Vision of Department

Electrical and Instrumentation Engineering department shall strive to act as a podium for the development and transfer of technical competence in academics, entrepreneurship and research in the field of Electrical and Instrumentation Engineering to meet the changing need of society.

MISSION

1. To provide modular programmes from skill development to the research level
2. To impart Education and training in innovative state-of-the-art technology in the field of Electrical and Instrumentation Engineering.
3. To promote Promotion of holistic development among the students
4. To provide extension services to rural society, industry professionals, institutions of research and higher learning in the field of Electrical and Instrumentation Engineering.
5. To interact with the industry, educational and research organizations, and Alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

The following Programme Educational Objectives are designed based on the department mission. The graduates of Electrical Engineering should be able to demonstrate

1. Skill in professional / academic career using the knowledge of mathematical, scientific and engineering principles.
2. Expertise in solving real life problems, designing innovative products and systems that are techno-economically and socially sustainable.
3. Sustained learning and adaptation to modern engineering tools, techniques and practices through instruction, group activity and self-study
4. Leadership and team work while working with diverse multidisciplinary / interdisciplinary groups.
5. Professional ethics and commitment organizational goals

PROGRAMME OUTCOMES (PO):

Electrical Engineering Graduates of the Sant Longowal Institute of Engineering & Technology, Deemed University, Longowal will have ability to:

1. Apply knowledge of mathematics, science and engineering principles to solve complex Electrical engineering research and industrial problems.
2. Identify, formulate and analyse the research and real life problems using principles of mathematics, natural sciences and engineering.
3. Design solutions for electrical engineering problems or processes that meet the specified needs of public health, safety, cultural, societal, environmental considerations etc.
4. Use scientific and technical knowledge for design and analysis of experiments
5. Create, select, and apply recent techniques, resources, and modern engineering and IT tools for modelling engineering system
6. Think logically, analytically and apply reasoning in the contextual knowledge to assess societal, health, safety, legal cultural issues etc.
7. Understand the environmental and societal issues and suggest sustainable solutions.
8. Commit to professional ethics, responsibilities and norms of the engineering practice.
9. Function as effective member individually as well as team leader in multidisciplinary and diverse teams.
10. Communicate and present technical knowledge effectively in oral and written forms.
11. Demonstrate knowledge and understanding of project engineering and management
12. Recognize the need and prepare for lifelong learning and dissemination.

SCHEME
of
Bachelor of Engineering
Electrical Engineering

DEPARTMENT OF ELECTRICAL AND INSTRIUMENTATION ENGINEERING
FOUR YEAR DEGREE PROGRAM IN ELECTRICAL ENGINEERING

Semester-I B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CYT-411	Applied Chemistry	3	1	0	4	3.5
2	HUT-412	Engineering Economics and Entrepreneurship	3	1	0	4	3.5
3	CST-411	Elements of Computer Programming	2	0	0	2	2
4	ECT-411	Elements of Electronics Engineering	3	1	0	4	3.5
5	WS-412	Workshop Technology & Practices-I	2	0	0	2	2
6	CYP-411	Applied Chemistry	0	0	2	2	1
7	CSP-411	Elements of Computer Programming	0	0	2	2	1
8	ECP-411	Elements of Electronics Engineering	0	0	2	2	1
9	MEP-413	Engineering Drawing*	1	0	3	4	2.5
10	WSP-412	Workshop Technology & Practices-I	0	0	4	4	2
		Total	14	3	13	30	22
	*ME-452 is a practical Subject only with LTP:1-0-3						

Semester-II B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-421	Engineering Mathematics	4	1	0	5	4.5
2	PHT-421	Applied Physics	3	1	0	4	3.5
3	HUT-422	English communication and Soft Skills	3	0	0	3	3
4	EET-421	Elements of Electrical Engineering	3	1	0	4	3.5
5	MET-422	Elements of Mechanical Engineering	3	1	0	4	3.5
6	PHP-421	Applied Physics	0	0	2	2	1
7	HUP-422	English communication and Soft Skills	0	0	2	2	1
8	EEP-421	Elements of Electrical Engineering	0	0	2	2	1
9	MEP-422	Elements of Mechanical Engineering	0	0	2	2	1
		Total	16	4	8	28	22

