L: 03 Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

The objective of the course is to prepare the students:

1 To understand and analyse the different types of faults in Power system.
2 To study concept of power system stability and its analysis;
3 To understand and study the modern power system concepts like SCADA, PMU, security analysis.

Course Outcomes

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

CO1: Analyse three phase fault for small power systems
CO2: Apply the concept of symmetrical components and evaluate them under fault conditions.
CO3: Analyse unsymmetrical faults for small power networks
CO4: Apply the knowledge for stable operation of power system and analyse the stability of power system
CO5: Evaluate the importance and concepts of secured operation of power system.

Syllabus

Unit I (Teaching hours: 8)

Symmetrical Fault Analysis: Symmetrical fault analysis without and with pre-fault load currents, selection of circuit Breakers ratings, current limiting reactors.

Unit II (Teaching hours: 8)

Symmetrical Components: Symmetrical Component transformation, Three phase power in unbalanced circuit in terms of symmetrical component, Sequence impedances of Generator, Transformer, Transmission line and Passive loads, Phase Shift in Star/delta three phase transformer (Yd1, Yd11 connection).

Unit III (Teaching hours: 8)

Unsymmetrical Fault Analysis: Unsymmetrical fault Analysis – L-G, L-L-G, L-L, Open Conductors faults analysis using symmetrical components.

Unit IV (Teaching hours: 10)

Power system stability: Swing Equations of a synchronous machine connected to an infinite bus, Power angle curve, Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three-phase fault, Analysis using the Equal Area Criterion, Impact of stability constraints on Power System Operation.

Unit V (Teaching hours: 6)

Power system security: Overview of Energy Control Centre Functions, SCADA systems, State-estimation, System Security Assessment, Normal, Alert, Emergency, Extremis states of a Power System, Contingency Analysis, Load frequency control

Text Books

1 Power System Analysis: J. Grainger and W. D. Stevenson, McGraw Hill Education,1994.
2 Electric Energy Systems Theory: O. I. Elgerd, McGraw Hill Education, 1995.
3 Power System Analysis: A. R. Bergen and V. Vittal, Pearson Education Inc., 1999.
4 Modern Power System Analysis: D. P. Kothari and I. J. Nagrath, McGraw Hill Education, 2003.

Reference Books

1 B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, " Electric Power Systems", Wiley, 2012.
2 Internet websites: Other reference material (e.g. e-resources)

B. Tech VI Semester

Department of Electrical Engineering

Course Code: EEP371 **Course: Power System-II Lab**
L: 00 Hrs., T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Objectives

The objective of the course is to:

1 Make students familiar with concepts and analysis of power systems
2 Make students familiar with prototype model of power system
3 Make students able for understanding, analysing performance of power system
4 Make students able to understand and correlate the theory with experiments based on power system.

Course Outcomes

Upon successful completion of the course, the student shall be able to

1 Apply and analyse fundamental principles of power system Engineering with laboratory experimental work and programming work
2 Understand and perform the experiment, Analyse the observed data & make valid conclusion
3 Write Journal with effective presentation of diagrams and characteristics
4 Use the modern software like MATLAB, PSAT and P-W simulator for plotting and analysing power system.

List of Experiments

Experiments will be based on transmission line prototype model and analysis using softwares like PSAT, MATLAB, P-W simulator etc

Text Book

Modern Power System Analysis: Nagrath and Kothari

Reference Books

1 Eleictric Energy Systems: Olle Elgerd
2 Power system Stability: Prabha Kundur

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET372 **Course: Control Systems**
L: 03 Hrs., T: 01 Hrs., P: 00 Hrs., Per week **Total Credits: 04**

Course Objectives
To be able to obtain a working mathematical model of a system and to do time-domain and frequency domain analysis of the model to predict system's behaviour.

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

1. Develop appropriate mathematical model of the physical systems and converting mathematical models into the block diagrams/ signal flow graphs to evaluate the transfer function of the system

2. Analyse the system in time domain to find the time domain specifications with that use Routh's array tools to determine absolute, relative and conditional stability of the system.

3. Understand the concept of root locus for the stability of the systems.

4. Analyse the system in frequency domain to get close loop frequency domain specification and understand the concept of Bode plots, Nyquist plots.

5. Develop and understand state space model of system with stability analysis.

Syllabus

Module-I (Teaching Hours – 12)
Introduction: Introduction to automation and automatic control, Broad spectrum of the control system applications, , Mathematical modelling of physical systems, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function of linear time invariant systems , Block diagrams and signal flow graphs, Benefits of feedback, servomechanism.

Module-II (Teaching Hours – 06)
Time Response Analysis: - Standard test signals, Time response of first and second order systems for standard test inputs, Concept of system type and time constants, Application of initial and final value theorem. Design specifications for second order systems based on the time response, introduction to P, PI and PID controller.

Module-III (Teaching Hours - 5)
Control System stability: Concept of Stability, Stability types, Routh's and Hurwitz Criteria, Relative and conditional stability analysis.

Module-IV (Teaching Hours - 6)
Root Locus Techniques: Concept and use of root locus, Magnitude and angle criteria, Construction of root loci, effect of addition and poles and zeros on root loci

Module-V (Teaching Hours - 12)
Frequency Response Analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion gain and phase margin,

Closed-loop frequency response, Introduction to lag, lead, lag-lead compensation

Module VI (Teaching Hours - 5)
State Variable Analysis: Concepts of state variables, State space model. Diagonalization of State Matrix, State model in canonical and phase variable form, eigenvalues and Stability Analysis, Finding transfer function from state model

Text Books:

1. Control Systems: Principles and Design: M. Gopal, McGraw Hill Education, 1997.
2. Modern Control Engineering: K. Ogata, Prentice Hall, 1991.
3. Control Systems Engineering: I. J. Nagrath and M. Gopal, New Age International,2009

Reference Books

1. Automatic Control System: B. C. Kuo, Prentice Hall, 1995.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EEP372 **Course: Control Systems Lab**
L: 00Hrs.,T: 001 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Objectives

The objective of this laboratory course is to prepare students for control system components, servomechanism and Make them understand, analyse and perform various control systems practical. Also to introduce MATLAB tool to analyse the system performance.

Course Outcomes:

Upon successful completion of the course, the student shall be able to

1. Co-relate, analyze and apply the fundamental principles of Control System Engineering to understand the laboratory experimental work.
2. Perform the experiment, Analyze the observed data & make valid conclusion
3. Write Journal with effective presentation of diagrams and characteristics.
4. Use the modern software like MATLAB for plotting and analysing time response and frequency response and obtain optimal system design

Text Book

1. Control Systems Engineering: Nagrath and Gopal, New Age International Publisher

Reference Books

1. Modern Control Theory: M.Gopal, John Wiley & Sons, 2nd edition, 1993
2. Automatic Control Systems: B.C.Kuo, PHI, 9th edition, 2014
3. Linear System Design: D'azzo and Houpis (M.H.), 4th edition

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET373-2 **Course: Power Station Practice**
L: 03Hrs., T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

To solve the load problems along with the load study of practical parameters.
To understand the practical aspects of plant capacity, economics and billing system.
To understand the practical aspects of working of all conventional power stations.
To understand the workings of major equipments, different excitation systems, captive and cogeneration

Course Outcomes

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

1. Participate in the Load Calculation, Operation and Distribution, and will be able to classify the load with their properties.

2. Take part in the practices of execution, operation, testing, cost and technical anaysis, developments, deterioration evaluation of important parts of different conventional power stations.

3. Compare the advantages and dis-advantages for practical implementation of different stations.

4. Understand the working of different parts for voltage and frequency control. Take part in interconnections of different power stations proving the cost and efficiencies of generation of power.

Module- I: (07 Hours)

Sources of Electrical Energy : Coal, oil and natural gas, water power, nuclear fission and fusion. Recent development in power generation.
Electrical Load & Curves : Different factors connected with a generating station, connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity and utilization factor, load curve, load duration curve, load survey, base load and peak load station, advantages of interconnection. load forecasting.

Module-II: (07 Hours)

Plant Capacity & Economics : Choice of site, size and number of units, Cost of electrical energy, Depreciation of plant, Effect of Load Factor, Tariff: different consideration of Flat & two part economical choice.

Module-III: (07 Hours)

Thermal Stations : General layout, major equipment, essential and non- essential auxiliaries, electric supply to auxiliaries, cost of generation, effect of different factor on costs. Treatment on water, Tests on coal, Automatic control of different system. Advantages and disadvantages.

Module-IV: (07 Hours)

Hydro station : Hydrology, stream flow, flow duration curve, power duration curve, mass curve and reservoir capacity, type of hydro plants and their field of use, pumped storages plants and their utility, surge tanks, governing characteristics of turbine and hydro generators. Advantages and disadvantage.

Module- V: (07 Hours)
Nuclear station : Principle of Nuclear energy, materials, types of nuclear reactors, breeder reactors, location, material for moderator and control rods, cost economics.

Module-VI: (07 Hours)
Voltage control of A.C. generators: Methods of stabilizing exciter voltage, Automatic Voltage regulator action. Captive & Cogeneration.

Text Books:

1. Modern Power Station Practice: Turbines, Generators and Associated Plant Vol C, Publisher: Pergamon; 3rd Revised edition E,dition (31 December 1992)
2. Generation of Electrical Energy: Dr. B. R. Gupta, Publisher: S Chand (1 December 2010)
3. Power Plant Engineering: P. C. Sharma, Publisher: Kataria, S. K., & Sons (2004)

Reference Books

1. Electrical Power Station Control: H.P. Young..Vol-XI, Publisher: Chapman and Hall Ltd, London.
2. Elements of Power Station Design: M.V.Deshpande. Edition:Reprint, Publisher: PHI Learning, Pvt. Ltd., 2009.
3. Electric Power Generation the Changing Dimensions: Digambar M. Tagare, Publication by John Wiley & Sons, Inc IEEE Press.
4. Power Plant Engineering: P. K. Nag, Publisher: Tata Mc Graw - Hill Education, Edition: 2nd, 2001.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET373-5 **Course: Electrical Drives and Control**

L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

The objective of the course is to prepare the students:

1. To impart knowledge about fundamentals of electric drives and control, operational strategies of dc and ac motor drives.
2. To justify the selection of drives for various application.
3. To provide knowledge about operation of contactors.
4. To know the performance and suitability of motors in ac/dc traction.
5. To provide knowledge about basic PLC programming in electrical drives.