Semester-II B (UG: Practical Training)

	TP-401	Two weeks Practical Training during summer vacations			5	80	S/US

Semester-III B(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	EET-511	Transformer and DC Machines	3	1	0	4	3.5
2	EET-512	Circuit Theory	4	1	0	5	4.5
3	EET-513	Electrical and Electronics Measurements	4	0	0	4	4
4	EET-514	Analog Devices and Circuits	4	1	0	5	4.5
5	EET-515	Digital Electronics	3	1	0	4	3.5
6	EEP-512	Circuit Theory Lab	0	0	2	2	1
7	EEP-513	Electrical and Electronics Measurements Lab	0	0	2	2	1
8	EEP-511	Electrical Workshop	0	0	2	2	1
9	EEP-514	Analog and Digital Electronics Lab	0	0	2	2	1
		Total	18	4	8	30	24

Semester-IV B(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-521	Higher Engg. Mathematics	4	2	0	6	5
2	EET-521	Network Analysis and Synthesis	3	1	0	4	3.5
3	EET-522	Asynchronous Machines	3	1	0	4	3.5
4	EET-523	Electrical Power Transmission and Distribution	3	1	0	4	3.5
5	EET-524	Signals and Systems	3	1	0	4	3.5
6	EET-525	Microprocessor and Application	3	0	0	3	3
7	EEP-525	Microprocessor Lab	0	0	2	2	1
8	EEP-526	Electrical Machine Lab-I	0	0	2	2	1
		Total	19	6	4	29	24

Semester-V B(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	EET-611	Synchronous and Special Electric Machines	3	1	0	4	3.5
2	EET-612	Linear Control Systems	3	1	0	4	3.5
3	EET-613	Industrial Electronics and Drives	3	1	0	4	3.5
4	EET-614	Power System Protection	4	0	0	4	4
5	EET-615	Generation and Control Of Electric Power	3	1	0	4	3.5
6	EET-616	High Voltage Engineering	4	0	0	4	4
7	EEP-613	Industrial Electronics and Drives Lab	0	0	2	2	1
8	EEP-617	Electrical Machine Lab-II	0	0	2	2	1
9	EEP-618	Power System Lab	0	0	2	2	1
		Total	20	4	6	30	25

Semester-VI B(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-621	Numerical Analysis	3	1	0	4	3.5
2	AMP-621	Numerical Analysis	0	0	2	2	1
3	EET-621	Electromagnetic Field Theory	3	1	0	4	3.5
4	EET-622	Non Linear and Discrete Control Systems	3	1	0	4	3.5
5	EET-623	Power System Analysis	3	1	0	4	3.5
6	EET-62*	Elective- I	4	0	0	4	4
7	EEO-62*	Open Elective Subject	3	0	0	3	3
8	EEP-623	Power System Analysis Lab	0	0	2	2	1
9	EEP-625	Control System Laboratory	0	0	2	2	1
		Total	19	4	6	29	24

Semester- VII B (UG: Industrial Training)

		Industrial Training (6 weeks)					8

Semester-VII B (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PHT-711	Physics of Materials	3	1	0	4	3.5
2	PHP-711	Physics of Materials	0	0	2	0	1
3	HUT-712	Human Values and Professional Ethics	2	0	0	2	2
4	EEO-71*	Open Elective Subject	3	0	0	3	3

5	EET-71*	Elective -II	4	0	0	4	4
6	EET-71*	Elective -III	4	0	0	4	4
7	EEP-713	Software and Simulation Lab	0	0	2	2	1
8	EEP-714	Innovative Skill Lab	0	0	2	2	1
9	EEP-715	Minor Project	0	0	4	4	2
		Total	16	1	10	27	21.5