Course Outcomes

Upon the completion of this course, students shall be able to,

1. Examine factors governing selection of Electric Motors for particular application in a common electric drive system.
2. Select motor rating of common drive motors for continuous and intermittent periodic duties.
3. Analyze control circuit of ac/dc contactors and relays.
4. Analyze the performance and suitability of motors used in ac/dc traction.
5. Apply basic PLC programming in electrical drives.

Unit I

Industrial Application of Electric Motors : Factors governing selection of Electric Motors, Types of Drives and types of load, starting of electric motors, Speed control of Electric motors. Definition classification and speed torque characteristics of common drive motors and their characteristics under starting, running, Electric Braking, Types of enclosures.

Unit II

Selection of Motors: Size & Rating : Insulating materials, Temperature rise in Electrical machines, Duty cycles, Power capacity for continuous and intermittent periodic duties, Load equalization and flywheel effect. Brief idea about drives commonly used in industries.

Unit III

Contactors: Control devices for industrial motors, AC and DC contactors and relays: Lock out contactors, magnetic structure, operation, arc interruption, contactor rating, and H.V. contactors. Control circuits for automatic starting and braking of DC motor and three phase induction motor.

Unit IV

Motors for Electric Traction: Different systems of Traction. Train movement and energy consumption. Traction Motors: Motors used in AC/DC traction, their performance and desirable characteristics, requirements and suitability of motor for traction duty.

Unit V

Control of Electric Traction Motors: Traction motor control – Starting and speed control traction motors. Series parallel control with numerical. Starting and speed control of 3-phase induction motors. Braking of traction motor

Unit VI

Introduction to PLC: PLC, its programming and applications in electrical drives.

Text Books

1. Utilization of Electric Power and Electric Traction: J. B. Gupta, Volume IV, S. K. Kataria & Sons publisher
2. A textbook of Electrical Technology: B. L. Theraja & A. K. Theraja, Volume III, S. Chand Publication

Reference Books

1. A textbook on Power System Engineering: A. Chkrabarti, M.L. Soni, P.V. Gupta & U. S. Bhatanagar, Dhanpat Rai & Co. Publisher.
2. Magnetic Control of Industrial Motor: Heumann.
3. Performance and design of AC machines: M. G. Say, CBS Publishers, 2002.
4. NPTEL lectures/courses on related topics.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET373-6 **Course: Non-Conventional Energy Sources**

L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course outcome

CO1: To understand solar energy its radiation, collection, storage and application.

CO2: To understand the Wind energy, Biomass energy, Geothermal energy and ocean energy as alternative energy sources.

CO3: To understand the Direct Energy Conversion

Module – I

PRINCIPLES OF SOLAR RADIATION: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.
SOLAR ENERGY COLLECTION: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

Module –II

WIND ENERGY: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Module –III

BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

Module –IV

GEOTHERMAL ENERGY: Resources, types of wells, methods of harnessing the energy, potential in India.

Module –V

OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Module –VI

DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC. Thermoelectric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

TEXT BOOKS:

1. Non-Conventional Energy Sources /G.D. Rai
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa

REFERENCE BOOKS:

1. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
2. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
3. Non-Conventional Energy Systems / K Mittal /Wheeler
4. Solar Energy /Sukhame

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET373-3 **Course: Utilization of Electrical Energy**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

The objective of the course is to prepare the students:

1. To train students on characteristics of various Heating, Welding methodologies, Illumination methods and traction supply system.
2. Understanding of the concepts of Electrolysis processes, DG system and design of domestic wiring.

Course Outcomes

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

1. The students should be able to understand the process and application of different types Electric Heating and Welding equipments.
2. The students should be able to design illumination systems for lighting design by applying the fundamentals and by understanding basics of illumination
3. The students should be able to understand Electric Traction system with its power supply structure.
4. The students should be able to understand the working principles and applications for various electrolytic processes for industrial applications.
5. The students should be able to select proper rating of DG sets, know the operational factors and know the design aspects of domestic electrical wiring.

Unit I

Electric Heating and Welding: I) Electric Heating: Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipment

II) Importance, Advantages & Disadvantages of welding, classification of welding processes, Resistance welding, Electric arc welding, Ultrasonic welding, electron beam welding, laser beam welding.

Unit II

Illumination and Lighting Systems: Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, basics of CFL, LED & Plasma, Lux level requirements for various applications, classification of light fittings and luminaries, factors affecting the design of indoor lighting installations, total lumen method of calculation,Lighting design for indoor applications, Outdoor lighting system design for street lighting and flood lighting.

Unit III

Electric Traction Supply system : Features of an Ideal Traction System, Advantages and Disadvantages of Electric Traction, System of Traction, Traction Supply System, Transmission system for Traction substation, Feeding and Distribution System on an AC Traction, System of

Current Collection, Booster Transformer.

Unit IV

Electrolytic Processes: Fundamental principles, laws of electrolysis, Extraction & Refining of metals, Electro-deposition, Electro plating, Anodizing, manufacture of chemicals, Power supply for electrolytic processes.

Unit V

Diesel Generating Systems: Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets.

Unit VI

Electrical Wiring: Introduction, Basics of Domestic Electrical Wiring, Types of Cables, Flexible Wires Sizes and Current Capacity

Text Books

1. Utilization of Electric Energy: E. Open shaw Taylor, Orient Longman.
2. Utilization of Electric Power & Electric Traction: J.B. Gupta, Kataria & Sons.
3. Art and Science of Utilization of Electrical Energy: H Partap, Dhanpat Rai & Sons, Delhi

Reference Books

1. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.
2. Other reference material (e.g. e-resources): Catalogues of wires, lighting accessories.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET374-6 **Course: Electrical Machine Design**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Outcomes:

CO1: Understand the properties of electrical engineering materials and **able to c**ompute the final temperature attained by machines during heating & cooling process.

CO2: Design the major parts of transformers, understand the temperature rise and discuss the methods of cooling. Evaluate the performance characteristics from the design data.

CO3: Design the main parts of an Induction motor, describe the effects and methods to reduce the effects of harmonics on the performance of an induction motor. Evaluate the operating characteristics of the machine.

CO4: Discuss different types of electro-magnets and calculate the electro-magnetic pull/force.

CO5: Use the software tools for design calculations like MATLAB (m file) and Python.

Syllabus

Module-1 (05 Hours)
Introduction: Major considerations in electrical machine design, electrical engineering materials, temperature rise, heating and cooling characteristics, standard specifications, rating of machines: CMR and short time ratings, etc.

Module-2 (07 Hours)
Transformer Design: Main Dimensions: KVA output for single and three phase transformers, main dimensions, window space factor, overall dimensions.

Module-3 (06 Hours)
Transformer Design: **Performance Characteristics**: Winding resistance, magnetic leakage reactance, temperature rise in transformers, design of cooling tank, and method for cooling of transformers.

Module-4 (07 Hours)
Induction Motor: Stator Design: Output equation, main dimension, choice of specific loadings, stator design, air gap length.

Module-5 (07 Hours)
Induction Motor: Rotor Design & operating Characteristics: Rules for selecting rotor slots of squirrel cage machines, design of rotor slots, bars & end rings. Operating characteristics: different types of leakage reactance, magnetizing current.

Module-6 (03 Hours)
Design of Electro-magnets: Types of Electro-magnets, magnetic pull/force, ampere turn requirement.

Module-7 (02 Hours)
Computer aided design: Limitations (assumptions) of traditional designs, need for computer analysis. Python, MATLAB (m file) based machine design.

Text Books:
1. Electrical Machine Design: A.K. Sawhney in Dhanpatrai& Sons. Delhi.
2. Principles of Electrical Machine Design: R. K. Agrarwal
3. Performance and design of A.C. machines: M.G. Say.

Reference Books:
1. Electrical Machine Design: Balbir Singh in Brite Students Publications. Pune.
2. Electrical Machine Design: M.V. Deshpande.

Other reference material (e.g., e-resources): In addition to the suggested textbooks,
E-resources

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET374-7 **Course: PLC and SCADA**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

An objective of this course is to introduce the basics of PLC & SCADA, its components and controls to the students. Students will be made familiar with the designing of application in PLC & SCADA.

Course Outcomes

Upon the completion of this course, students will be able to...

1. Understand automation tools & its components.
2. Apply logic with ladder diagram for the industry application.
3. Understand the functioning of PLC & SCADA.
4. Apply knowledge of PLC & SCADA for design of industrial automation.

Unit - I

Introduction to PLC : Technical Definition, advantages, chronological Evolution, Types of PLCs, Block Diagram, processor software/Executive software. PLC vs PC

Unit - II

Ladder diagram fundamentals : Introduction to basic components and their symbols, development of relay and contactor logic, Concept of PCC, MCC, Control desk , No, NC switches, limit switches, relay, relay board, contactor, timer, voltage to current converter, current to voltage converter, solenoid valve, Electrically Hydraulic & pneumatic control, Hydraulic electric power pack, Hydraulic motor control, selection of sensor, fundamentals of Ladder Diagrams.

Unit - III

Fundamental PLC programming: Ladder diagram, physical component vs program components, examples, ladder diagram having more than one rung.

Unit - IV

Advanced programming technique: Addressing Data files, format of logical address Different addressing types, PLC input output modules and power supply.

Unit - V

Industrial Communication and networking: evolution of Industrial Communication technology, types of communication interfaces, synchronization and timing in communication.

Unit - VI

Introduction to Industrial Automation: Industrial automation components, smart sensors, PLC, DCS and SCADA. Introduction to SCADA. Examples of some simple automated systems.

Text Books

1. Programmable Logic Controllers and Industrial Automation: An Introduction Madhuchchanda Mitra, Samarjit Sengupta (Author), 2nd Edition,

Reference Books

1. Programmable Logic Controllers: John Hacworth and Frederick D. Hackworth Jr, Pearson publisher
2. Programmable Logic Controllers: W. Bolton , Newnes an imprint of Elesevier, 6th edition.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET374-5 **Course: Photovoltaic System Engineering**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives
To enable the students to acquire the fundamentals of solar radiation and Solar Photovoltaic (PV) Systems and gain the knowledge of PV system components and related applications.

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

1. Understand the terms related to Solar radiations and calculate the average monthly solar insolation from given data.
2. Discuss the equivalent circuit of PV cell and interpret I-V & P-V curves under different operating conditions.
3. Discuss the algorithms used for the maximum power point tracking of PV array.
4. Discuss the principle of power conversions used in PV system.
5. Design PV system by estimating the load, sizing and selecting the batteries, sizing and selecting the PV modules and other components.

Syllabus

Module-I (Teaching Hours - 10)
Introduction: Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems.
Solar Radiation: - Extra-terrestrial and terrestrial solar spectrum, Sun-Earth movement, Angles of sunrays on Solar Collector, Sun Tracking, Estimating Solar radiation empirically.

Module- II (Teaching Hours - 10)
PV Cells and Modules: Photovoltaic cell and its simple model; I-V and P-V characteristics; PV modules and arrays; effect of shading, use of bypass and blocking diodes; Effect of radiation and temperature; Types of solar cells and their performance.

Module- III (Teaching Hours - 6)
Maximum Power Point Tracking: - Concept of Maximum Power Point Tracking (MPPT) , Tracking algorithms; Charge controller: types and function.

Module- IV (Teaching Hours - 6)
Power converters in Photovoltaic system: - DC - DC converter, DC - AC converter; Types of Solar PV systems.

Module- VI (Teaching Hours - 8)
Photovoltaic System Design and Application: Introduction to batteries and its parameters; Design of PV-powered DC load, Design of stand-alone system with Battery and AC or DC load; Introduction to Hybrid PV system.

Text Books:

1. Solar Photovoltaic: Fundamentals, Technologies and Applications: *Chetan Singh Solanki, PHI Learning Pvt Ltd, 2009*
2. Solar Photovoltaic Technology and Systems: *Chetan Singh Solanki, PHI learning Pvt. Ltd.,2014*

Reference Books:

1. Renewable and Efficient Electric Power Systems: *Gilbert M. Masters, John Wiley & Sons, 2004*
2. Photovoltaic Systems Engineering: *Roger A. Messenger & Jerry Ventre, CRC Press, 2004, 2nd edition.*
3. Renewable Energy Technologies: *Sanjay Agrawal and Rajeev Mishra, AICTE, March 2023*

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EEP374-8 **Course: Electrical Workshop**
L: 00Hrs.,T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students shall be able to,

1. Design and test the efficiency and regulation of single-phase transformer.
2. Draw 3-ph stator winding diagram and assemble stator winding of 3-ph I.M.
3. Connect the control panel wiring of DOL starter, and Star–Delta Starter with three phase motors.
4. Draw the single line diagram of Electrical Installation Layout and starter using VISIO and AutoCAD.

Experiment List:

1. Design, assemble and test the efficiency and regulation of single-phase transformer.
2. To draw and make the stator winding of three phase induction motor.
3. Drawing and wiring of control panel of
   a. Direct online (DOL)starter
   b. Star- delta starter
4. Industry visit for Electrical Installation Layout (EIL) study and drawing the single line diagram of Electrical Installation Layout.
5. Drawing of Electrical Installation Layout and starters using VISIO and AUTOCAD.

Text Books/ Reference Books

1. Electrical Machine Design: A.K. Sawhney in Dhanpatrai & Sons. Delhi.
2. L and T motor Starter Handbook

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EEP374-7 **Course: PLC and SCADA Lab**
L: 00Hrs.,T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course Outcomes

Upon the completion of this course, students will be able to...

1. To understand the automation tools & its components with PLC software
2. To develop the logic with ladder diagram for the industry application.
3. To understand and apply the use of sensors in PLC Lab.
4. To communicate PLC with HMI and other measuring devices.

References:

1. Programmable Logic Controllers by John Hacworth and Frederick D. Hackworth Jr, Pearson publisher
2. Programmable Logic Controllers by W. Bolton , Newnes an imprint of Elesevier, 6th edition.
3. Online resource available

List of Experiments:

1. Simple ON-OFF operation of Lamp using Toggle or push Button
2. Combinational Logic design and implantation on PLC
3. Power ON Delay using PLC
4. Power OFF Delay using PLC
5. Sequential operation using PLC
6. Study of timers from PLC
7. Proxy sensing using PLC (Inductive & Optical)
8. Use of Limit Switch
9. Use of magnetic read sensing
10. Level sensing using Magnetic float switch
11. Temperature measurement using PLC
12. Heater Actuation with Temperature sensing (Temp Control)
13. Actuation of solenoid valve using PLC
14. Motor ON-OFF and Forward/Reverse operation using PLC
15. Counting applications using PLC

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EEP374-5 **Course: Photovoltaic System Engineering Lab**

L: 00Hrs.,T: 00 Hrs., P: 02 Hrs., Per week **Total Credits: 01**

Course outcomes

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

1. Discuss the various parameter of Solar PV panel using the manufacturer's Datasheet.
2. Configure the PV panels in Series and Parallel arrangement.
3. Plot I-V and P-V Characteristics of PV panel and appreciate the effect of variation in atmospheric parameters on PV system output.
4. Implement the Maximum Power Point tracking algorithm using suitable software.
5. Design a simple PV based applications

List of Experiments

1. To study the manufacturers datasheet and analyse various parameters.
2. To measure the open circuit voltage and short circuit current of given panel.
3. To study Series and Parallel connection of PV panels.
4. To measure the maximum power point voltage and current of PV Panel and draw its V-I and P-V characteristics.
5. To study effect of irradiance and temperature on V-I and P-V Characteristics of PV panel.
6. To demonstrate MPPT algorithms using suitable Software.
7. To demonstrate application of power converter in PV System.
8. To demonstrate battery charging application with PV System.
9. To design simple PV based application.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET399-1 **Course: Solar Photovoltaic Systems**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives

1. To introduce solar insolation, equivalent circuit of solar Photovoltaic(PV) cell and the factors affecting PV power generation.
2. To introduce the concept of maximum power point (MPP) and algorithms used to track the MPP.
3. To introduce power electronics required in PV system.
4. To introduce the various applications of PV system.

Course Outcomes

On the completion of this course, Students will be able to:

1. Calculate the average monthly solar insolation from given data.
2. Understand circuit model of PV cell and interpret I-V curves under different operating conditions.
3. Understand the algorithms used for the maximum power point tracking of PV array.
4. Understand the principle of power conversions used in PV system
5. Design PV system by estimating the load, sizing and selecting the batteries, sizing and selecting the PV modules and other components
6. Understand the various applications of PV systems.

Unit - I

Introduction : Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems.

Unit - II

Solar radiation : Extra-terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky insulation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insolation from measured data.

Unit - III

PV cells and modules : Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays; effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; schemes for maximum power point tracking;

Unit - IV

Maximum Power Point Tracking: Maximum Power Point Tracking and MPPT algorithms

Unit - V

Power converters in Photovoltaic system : Introduction to DC-DC converter, DC-AC Converter, PV- Grid Interface

Unit - VI

PV system applications: PV-Battery Interface, PV and Water Pumping,

Text Book

1. Solar Photovoltaic: Fundamentals, Technologies and Applications: Solanki, PHI Learning Pvt Ltd, 2009

Reference Books

1. Renewable and Efficient Electric Power Systems: Gilbert M. Masters, John Wiley & Sons, 2004
2. Photovoltaic Systems Engineering: Roger A. Messenger & Jerry Ventre, CRC Press, 2004, 2nd edition.

B. Tech VI Semester
Department of Electrical Engineering

Course Code: EET399-2 **Course: Automation with PLC**
L: 03Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 03**

Course Objectives:
Objective of this course is to introduce the basics of Automation, its components and controls to the students. Students will be made familiar with the designing of simple Automatic system.

Course Outcomes:

Upon the completion of this course, students will be able to...\

1. To understand automation tools and its components.

2. To understand the functioning of PLC.

3. To apply knowledge of PLC for design of industrial automation applications.

Unit I (5 hours)
Introduction to Automation: Role of automation in industrial process, History of automation and automation tools.

Unit II (6 hours)
Components used in Automation: Concept of relays, relays wiring and logic gates, switches and its type, types of sensors, control actuators, relay board, contactor, timer, solenoid valve, Hydraulic & pneumatic control, selection of sensor.

Unit III (9 hours)
Programmable Logic Controller: Introduction to PLC & its need in automation, block diagram of PLC, I/O modules in PLC, Addressing in I/O modules, Ladder diagram, and component of Ladder diagram.

Unit IV (9 Hours)
Advance Instructions in PLC: Ladder diagram design with advance instruction, interfacing of component & sensors used in automation, PLC communication (Modbus communication, Ethernet, RTU.)

Unit VI (6 Hours)
Application & Design of Automation: Conveyer belt, starting of induction motor, Automation of water management system

Text Books
1. Programmable Logic Controllers: William Bolton (Author), ISBN-13: 978-0750681124 4th Edition

Reference books
1. PLC Manuals & user guide.

B. Tech VI Semester
Department of Electrical Engineering
Honors in Distributed Energy Generation Systems

Course Code: EETH62 **Course: Distributed Generation & Smart Grid**
L: 04Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 04**

Course Objective.

To develop a conceptual introduction to various distributed generation systems, micro grids, smart grids and their control

Course Outcome:

The students will be able to:

CO1. Explain various distributed generation systems

CO2. Work with the microgrid and their control schemes

CO3. Differentiate various tools and methods developed in the field of Smart Grids.

Module-1 (06 Hours)
Distributed Generation – Introduction, Integration of distributed generation to Grid, Concepts of Micro Grid, Typical Microgrid configurations, AC and DC micro grids, Interconnection of Microgrids, Technical and economical advantages of Microgrid, Challenges and disadvantages of Microgrid development.

Smart Grid: Evolution of Electric Grid - Definitions and Need for Smart Grid, Opportunities, challenges and benefits of Smart Grids.