Semester-VIII B(UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CHT-721	Environmental Studies	3	0	0	3	3
2	HUT-722	Principle of Management	3	1	0	4	3.5
3	EEO-72*	Open Elective Subject	3	0	0	3	3
4	EET-72*	Elective- IV	4	0	0	4	4
5	EEP-721	Major Project	0	0	8	8	4
6	EEP-722	Seminar	0	0	2	2	1
7	EEP-723	Self-Study Course (Electrical Engineering)	0	0	0	0	1
		Total	13	1	10	24	19.5
			Credits	Total		182	

Elective-I

EET-624	Process Dynamics and Control	4	0	0	4	4
EET-625	Electric Power Utilization and Traction	4	0	0	4	4
EET-626	Power Quality	4	0	0	4	4
EET-627	Power System Operation and Control	4	0	0	4	4

Elective-II

EET-711	Microcontroller and PLC	4	0	0	4	4
EET-712	Communication System	4	0	0	4	4
EET-713	Digital Signal Processing	4	0	0	4	4
EET-714	Soft Computing	4	0	0	4	4

Elective-III

EET-715	Sensors and Signal Conditioning	4	0	0	4	4
EET-716	Bio-medical Instrumentation	4	0	0	4	4
EE-717	HVDC Transmission & FACTS	4	0	0	4	4
EET-718	Data Acquisition System	4	0	0	4	4

Elective-IV

EET-721	Non- Conventional Energy Sources	4	0	0	4	4
EET-722	Electrical Machine Design	4	0	0	4	4
EET-723	Power Plant Engineering	4	0	0	4	4
EET-724	Energy Management and Auditing	4	0	0	4	4

Open Elective-I

EE0-621	Elements of Power System	3	0	0	3	3

Open Elective-II

EE0-711	Electrical Special Machines	3	0	0	3	3

Open Elective-III

EE0-721	Energy Conservation and Practices	3	0	0	3	3

SYLLABUS
of
Bachelor of Engineering
Electrical Engineering

Subject Code : EET-421
Title of the course : Elements of Electrical Engineering

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

CO1: Apply the knowledge of Electrical Engineering principles to solve DC and AC circuits.
CO2: Formulate and analyze electrical circuits.
CO3: Understand basic principles of electromagnetism to implement in electrical machines and transformers.
CO4: Identify and select various electrical machines according to the applications.
CO5: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											S
CO2		S										M
CO3	S											S
CO4	S											M
CO5						S		S				S

Theory:

Unit	Main Topics	Course outlines	Hour(s)
Unit-1	**Basic Elements**	Concepts of Electric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric, Electrical Power and Energy; Basics of Instruments used for Measuring Current, Voltage, Power and Energy, Methods and precautions in use of these and other instruments e.g. digital multimeters, oscilloscopes, signal generators etc.; Basics of various protection and safety devices e.g. Fuses, Earthing, Miniature circuit Breaker (MCB) and Earth leakage circuit Breaker (ELCB)	04
	Concepts of DC	Ohm's Law, Resistance, and color coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel Connection of Resistances and capacitances, Kirchoff's Laws and Their Applications, Network Theorems	04
	AC Fundamentals	Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; RMS and Average Values, Concept of Phase Difference and Phasor, Single Phase and Three Phase Supply; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Impedance and Power in AC Circuit.	07
	Three phase AC	Phasor representation of three phases, Star and Delta connections, Inter-Relation between phase and line values of voltage/current, power measurement in three phase system;	06

Unit-2	**Electromagnetic Induction**	Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in A Magnetic Field, various losses in magnetic circuits;	04
	Electrical Machines	Elementary concepts and classification of electrical machines, Common features of rotating electrical machines, Basic principle of a motor and a generator, Need of Starters and their classifications..	09
	Transformers	Transformer- Classification, Principle of operation, Construction, Working and applications	04
	Basic Troubleshooting	Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g. fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays.	04

Recommended Books:

1. D.P. Kothari and I J Nagrath, Basic Electrical Engineering, 3rd edition, Tata McGraw Hill Education, 2009.
2. D.P. Kothari and I.J. Nagrath, Electric Machines, 4th edition, McGraw Hill Education, 2010.
3. Edward Hughes and John Hiley, Electrical and Electronic Technology, 10th edition, Pearson Education, 2010.
4. S.K. Bhattacharya, Electrical Machines, 3rd edition, Tata McGraw - Hill Education, 2008.