Module-2 (07 Hours)
Distributed energy resources: Introduction, Combined heat and power (CHP) systems, Solar photovoltaic (PV) systems, Wind energy conversion systems (WECS), Small-scale hydroelectric power generation, Storage devices: Batteries: Lead acid, nickel metal hydrate and lithium ion batteries, ultra-capacitors, flywheels.

Control of Microgrids: Introduction to Central Controller (CC) and Microsource Controllers (MCs) - Control functions for microsource controller, Active and reactive power control, Voltage control, Storage requirement for fast load tracking, Load sharing through power-frequency control

Module-3 (07 Hours)
Protection issues for Microgrids: Introduction, Islanding, Different islanding scenarios, Major protection issues of stand-alone Microgrid - Impact of DG integration on electricity market, environment, distribution system, communication standards and protocols.

Smart Grid: Components –Smart Grid Reference Architecture, Introduction to Smart Meters, Electricity tariff – one part tariff, two tariff and maximum demand tariff - Dynamic pricing: time-of-use (TOU) pricing, critical- peak pricing (CPP) and Real Time Pricing- Automatic Meter Reading (AMR), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation. Intelligent Electronic Devices (IED) and their application for monitoring & protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Module-4 (07 Hours)
Smart energy efficient end use devices- Smart distributed energy resources- Load Curves-Load Shaping Objectives- Methodologies - Peak load shaving - Energy management-Role of technology in demand response- Demand Side Management – Numerical Problems

Module-5 (06 Hours)
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood-Area Networks (NANs), Sensor and Actuator Networks (SANETs) Smart Substations, Substation Automation,
IEC 61850 Substation Architecture, Feeder Automation.

Module-6 (07 Hours)
Cloud computing in smart grid: Private, public and Hybrid cloud. Cloud architecture of smart grid.
Power quality: Introduction - Types of power quality disturbances - Voltage sag (or dip), transients, short duration voltage variation, Long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker - Harmonic sources: SMPS, Three phase power converters, arcing devices, saturable devices, fluorescent lamps, harmonic indices (THD, TIF, DIN, C – message weights)
Power quality aspects with smart grids.

TEXT BOOKS/REFERENCES:

1. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, ISBN: 978-0-470-62761-7, Wiley
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, ISBN: 978-0-470-88939-8, Wiley
3. R. C. Durgan, M. F. Me Granaghen, H. W. Beaty, “Electrical Power System Quality”, McGraw-Hill
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, ISBN: 978-0-470-05751-3, Wiley
5. S. Chowdhury, S.P. Chowdhury and P. Crossley, Microgrids and Active Distribution Networks, ISBN 978-1-84919-014-5, IET, 2009
6.EkanayakeJ.,Jenkins N., Liyanage K., Wu, J., Yokoyama A., Smart Grid: Technology and applications, Wiley Publications.
7. Momoh J., Smart Grid: Fundamentals of design and analysis, John Wiley & Sons.
8. Smart Grid: Technology and Applications by Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage,Jianzhong Wu, Akihiko Yokoyama Wiley India

B. Tech VI Semester
Department of Electrical Engineering
Minors in Electric Vehicles

Course Code: EETM62 **Course: EV Energy Management and Charging Infrastructure**

L: 04Hrs.,T: 00 Hrs., P: 00 Hrs., Per week **Total Credits: 04**

Course Objective:

To introduce the basics of EV energy management and impart the knowledge of chargers, electric vehicle supply equipment, their components, charging protocols and standards

Course Outcomes

On the completion of this course the student will be able to:

CO1: Understand the various energy management strategies in EV

CO2: Identify the various components of Electric vehicle charging system

CO3: Comprehend the different types of Electric vehicle chargers and their standards

CO4: Interpret the various communication protocols used in Electric vehicle charging

CO5: Familiarize with the recent trends in Electric vehicle charging

Syllabus:

Module: 1 Energy Management Strategies: (6 Hours)

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Module: 2 Introduction to EV charging: (7 Hours)

Electric Vehicle Charging; Charging Modes; Electric Vehicle Supply Equipment (EVSE): Types, Components of EV Battery Chargers; Challenges in Electric Vehicle Charging

Module: 3 Charger sizing and standards: (9 Hours)

Charger Classification; Slow Charging and Fast Charging; DC Charging and AC Charging; Selection and Sizing of Chargers: Charger Connectors and Cables; Charging Standards: Connectors, Supply Equipment; EMI/EMC; Testing Methods for Chargers and EVSE

Module: 4 EV charger communications protocols: (9 Hours)

Open Charge Point Protocol (OCPP); Open System Interconnection Layer Model (OSI); Introduction to adapted PWM Signal based Low-level Communication; PLC based High-level Communication; CAN Communication; Billing and Authentication

Module: 5 Public charging infrastructure: (9 Hours)

Location, Planning and Implementation of Public Charging Stations; Components; Selection and Sizing - HT/LT Equipment & Cables; Protection; Safety Standards: Policy and Regulatory Aspects; EV Charging Station and their Business Models; Economic Aspects; Major Challenges

Module: 6 Future frontiers in EV charging : (9 Hours)
Bulk Charging; Battery Swapping; Wireless Charging; EVs as Distributed Storage Resources: Grid to Vehicle (G2V) and Vehicle to Grid (V2G), V2X Concept, Integration of Charging Station with Renewable Sources and its Impact on the Grid

Module: 5 Future frontiers in EV charging: (9 Hours)
Bulk Charging; Battery Swapping; Wireless Charging; EVs as Distributed Storage Resources: Grid to Vehicle (G2V) and Vehicle to Grid (V2G), V2X Concept, Integration of Charging Station with Renewable Sources and its Impact on the Grid

Text Book(s)
1. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, CRC Press, 2021.
2. Code of Practice for Electric Vehicle Charging Equipment Installation, 4th Edition, IET, 2020.

Reference Books
1. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", 1st Edition, Springer, 2013.

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EET452-7 **Course: High Voltage Engineering**
L: 3 Hrs, T: 0 Hr, P: 0 Hrs. Per week **Total Credits: 03**

Course Outcomes

Upon the completion of this course, students will be able to,

CO1. Understand breakdown mechanisms in dielectrics.

CO2. Know the over voltage phenomenon in power system with protection and insulation coordination.

CO3. Apply generation and measurement techniques of high voltage and current for testing purpose.

CO4. Aalyze non-destructive and high voltage testing of electrical equipment.

Syllabus

Module-I: Breakdown Mechanism in Dielectrics
Ionization processes in gaseous dielectrics, Townsend's criterion Streamer theory, Paschen's law, practical considerations in using gases for insulation purpose; break-down in vacuum, liquid as insulators, break-down in solid dielectrics.

Module II: Lightning and Switching Over Voltages
Lightning mechanism, types of lightning strokes, protection of power system against lightning over voltages, types of lightning arresters, surge absorbers; types of switching over voltages and their causes, protection against switching over voltages; Insulation coordination.

Module-III: Generation of High Voltage and Currents
Generation of high D.C. voltage, generation of high AC voltage, generation of high frequency AC high voltage; impulse waveform, generation of impulse voltage, generation of impulse current, generation of switching surges.

Module-IV: Measurement of High Voltage and Current
Measurement of high AC and DC voltages by micro ammeter, generating voltmeters, resistance and capacitance potential divider, series impedance voltmeter, peak reading AC voltmeters, sphere gap arrangement; measurement of impulse voltage by potential dividers and peak reading voltmeters; measurement of high AC, DC and impulse currents.

Module- V: Non-destructive Testing
Significance of non-destructive testing, measurement of DC resistivity, measurement of dielectric constant and loss-factor, partial discharge phenomenon and measurement, discharge detection in power cables.

Text Books:

1. High Voltage Engineering, *M.S.Naidu & V. Kama Raju, Tata McGraw Hill Publication.*
2. High Voltage Engineering, *C. L. Wadhawa, New Age international (P) Ltd Publisher.*

3. High Voltage and Electrical Insulation Engineering, *Ravindra Arora & Wolfgang Mosch Wiley-IEEE Press.*
4. High Voltage Engineering, *M. P. Chaurasiya, Khanna Publisher.*

Reference Books:

1. Fundamentals of High Voltage Engineering, *S. K. Singh, Dhanpatrai & Co.*
2. High Voltage Engineering Fundamentals, *Kuffel E., Butterworth-Heineman, 2000.*
3. Various IS standards for HV Laboratory Techniques and Testings.

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EET452-8 **Course: Digital Signal Processing**
L: 03Hrs, T: 0Hr, P: 0Hrs. Per week **Total Credits: 03**

Course Outcomes

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

CO1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
CO2. Analyse discrete-time systems using z-transform.
CO3. Apply the Discrete-Fourier Transform (DFT) and the FFT algorithms.
CO4. Represent and design digital filters for various applications.
CO5. Apply digital signal processing for the analysis of real-life signals.

Syllabus

Module-I: Discrete-time signals and systems (05 Hours)
Revision of different types of signals and system, representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate, Convolution.

Module-II: Z-Transform (06 Hours)
Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

Module-III: Discrete Fourier Transform (05 Hours)
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems.

Module-IV: Representation of Digital Filters (05 Hours)
Basic structures of IIR and FIR filter, direct form, cascade and parallel structure

Module-V: Design of Digital Filters (07 Hours)
Design of IIR filter by Impulse Invariant method, Bilinear Z Transformation with prewarping effect, Matched Z Transformation Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Bandstop and High-pass filters. Design of FIR filters by Fourier Series Method, Windowing Method. Introduction to multi-rate signal processing.

Module-VI Applications of Digital Signal Processing (05 Hours)
Application in A/D Converter, D/A Converter, Radar, Signal Processing, Modulation and any other.

Text Books

1. Discrete Time Signal Processing: A.V. Oppenheim and R. W. Schafer, Prentice Hall, 1989.
2. Digital signal processing Theory & Applications: N.G.Palan, Tech Max Publication Reference Books, Prows and Manolakis, PHI Ltd, 3rd Edition
3. Digital Signal Processing: Principles, Algorithms and Applications: J. G. Proakis and D.G. Manolakis, Prentice Hall, 1997.
4. Digital Signal Processing- A computer based approach: S. K. Mitra, McGraw Hill, 2011.

Reference Books

1. Digital Signal Processing: S Salivahanan, AVallavaraj, Mc. Graw Hill Publication. 2nd Edition
2. Theory and Application of Digital Signal Processing: L. R. Rabiner and B. Gold, Prentice Hall, 1992.
3. Introduction to Digital Signal Processing: J. R. Johnson, Prentice Hall, 1992.
4. Digital Signal Processing: D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, John Wiley & Sons, 1988. DSP First Hardcover : James MacClellan, Ronald Schafer, Mark Yoder

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EET452-9 **Course: IoT Applications for Energy**
L: 03Hrs, T: 0Hr, P: 0Hrs. Per week **Total Credits: 03**

Course Outcomes

At the end of this course students will be able to

CO1. Explain the basic blocks and application of IoT

CO2. Develop an understanding of various communication networks

CO3. Select various sensors and transducers required for IoT based energy systems.

CO4. Describe IoT applications in the field of Electrical Engineering

Syllabus

Module 1: Introduction to IoT (Teaching Hours: 6 Hrs)
Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & Application, Programming Interface, Benefits of IoT.

Module 2: IoT Communication networks (Teaching Hours: 7 Hrs)
Architecture of IoT, Communication network: Home Area Network (HAN), Neighbourhood Area Network (NAN), Field Area Network (FAN), Wide Area Network (WAN), Wireless Sensor Networks (WSNs)

Module 3: Sensor for energy (Teaching Hours: 7 Hrs)
Sensors for measurement of voltage, current. Position sensor: GPS Position, Altitude. Human Machine Interface sensor: Touch Sensors, buttons, sliders.

Module 4. Application of IoT (Teaching Hours: 8 Hrs)
Smart Homes: Smart Appliances, Security and Safety. Smart Energy: Smart Meters, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), Real Time Pricing, Smart grid, Smart Cities: Smart Vehicles, Smart Lighting, Smart Parking etc.

Module 5. IoT applications in Smart Grid (Teaching Hours: 8 Hrs)
IoT application in Block chain, Demand side management and case studies

Text Books

5. Internet of Thing, By Rajkamal, Tata McGraw Hill publication.
6. Transducers and Instrumentation: D.V.S. Murthy, PHI Publications
7. Internet of things (A-Hand-on-Approach) By Vijay Madisetti and ArshdeepBahga1st Edition, Universal Press.
8. Online resources: IEEE Journals

Reference Books

5. The Internet of Things: Connecting Objects By Hakima Chaouchi Wiley publication
6. The Internet of Things – Key applications and Protocols By Olivier Hersent, David Boswarthick, Omar Elloumi,, Wiley, 2012

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EEP452-7 **Course: High Voltage Engineering Lab**
L: 00Hrs, T: 0Hr, P: 02Hrs. Per week **Total Credits: 01**

Course Outcomes:

Upon the completion of this course, students will be able to:

CO1: To apply, analyze and co-relate fundamental principles of science and engineering with laboratory experimental work.
CO2: To understand and connect the circuit to perform the experiment, analyze the observed data and make valid conclusion.
CO3: To understand and write practical record with effective presentation of diagrams, characteristics and graphs.
CO4: To understand the use of modern tools in high voltage engineering lab.

List of Experiments:

No.	Experiment
1	Study of Power System insulators.
2	Study of Ferranti-Effect on Model of Long EHV Transmission Line.
3	To find the Break-down Voltage of Transformer Oil.
4	To find the Breakdown Voltage of Solid Insulator (Insulation papers) and Observe the Effect of Number of Layers on Breakdown Voltage.
5	Calibration of Panel Voltmeter using Sphere-gap Arrangement.
6	To find Dry & Wet Flash over Voltage of Pin Type Insulator.
7	To find String Efficiency of 132 kV String of Disc Insulators
8	To Observe the Corona Effect & Computation of Corona Power-Loss.
9	To Observe the Movement of Arc in Horn-gap type Lightning Arrester
10	To Draw Equipotential Lines for Different Electrode Geometries.
11	To find Dielectric constant, Dissipation Factor (tanδ) and Insulation Resistance of Transformer Oil.
12	To observe the Partial-Discharge Phenomenon in Needle-Plate Electrode configuration in Air.
13	Measurement of tanδ & Capacitance for the given test object..
14	To observe the effect of the shape of the Electrode (Electrode Geometry) on Break-down Voltage.
15	To Observe the Effect of the Nature of Applied Voltage on Break-down in Air.
16	To Observe Fiber-Bridge Formation in Insulating Oil.
17	Comparison of High AC Voltage Measurement Techniques (Panel Voltmeter, Sphere Gap Arrangement, Resistance Potential Divider & Capacitance Potential Divider).
18	Comparison of High DC Voltage Measurement Techniques (Panel Voltmeter, Series Resistance Micro- Ammeter, Sphere Gap Arrangement & Resistance Potential Divider).
19	Study of Impulse Voltage Generation & Measurement Technique.
20	Impulse Voltage Testing of Pin Type Insulator.
21	To Observe the Effect of Pressure/Vacuum on the Breakdown Voltage
22	To find Power Frequency Flash over Voltage of Pin Type Insulator under Polluted Condition.
23	To Observe the Tracking and Gliding Discharge on the Surface of PVC Insulation Paper.
24	Measurement of Insulation Resistance (IR) and Conduction/Leakage Current for Insulation Papers.
25	Cockcroft Walton Voltage Multiplier Circuit: A) To plot input-output voltage characteristic. B) To plot the spark/breakdown characteristic with sphere-sphere electrodes. C) To find spark/breakdown voltage of insulation paper.

26 To Observe the Arc/Spark Generated by High Frequency Voltage by Tesla Coil between the Spherical Electrodes, on the Surface of Power System Insulator and on the Surface of PVC Insulation Paper.

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EEP452-8 **Course: Digital Signal Processing Lab**
L: 00Hrs, T: 0Hr, P: 02Hrs. Per week **Total Credits: 01**

Course Outcomes

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

CO1. Plot various signals in continuous and discrete-time.

CO2. Find convolution of sequences

CO3. Find the Fourier transform of a sequence in discrete time domain

CO4. Design IIR and FIR filter

List of Experiments

1. Write a python program to plot sine and cosine waveform with fundamental frequency of 50Hz in discrete.
2. Write a python program to plot unit impulse, step and ramp function in discrete.
3. Write a python program to plot various signals.
4. Write a python program to find Convolution of two sequences.
5. Write a python program to find DIT FFT
6. Write a python program to show sampling of continuous sine waveform at different sampling frequency.
7. Write a python program to find the modified coefficient of FIR low pass filter using different window technique
8. Design IIR Lowpass Butterworth Filter using Bilinear Transformation Method in Scipy- Python.

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EEP452-9 **Course: IoT Applications for Energy Lab**
L: 00Hrs, T: 0Hr, P: 02 Hrs. Per week **Total Credits: 03**

Course Outcomes

At the end of this course students will be able to

CO1. Interface various sensors using Arduino/Raspberry Pi

CO2. Interface Bluetooth module to send and receive data

CO3. Upload and receive data to and from cloud

List of Experiment

1. To interface LED/Buzzer with Arduino/Raspberry Pi
2. To interface sensor with Arduino/Raspberry Pi to find temperature and humidity
3. To interface motor using relay with Arduino/Raspberry Pi
4. To interface Bluetooth module with Arduino/Raspberry Pi and receive data from smartphone using Bluetooth.
5. To interface Bluetooth module with Arduino/Raspberry Pi and send data to smartphone using Bluetooth
6. Write a program on Arduino/Raspberry Pi to upload and receive temperature and humidity data to and from cloud.
7. To interface camera using Arduino/Raspberry Pi
8. To interface voltage and current sensors using Arduino/Raspberry Pi
9. Open Ended Experiments

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EET456 **Course: Power System Protection**
L: 03 Hrs, T: 0 Hr, P: 0 Hrs. Per week **Total Credits: 03**

Course outcomes

After completion of this course, students will be able to

CO1. Discuss performance of protective relays, its co-ordination and settings for any general power network.

CO2. Apply principles of overcurrent relaying to achieve relay coordination of low and medium voltage transmission line.

CO3. Implement different distance protection scheme for high voltage transmission line.

CO4. Identify the different protective schemes for equipment such as transformers, generators, motors etc.

CO5. Understand digital relay, its fundamental attributes and implementation in power system.

CO6. Explain the construction and operation of different types of circuit breakers.

Syllabus

Module-I: Introduction to fundamentals of protection System (05 Hours)
Need for protective schemes, Nature and cause of faults, Types of fault, Effects of faults, Fault Statistics, Zones of protection, Primary and backup protection, Essential qualities of protection, Performance of protective relaying, Classification of protective Relays construction wise and their comparison, Instrument transformers.

Module-II: Unit II: Overcurrent Protection (08 Hours)
Introduction, Types of overcurrent relays as per time – current Characteristics, Current setting, Time setting, PSM and TSM, Overcurrent protective schemes for radial lines, Directional overcurrent relay, Overcurrent protection of three-phase feeder Construction, Operating principle and characteristics of directional overcurrent relay, , Applications and drawback of overcurrent relays,

Module-III: Distance Protection (08 Hours)
Introduction, Universal torque equation, Operating principle and characteristics of Impedance relay, Reactance relay, and Mho relay, Performance of different distance relays during normal loading condition, power swing and effect of arc resistance, Three-stepped distance protection. Carrier protection, Applications and Numerical problems.

Module-IV: Equipment Protection Schemes (08 Hours)
Introduction, Differential relays, Dot convention, Simple differential protection during normal load, external fault and internal fault, Percentage or biased differential Relay, Transformer Protection, Protection of Generators and Induction motors.

Module-V: Fundamentals of Digital Protection (06 Hours)
Evolution of digital relays from electromechanical relays, Digital signal processing and architecture of Numerical relays, Analog to digital converters, Sampling, Anti-aliasing filters, Numerical

relaying algorithms, Application of Numerical relays for power system protection.