Subject Code : EEP-421
Title of the course : Elements of Electrical Engineering

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Apply the knowledge of Electrical Engineering principles to verify D.C and A. C. circuits.

CO2: Formulate and analyze electrical circuits.

CO3: Understand basic characteristics of electromagnetism to proficiently use machines and transformers.

CO4: Apply the ethical principles for troubleshooting & installation of safety devices as per norms of engineering practice.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											S
CO2		S										M
CO3	S											S
CO4						S		S				S

To understand the practicability of **Elements of Electrical Engineering**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.
3. Verification of Kirchoff's current and voltage laws.
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of voltage, current, phase angle, power and power factor in RL, RC and RLC circuits.
6. Implementation of various types of earthing.
7. Study of various types of protection devices e.g. fuses, Miniature circuit Breaker (MCB) and Earth leakage circuit Breaker (ELCB)
8. Verification of Faraday's laws and Lenz's law.
9. To start the DC and AC motors with various types of starters.
10. Verification of turns ratio of transformer and find the efficiency.
11. Starting and reversing various AC and DC motors.
12. Fault diagnosis and removal in general electrical connection /apparatus.

Subject Code : EET-511
Title of the course : Transformers and Direct Current (DC) Machines

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Understand construction and working principle of single phase and auto transformers.

CO 2: Acquire the knowledge of three phase transformers, different type of winding connection, parallel operation and testing of transformers.

CO 3: Explain construction and working principle of DC generator and various method of improving commutation.

CO 4: Describe the construction, working principle and characteristics of DC motor.

CO 5: Learn various method of starting and braking of DC motor.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M									
CO2		W	M			M						
CO3				S	M			W				
CO4				S	M			W				
CO5	S		M			M						W

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Transformers** Effect of saturation on exciting current and in-rush current phenomenon. Parallel operation of single phase transformers.	08
	Auto Transformers Principle of operation, equivalent circuit and phasor diagrams, comparison with two winding transformer.	08
	Three-Phase Transformers Different types of winding connections, Voltage and current ratios, Parallel operation of three phase transformers. Three winding transformer's equivalent circuit, off-load and on-load tap changing transformer, Scott connections. Testing of transformers.	08
Unit-2	**D.C. Generator** Working principle , construction of DC Machines, Armature windings, single and double layer winding diagrams, Electro motive force (E.M.F.) and torque equations, armature reaction, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics.	12
	D.C. Motor Working principle characteristics, starting of shunt and series motor, starters, speed control methods: field and armature control. Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.	12

Recommended Books-

1. A.E. Fitzgerald, C. Kingsley.and S.D. Umans, Electric Machinery, 6th Edition, McGraw Hill, 2005
2. E.H. Langsdorff, Principles of D.C. machines, McGraw Hill, 2013
3. I.J. Nagrath and D.P. Kothari, Electrical Machines, 4th Edition, Tata McGraw Hill, 2010
4. M.G. Say, Alternating Current Machines, 5th edition, Sir Isaac Pitman & Sons Ltd, 2005
5. P.S. Bimbhra, Electrical Machinery, 7th edition, Khanna Publishers, 2015

Subject Code : EET-512
Title of the course : Circuit Theory

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Understand the concept of circuit elements, lumped circuits, circuit laws and network reduction.
CO 2: Apply circuit analysis to DC and AC circuits using network theorems/ methods.
CO 3: Analyse the transient and steady-state response of series and parallel A.C. circuits.
CO 4: Acquire the knowledge of coupled circuits and resonance in various RLC networks.
CO 5: Be competent to handle three phase circuits, star-delta connections.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											W
CO2			S									M
CO3		S										
CO4	M					M						
CO5	S					S						S