Module-VI: Circuit Breakers (05 Hours)
Introduction, Comparison between fuse and circuit breaker, Fault clearing time of a Circuit Breaker, Arc voltage, Arc interruption, Restriking voltage and Recovery voltage, Current chopping, Interruption of capacitive current, Classification of circuit breakers, Rating of circuit breakers, Testing of circuit breakers.

Text Books:

1. Fundamentals of Power System Protection: *Y G Paithankar, S R Bhide, 2nd edition, PHI pvt. Ltd, 2013*
2. Power System Protection and Switchgear, B Ravindranath M. Chander, *2nd edition, New Age International Publisher, 2016*
3. Principles of Digital Protection: *S R Bhide, PHI pvt. Ltd, 2014*

Reference Books:

1. Art & Science of Protective Relaying: *Russel Mason*
2. Power System Relaying: *Stanley H Horowitz, A G Phadke; Willey*
3. Synchronized Phasor Measurements and their Applications: *A G Phadke, J S Thorp; Springer, 2008*

Other reference material (e.g. e-resources):
Relay Manufacturer's catalogues and application notes, NPTEL online lectures

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EEP456 **Course: Power System Protection Lab**
L: 00 Hrs, T: 0 Hr, P: 02 Hrs. Per week **Total Credits: 03**

Course Outcomes

Upon the completion of this course, students will be able to

CO1. Analyze, apply and co-relate principle of protective relaying with laboratory experimental work.

CO2. Carry out the connection of the circuit by choosing proper terminals and perform the experiment using proper relay settings.

CO3. Analyze the observed data & make valid conclusion by plotting characteristics of relay.

CO4. Write Journal with effective presentation of diagrams and characteristics.

Proposed Syllabus

Students need to perform 08 to 09 practical based on the theory course of Power System Protection.

B.Tech VII Semester
Department of Electrical Engineering

Course Code: EET498-1 **Course: Electric Vehicles**
L: 00 Hrs, T: 0 Hr, P: 02 Hrs. Per week **Total Credits: 03**

Course outcomes

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

CO1. Describe the vehicle dynamics of conventional and electric vehicles.

CO2. Explain the various drive train topologies and their power flow control in hybrid and electric vehicle.

CO3. Understand the working of advanced electric motors and their application in electric vehicles.

CO4. Compare the various energy storage systems used in electric and hybrid electric vehicles.

CO5. Explain the various charging systems used in hybrid and electric vehicles.

Syllabus

Module I -Vehicle dynamics

Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Module II -Hybrid and Electric Vehicle

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drivetrains on energy supplies.

Hybrid and Electric Drive-trains: Basic concept of hybrid and electric traction, introduction to various hybrid and electric drive train topologies, power flow control in hybrid and electric drive-train topologies, fuel efficiency analysis.

Module III- Electric components and Propulsion system

Introduction to electric components used in hybrid and electric vehicles.

Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives.

Module IV- Energy Storage Systems

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery, Fuel Cell, Super Capacitor and Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

Introduction of Battery management system.

Module V- Charging systems of EVs and HEV's

AC Charging, DC Charging, Smart charging, ICT for charging, Wireless charging of EVs, Battery Swapping Technology, Charging EVs From Renewables.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV)

Text Books:

1. Hybrid Electric Vehicles - Principles and Applications with Practical Perspectives: C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
2. Hybrid Electric Vehicles - Energy Management Strategies: S. Onori, L. Serrao and G. Rizzoni, Springer, 2015.
3. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles - Fundamentals, Theory, and Design: M.Ehsani, Y. Gao, S. E. Gay and A. Emadi, CRC Press, 2004.
4. Electric and Hybrid Vehicles: T. Denton, Routledge, 2016

B.Tech VII Semester
Department of Electrical Engineering

Course Code: - EET 498-3 **Course: Energy Management and Audit**
L: 3Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course Outcomes:

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

CO1: Discuss the current energy scenario and importance of energy conservation.

CO2: Describe the concepts of energy management.

CO3: Explain the methods of improving energy efficiency in different electrical systems.

CO4: Explain the methods of improving energy efficiency in different industrial systems.

CO5: Illustrate the concepts of different energy efficient devices.

Syllabus

Module-I: Energy Scenario (06 Hours)
Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module-II: Basics of Energy and its various forms (05 Hours)
Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Module-III: Energy Management & Audit (06 Hours)
Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module-IV: Energy Efficiency in Electrical Systems (06 Hours)
Electrical system: performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Module-V: Energy Efficiency in Industrial Systems (07 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components.
Fans and blowers: Types, efficient system operation, flow control strategies and energy conservation opportunities.
Pumps and Pumping System: Types, efficient system operation, flow control strategies and energy conservation opportunities.
Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Module-VI: Energy Efficient Technologies in Electrical Systems (0**7 Hours**)
Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Shri Ramdeobaba College of Engineering and Management, Nagpur
Department of Electrical Engineering
B.Tech VII Semester

Course Code: HUT453 **Course: Engineering Economics and Management**
L: 03Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course Outcome:

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

CO1: Interpret basic concepts of engineering economics and analyse the strategic role of engineers in business and engineering economic decision making
CO2: Apply and analyse the principles of Macroeconomics and their implementation at national and global level.
CO3: Analyse the application of Economics in society and environment.
CO4: Understand the basics of management
CO5: Analyse the key functions of management and its application
CO6: Analyse the role and implementation of financial management tools in decision making

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Syllabus

Unit I: Foundation of Engineering Economics (06 Hours)
Definition of Economics, basic concepts of Economics (value, goods, wealth, income, savings, utility); definition and scope of engineering economics; **demand and supply:** Laws and elasticity. Engineer's role in business, types of strategic engineering economic decisions, fundamental principles in engineering economics, methods to evaluate business and engineering projects (the teacher can take up one method from the text book).

Unit 2: Macro Economics (06 hours)
Different types of economy (Capitalist, Socialist, Mixed), Introduction to Indian Economy, **National Income in India:** Basic Concepts- GDP, GNP, NDP, NNP, FID, NFIA, per capita Income, **Banks:** Central Banks (Function and Credit control) Commercial Bank (Functions and credit creation), NBFSs, Inflation, Phrases of Business cycle, **Taxation** (Direct, Indirect/GST),

Unit 3: Economic Sociology and Environmental Economics (07 hours)
Sociology of labour markets: Sociological approaches (Classical and Neoclassical theory) to labour markets; Social determinants of inequalities in wage and earning. **Social cultural aspects of economic development:** Impact of religion, caste, gender, ethnicity, family on economy. **Environmental economics:** Concept of sustainable development, **methods of environmental evaluation**: cost and benefit analysis, Hedonic pricing, willingness to pay (Consumer surplus).

Unit 4: Introduction to Management (06 hours)
Definition of management, difference between management and administration, evolution of management;
Group Dynamics: Types of Groups, Formation of groups, Leadership Skills, Conflict Management**;**
Team Building: Types of Teams, GRIP Model, Diversity and multiculturalism; Work **stress and Mental Health**

Unit 5: Functions of Management (07 hours)
Planning: Definition, Types of planning, steps in planning, PESTEL Model,
Organizing: Definition, Delegation of authority, Span of control,
Directing: Definition, Techniques of Directing, Elements of Directing.

Controlling: Definition, Steps in controlling, Techniques of controlling.

Unit 6: Financial Management (05 hours)

Introduction to Financial Management: Definition, Objectives, Role of financial management in contemporary scenario,

Financial Statements and tools: balance sheet, profit and loss account, budget, ratio analysis, depreciation.

Additional Reading: Introduction to CPM, PERT, Basics of LPP and Forecasting models.

Text Books

1. Panneerselvam. R., (2020) *Engineering Economics*, PHI learning, private limited, Delhi, 2nd ed.
2. Park.C., (2018) *Fundamentals of Engineering Economics*, Pearson India Education Services, Pvt. Ltd, 3rd ed.
3. KK Dewett, *Modern Economic Theory*, (43rd Edition), S. Chand and Co. Ltd, New Delhi
4. P.C. Tripathi and P.N. Reddy "*Principles of Management*", Tata MacGraw Hill Publishing Co. Ltd. , New Delhi
5. K. Aswathappa "*Organisational Behavior*" Himalaya Publication, Mumbai (2005).
6. Ravi M. Kishore "*Financial Management*" Taxman Allied Services (P) Ltd., New Delhi
7. Fevre, Ralph. (1992). *The Sociology of Labour Markets*. Harvester Wheatsheaf, the University of California.
8. Rabindra N. Bhattacharya (2002) "*Environmental Economics: An Indian Perspective*", Oxford university Press
9. Karpagam M. (2012) "*Environmental Economics*", Sterling Publishers ltd

Reference books

1. M.L. Jhingan (2016) "*Micro Economics*", 8th Edition, 2016
2. M.L. Jhingan (2016) "*MacroEconomic Theory*", 13th Edition, 2016
3. K.K. Dewett and J.D. Varma "*Elementary Economic Theory",* S. Chand and Co, New Delhi
4. Rudradutt, K.P.M. Sundaram "*Indian Economy*", S. Chand and Co. Ltd
5. Martang. S. Telang "*Industrial and Business Management*", S. Chand and Co. Ltd, New Delhi
6. T. Ramaswamy, "*Principles of Management*" Himalaya Publishing House, Mumbai

B.Tech VII Semester
Department of Electrical Engineering
Honors in Distributed Energy Generation Systems

Course Code: EETH72 **Course: Design of Power Converter for Distributed Generation System**

L: 04Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 04**

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

CO1. Select the Inverter topology for grid interfacing of DGS

CO2. Understand the Grid interfacing requirements for DGS.

CO3. Design the control scheme for Grid synchronization in Single phase Inverter.

CO4. Design the control scheme for Grid synchronization in Three phase Inverter.

Syllabus

Module-I: Photovoltaic Inverter Structures
Introduction to Inverter Structures Derived from H-Bridge Topology, Basic Full-Bridge Inverter, Three-Phase PV Inverters.

Module-II: Grid Requirements for PV
International Regulations, Response to Abnormal Grid Conditions, DC Current Injection.

Module-III: Grid Synchronization in Single-Phase Power Converters
Grid Synchronization Techniques for Single-Phase Systems, Phase Detection, PLL Introduction

Module-IV: Grid Synchronization in Three-Phase Power Converters
Introduction to requirements of Three Phase power converters, Converter structure

Text books:

1. Grid Converters for Photovoltaic and Wind Power Systems by Remus Teodorescu,Marco Liserre,Pedro Rodr´ıguez, John Wiley and Sons, Ltd., Publication

Reference Books:

1. Power Electronics converters, Application and Design: Mohan N. Underland TM, Robbins WP., John Wiley & Sons.
2. Modern Power Electronics: P. C. Sen
3. Power Electronics and AC Drives: B. K. Bose, Prentice Hall, NJ, (1985).
4. Aelated IEEE papers/ NPTEL lectures

B.Tech VII Semester
Department of Electrical Engineering
Minors in Electric Vehicles

Course Code: EETM72 **Course: EV Communication and Instrumentation**
L: 04 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 04**

Course Outcomes:

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

CO1: Describe the different sensors required in EV.

CO2: Understand the basics of in-vehicle networking.

CO3: Describe about the various networks and protocols used in EV.

CO4: Understand the necessity of higher layer protocols used in EV communication.

MODULE- I: SENSORS and INSTRUMENTATION
Introduction, Architecture of Electronic Control Units, Voltage and Current Measurement, Temperature, Acceleration, Pressure, Velocity, Position, and Displacement Other Sensors, Reliability Constraints in Automotive Environment

MODULE-II: BASICS OF IN-VEHICLE NETWORKING
Overview of Data communication and networking –need for In-Vehicle networking – layers of OSI reference model –multiplexing and de-multiplexing concepts –vehicle buses.

MODULE-III: NETWORKS AND PROTOCOLS
Overview of general-purpose networks and protocols -Ethernet, TCP, UDP, IP,ARP,RARP - LIN standard overview –workflow concept-applications –LIN protocol specification –signals - Frame transfer –Frame types –Schedule tables –Task behaviour model –Network management –status management - overview of CAN –fundamentals –Message transfer – frame types-Error handling –fault confinement-Bit time requirements.

MODULE-IV: HIGHER LAYER PROTOCOL
Introduction to CAN open –TTCAN –Device net -SAE J1939 - overview of data channels –Control channel-synchronous channel – asynchronous channel –Logical device model – functions-methods-properties-protocol basics- Network section-data transport –Blocks – frames –Preamble-boundary descriptor

MODULE-V: LATEST TRENDS
Car networking protocols – Networking future trends –Roadmaps –Competitive advantage

Text Books:

1. J.Gabrielleen,"Automotive In-Vehicle Networks", John Wiley & Sons, Limited, 2008
2. Robert Bosch," Bosch Automotive Networking", Bentley publishers, 2007
3. Society of Automotive Engineers, "In-Vehicle Networks", 2002
4. Ronald K Jurgen, "Automotive Electronics Handbook", McGraw-Hill Inc. 1999
5. Indra Widjaja, Alberto Leon-Garcia, "Communication Networks: Fundamental Concepts and Key Architectures", McGraw-Hill College; 1st edition, 2000
6. Konrad Etschberger, "Controller Area Network, IXXAT Automation", August 22, 2001
7. Olaf Pfeiffer, Andrew Ayre, Christian Keydel, "Embedded Networking with CAN and CANopen", Annabooks/Rtc Books, 2003

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET472-6 **Course: Modern Electrical Grids**
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course Outcome:

After the completion the course, students will be able to

CO1. Describe the role of Distributed generation in modern grids.

CO2. Appreciate the necessity of Smart grid in modern power system

CO3. Familiar with the communication system in Smart grid

CO4 : Discuss about the role of Demand side management in modern grid.

Syllabus

Module-1: Distributed Generation and Microgrid
Introduction, Integration of distributed generation to Grid, Concepts of Micro Grid, Typical Microgrid configurations, AC and DC micro grids, Interconnection of Microgrids, Technical and economic advantages of Microgrid, Challenges and disadvantages of Microgrid development.

Module-II: Introduction to Smart Grid
Evolution of Electric Grid - Definitions and Need for Smart Grid, Opportunities, challenges and benefits of Smart Grids.

Module-III: Smart Grid
Components –Smart Grid Reference Architecture, Introduction to Smart Meters, Electricity tariff – one part tariff, two tariff and maximum demand tariff - Dynamic pricing: time-of-use (TOU) pricing, critical- peak pricing (CPP) and Real Time Pricing- Automatic Meter Reading (AMR), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation. Intelligent Electronic Devices (IED) and their application for monitoring & protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Module-IV: Advanced Metering Infrastructure (AMI)
Home Area Network (HAN), Neighborhood-Area Networks (NANs), Sensor and Actuator Networks (SANETs) Smart Substations, Substation Automation, IEC 61850 Substation Architecture, Feeder Automation. Cloud computing in smart grid: Private, public and Hybrid cloud. Cloud architecture of smart grid.

Module-V: Demand Side Management
Smart energy efficient end use devices**,** Smart distributed energy resources- Load Curves-Load Shaping Objectives- Methodologies - Peak load shaving - Energy management-Role of technology in demand response- Demand Side Management – Numerical Problems

Text Books/References:

1. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, ISBN: 978-0-470-62761-7, Wiley
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, ISBN: 978-0-470-88939-8, Wiley
3. S. Chowdhury, S.P. Chowdhury and P. Crossley, Microgrids and Active Distribution

Networks, ISBN 978-1-84919-014-5, IET, 2009

4. Momoh J., Smart Grid: Fundamentals of design and analysis, John Wiley & Sons.

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET472-7 **Course: Power Quality**
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course Outcomes

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

CO1. To understand the various power quality issues as sag, flicker, harmonic distortion, unbalance, transients, etc.

CO2. To suggest suitable mitigation strategies for some of the power quality issues

CO3. To select the tools required for the measurement of some of the power quality related issues.

Syllabus

Module- I
Introduction to Electric Power Quality, Power Quality standards, Different Power Quality terms and definitions.

Module - II
Voltage Sag and Interruptions, Sources of Voltage sag and interruptions, type and characteristics of voltage sag and interruptions, Factors affecting characteristics of voltage sag and interruptions, behavior of different equipments during voltage sag, concept of area of vulnerability, CBEMA and ITI Curves .

Module - III
Voltage Swell and transient over voltage, sources of over voltage like capacitor switching, load switching, lighting etc, various causes of voltage flicker and their effects. Short term and long term flickers, various means to reduce flickers, Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Module -IV
Harmonic distortions, voltage and current harmonics, THD, sources of harmonics, ill effects of harmonics, interharmonics, harmonics filters, IEEE 519-1992 definitions, reactive power under harmonics, K-rated transformer.

Module - V
Voltage Unbalance, Impact on equipment performance, other power quality related issues like EMI, noise, notching, DC offset , Typical wiring and grounding problems causing poor power quality, solution to wiring and grounding problems.

Module - VI
Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring, Mitigation techniques at different environments.

Text Books

1. Electrical power system quality – R. C. Dugan, Mark F. McGranghan, Surya santoso, H. Wayne Beaty, Second edition, McGraw Hill.
2. Understanding power quality problems, voltage sag and interruptions - M. H.J. Bollen, IEEE press, 2000, series on power engineering
3. Power Quality: C.Sankaran, CRC Press

Reference Books

1. IEEE std 519-1992/ IEEE std 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.
2. Power system quality assessment: J. Arrillaga, M.R. Watson, S. Chan, John Wiley and sons.

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET472-8 **Course: Advance Electrical Drives**
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course outcomes

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

CO1. Select proper power electronic converter to control speed of D.C. motor, 3 phase Induction motor, Synchronous motor and select controlling parameter depending on the application of motor.

CO2. Compare the electric and non electric traction system with conventional methods of operation of traction system.

CO3. Analyze the electrical vehicle performance. Discuss advanced motor drives.

Syllabus

Module-I: DC Motor Drives

Dynamics of electric drives and control of electric drives, Introduction of D.C. Motor drives, controlled rectifier fed D.C. Drives, single phase and three phase rectifier control of D.C. separately excited motor. Dual converter control of D.C. separately excited motor. Power factor supply harmonics and ripple in motor current. Chopper controlled DC drives of separately excited DC motor chopper control of series motor, source current harmonics.

Module-II: Induction Motor Drives

Introduction of Induction motor drives, stator voltage control, variable frequency control using voltage source inverter, current source inverter & cycloconverter. Modeling of 3-phase Induction Motor: a-b-c- to d-q-o transformation, Dynamic analysis in terms of stator -d-q windings and rotor d-q windings, Electromagnetic torque equation. Introduction to vector control of induction motor.

Module-III: Synchronous Motor Drives

Introduction of Synchronous Motor Drives, starting, braking of synchronous motor, variable frequency control, self-controlled synchronous motor drive employing load commutated Thyristor inverter or cycloconverter, starting of large synchronous motors.

Module-IV: Traction Drives: - Conventional D.C. and A.C. traction drives, semiconductors converter controlled Drives, 25KV AC Traction using semiconductor converter controlled DC Motor. DC Traction using semiconductor, chopper controlled DC motors

Module-V: Electric Vehicles

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, Basics of vehicle performance mathematical models to describe vehicle Performance, electrical loads in vehicle, Introduction to various electric drive train topologies, power flow control in electric drive-train topologies, Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles

Module-V: Advanced Motor Drives
Brushless DC motor drive, switched reluctance motor drives, permanent magnet synchronous motor drive.

Text Books:

1. Fundamentals of electric drives: *G. K. Dubey.*
2. Modern Electric Traction: H. Pratap.
3. Electric drives concepts and applications: *V. Subramanan.*

Reference Books:

1. Electrical Drives: *Jon Boldea, N.A. Nasar*
2. Electrical Drives Control: *R. Krishnan*
3. Electrical Machines and Drives: Ned Mohan
4. Analysis of Electric Machinery, Krause P. C. TMH, New Delhi, Latest Edn.

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET473-5 **Course: FACTS**
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course Outcomes

At the end of this course students will be able to

CO1. Analyze the power flow in transmission line and classify the different types of FACTS controllers for reactive power compensation.

CO2. Explain the working of power converter used in FACTS devices

CO3. Describe the application of FACTS controller to shunt and series compensation.

CO4. Explain the operation of static voltage and phase angle regulator.

CO4. Describe the application of FACTS controller for combined compensator.

Syllabus

Module-I: FACTS Concept & General System Consideration

Transmission inter connection, flow of power in an AC system, Factor affecting the loading capability, Power flow & dynamic stability consideration of transmission inter connection. Importance of controllable parameters, FACTS controller.

Module-II: Voltage sourced & current sourced converters

Basic concept of voltage source converters and current source converters, Operation of single phase and three phase voltage source converters used in FACTS devices, Comparison of voltage source converters with Current source converters

Module-III: Static Shunt Compensators

SVC and STATCOM : Objectives of shunt Compensation, Methods of Controllable VAR Generation, Static VAR Compensators SVC and STATCOM, Comparison between STATCOM and SVC, Static VAR System

Module-IV: Static Series Compensators

GCSC, TSSC, TCSC and SSSC : Objectives of series Compensation, Variable Impedance, Type Series Compensators, Switching Converter Type, Series Compensators, External (System) Control for Series Reactive Compensators.

Module-V: Static Voltage and Phase Angle Regulators

TCVR and TCPAR: Objectives of Voltage and Phase Angle Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVR and TCPARS) Switching Converter – Based Voltage and Phase Angle Regulators, Hybride Phase Angle Regulators.

Module-VI: Combine Compensators (UPFC, IPFC) and Special Purpose FACTS Controllers

The Unified Power Flow Controller (UPFC), Interline Power Flow Controllers Generalized and Multifunctional FACTS Controllers, Sub synchronous Resonance, NGH-SSR Damping Scheme, Thyristor- Controlled Braking Resistor(TCBR)

Text Books

1. Understanding FACTS, Naryan G. Hingorani and Laszlo Gyigyi (Standard Publishers).

Reference Books

1. Flexible AC Transmission System (FACTS)'Yong Hua Song and Johns (IEEE Publishers).
2. Thyristor Based FACTS controllers for Electrical Transmission System R. Mohan Mathur and Rajiv
K. Verma (IEEE Press)

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET473-2 **Course: Industrial Electrical Systems**
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 03**

Course outcomes

Upon the completion of this course, the students will be able to:
CO1. Assess the electrical load and select the conductors suitable to carry load currents

CO2. Calculate the short circuit current at different locations and select proper switchgear

CO3. Design and select suitable components of starters for induction motor, understand its operation and select capacitors for reactive power management.

CO4. Select and understand procedures for installation, testing and commissioning practices for transformers, substations, DG & UPS Systems.

CO5. Design PCC & MCCs for residential, commercial and industrial installations.

CO6. Understand important features of IS 3043 for earthing, protection of building against Lightening & IE Rules

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Syllabus

Module-I: Assessment of Electrical Load & Selection of Cables & Conductors

Electrical load assessment: Categories & types of electrical load, preparing load list, connected load, demand/diversity/load/power factor, TOD tariff, industrial electric bills.
Cables, conductors &busbar: Construction, selection, installation, testing of LT/HT cables, overload and short circuit ratings, rating factors, overhead line conductors, aluminum & copper busbar.

Module-II: Symmetrical Short Circuit Calculations, Switching & Protective Devices
Symmetrical short circuit calculations: Determining symmetrical short circuit currents for selecting appropriate switchgear ratings, determining specifications of current limiting series reactor.
Switching & Protective devices: Types, specifications and selection of isolators, switches, switch-fuse units, ELCB, MCB, MCCB, ACB,VCB and SF6 circuit breakers; dropout/horn gap fuses, AB switches, power contactors, capacitor duty contactors.

Module-III: Electric Supply to Induction Motors and Reactive Power Management in Industries
Electric supply to induction motors: Power & control circuit for manual/automatic DOL, star-delta and autotransformer starters, working of these starters, selection of contactors, overload relays, short circuit protective devices for induction motors.
Reactive power management in industries: Determining kVAr rating of PF improvement by using power triangle, calculation of payback period of capital cost of capacitor installation against reduction in system losses.

Module-IV: Transformers, Substations, DG, UPS and Batteries
Transformers: Specifications, ratings, selection, installation, testing & commissioning.
Substations: 11 & 33 kV, indoor/outdoor substations; plan/elevation/clearances
UPS and Batteries: UPS systems, battery banks, sizing and selection of UPS and battery banks.

Module-V: Design of Residential, Commercial and Industrial Installations

Design of PCC, MCC, APFC Panels; selection of all associated electrical apparatus, busbars, cables, switchgear, protective devices, instruments, testing, commissioning. Introduction to lightening protection of buildings.

Module-VI: Earthing, & IE Rules

Earthing& IE Rules/ CEA Regulations:

Earthing (IS 3043): Necessity of earthing, concept of system and equipment earthing, definition of various terms, types of earthing, earth tester, and measurement of earth resistance.

IE Rules: Important IE rules applicable to residential, commercial and industrial installations. Central Electricity Authority (Measures relating to Safety and Electric supply) regulations 2010.

Text Books:

1. Electric Power Distribution: *A.S. Pabla*
2. Design of Electrical Installation: *V.K. Jain & A. Bajaj*
3. Residential Commercial and Industrial Systems: *H. Joshi, McGraw Hill Education*
4. Handbook of Electrical Power Distribution: *G. Ramamurthy*

Reference Books:

1. Indian Electricity Rules latest edition
2. IS 3043 Code of practice for earthing
3. Manufacturers' catalogues

B.Tech VIII Semester

Department of Electrical Engineering

Course Code: EET473-6 Course: Energy Storage & EV charging infrastructure
L: 03 Hrs, T: 0 Hrs, P: 0Hrs, Per week Total Credits: 03

Course Outcomes:

Upon completion of this course, students will be able to.

CO1: Interpret the characteristics and different parameters of EV Battery.

CO2: Understand the different technologies and protocols used in EV battery charging.

CO3: Identify the various requirements of EV charging station.

CO4: Plan the Electrical layout of EV charging station

Syllabus

Module-I: EV Battery Characteristics and Parameters
EV Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters Heat generation- Battery design- Performance criteria for Electric vehicles batteries, Power and energy requirements of batteries

Module-II: Introduction to EV charging Technologies
Electric Vehicle Technology and Charging Equipment's, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, AC charging and DC charging, Inboard and off board charger specification, Type of Mode of charger Mode -2 , Mode-3 and Mode-4, EVSE associated charge times calculation

Module-III: EV Chargers Protocols
AC Pile Charger, DC Pile Charger, EVSE Power Module selection and technical specification, Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module), Communication gateway, Specification of open charge point protocol (OCCP 1.6/2.0), Bharat DC001 & AC001 Charger specification, Communication Interface between charger and CMS (central management system).

Module-IV: EV Charger Components
Selection of AC charger type-1 , type -2 and type -3, Communication between AC charger and EV, Selection of DC charger connector GB/T, CHAdeMO , CCS-1 and CSS-2,Communication methodology of DC fast chargers, IS/ IEC/ARAI/ standard of Charging topology ,Communication and connectors (IEC 61851-1, IEC 61851-24,62196-2), Selection sizing of Charger connector cable

Module-V: Public Charging infrastructure / Electrical system design
Assessment of site Location for Public charging station, Selection and Sizing of Distribution transformer. Selection and sizing of HT Equipment (VCB , CT , PT , Metering), Selection and Sizing HT Cables and LT cables, Selection and sizing of Distribution Board / feeders, Sizing calculation of LT and HT cable, Selection and of Compact Substation (CSS for EV CS)/ Power Sub station), Selection of relay and calculation, Preparation of EV Charger Single Line Diagram,

Text Book:

1. Smart Charging Solutions for Hybrid and Electric Vehicles, Editor(s):Sulabh Sachan, P. Sanjeevikumar, Sanchari Deb
2. CHARGING INDIA: Developing E-Mobility Ecosystem by Parag Diwan, Om Publications
3. HANDBOOK of ELECTRIC VEHICLE CHARGING INFRASTRUCTURE IMPLEMENTATION Published by NITI Aayog

B.Tech VIII Semester

Department of Electrical Engineering
Honors in Distributed Energy Generation Systems

Course Code: EETH82 **Course: Power Quality Improvement Techniques**
L: 04 Hrs, T: 0 Hrs, P: 0Hrs, Per week **Total Credits: 04**

Course Outcomes

On completion of this course, the students will be able to,

CO1: Identify the various power quality events like short and long duration variations, Waveform distortion, Unbalance, Transients, Power factor etc.

CO2: Analyze the power quality issues using the Power quality indices.

CO3: Suggest suitable mitigation strategies for some of the power quality issues.

CO4: Provide solution for the mitigation of power quality issues like waveform distortion, unbalance, and poor power factor.

Syllabus

Module 1:
Origin of power quality variation & events, power quality indices, causes and effects of power quality disturbances, Characterization of power quality events & event classification.

Module 2:
Analysis of Power outages, unbalance, distortions, voltage sag, flickers & load balancing.

Module 3:
Reactive Power Compensation under non-sinusoidal conditions, Power factor improvement techniques.

Module 4:
Effect of Harmonics on Transformers, Three phase induction motor, capacitor banks, etc, Passive Compensation, Harmonic Filters,

Module 5:
DSTATCOM, DVR and UPQC: Structure & control of power converters, load compensation using DSTATCOM, DVR/UPQC structures & control.

Text Books:

1. Power quality enhancement using Custom Power Devices: Ghosh A. Ledwich G., Kluwer academic publication-Boston, (2002)
2. Power Quality: C. Sankaran, CRC Press,
3. Power quality: problems and mitigation techniques. Bhim Singh, Ambrish Chandra, and Kamal Al-Haddad. John Wiley & Sons, 2014.
4. Signal Processing of Power Quality Disturbances: Bollen Math H.J., GU Irene Y.H., Wilely Interscience Publication, IEEE Press, (2006).

Reference Books:

1. Understanding Power quality Problems Voltage Sags and Interruptions: Bollen Math H.J, IEEE Press, Standard Publishers Distributors, (2001).
2. Power Quality in Power Systems and Electrical Machines: Fuchs E.F., Masoum Mohammad A.S, Elsevier Academic Press, (2008).