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basic Circuits Analysis** Circuits Elements, Independent and dependent sources, signals and wave forms; periodic and singularity voltages, step, ramp, impulse, Doublet. Loop currents and loop equations, node voltage and node equations, Network Theorems, Superposition, Thevenin's, Norton's, Maximum Power Transfer, Reciprocity. Concept of one port, two-port networks, characteristics and parameters, Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for DC and AC circuits – Phasor Diagram – Power, Power Factor and Energy	12
	Network Reduction And Network Theorems For DC and AC Circuits Network reduction: voltage and current division, source transformation – star delta conversion. Thevenin's and Norton Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem	12
Unit-2	**Resonance and Coupled Circuits** Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.	12
	Three Phase Circuits Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits	12

Recommended Books: -

1. A. Chakrabarti, Circuit Theory: Analysis and Synthesis, 6th edition, Dhanpat Rai & Co., 2014.
2. D. Roy Choudhary, Networks and Systems, 2nd edition, New Age International, 2013.
3. Donald E. Scott, An Introduction to Circuit analysis: A System Approach, New edition McGraw Hill Inc., 1987.
4. M.E. Van Valkenburg, Network Analysis, 3rd edition, Prentice Hall of India, 2014.
5. M.E. Van Valkenburg, An Introduction to Modern Network Synthesis, New Age International Publishers Ltd., 1984.
6. M L Soni, J C Gupta, Course in Electrical Circuits Analysis, Dhanpat Rai, 1999.
7. William H. Hayt, and Jack E-Kemmerly, Engineering Circuit analysis, 8th edition, McGraw Hill Education, 2013.
8. Mahmood Nahvi and Joseph A. Edminister, Schaum's Outline of Electric Circuits, Sixth Edition, McGraw-Hill Education, 2014.

Subject Code : EET-513
Title of the course : Electrical and Electronics Measurements

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge of the characteristics of measuring instruments and their classification.
CO2: Be conversant in construction, working of measuring instruments and their proficient use.
CO3: Acquire knowledge various methods of electrical parameters measurement.
CO4: Be competent to handle various instruments for the measurement of electrical quantities.
CO5: Demonstrate Cathode Ray Oscilloscope (CRO) and recorders.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M		M				W
CO2	S		S	M		M		M		M		W
CO3	M				M	M						
CO4	M				M	M			M	M		M
CO5	M				M				M	M		M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Elements of generalized measurement system, characteristics of instruments, accuracy, precision, sensitivity, range span.	4
	Basic Indicating Instruments Classification of analog, concept of deflecting, controlling and damping torque, control and damping system, construction and principle of moving iron and moving coil instruments, construction of ammeter and voltmeter and extension of their range and Electro dynamometer instruments, Principles of operation Permanent Magnet Moving Coil (PMMC) ohm meters and their types, Digital voltmeters and multimeters	10
	Measurement of Resistance Potentiometers: Basic principles, types of potentiometers, their functions and applications, Classification of resistance, measurement of low, medium and high resistance, ammeter-voltmeter method, wheat-stone bridge, digital LCR meter for measurement of resistance, insulation tester.	8
	Measurement of Various Electrical Quantities Measurement of current, voltage, power, energy and power factor, phase time and frequency	08
Unit-2	**Bridges** Sources and Detectors, General equation for bridge balance, Measurement of Resistance (R), Inductance (L), Capacitance (C), Mutual Inductance (M), frequency (f) etc. by Wheatstone, Kelvin, Maxwell, Hay's, Anderson, Owen, Heaviside,	10

	Campbell, Schering, Wien bridges. Bridge sensitivity. Errors, Wagner Earthing Device.	
	Magnetic Measurements Flux meter, B-H Curve, Hysteresis loop, Permeameters, AC Testing of Magnetic materials, Separation of iron losses, iron loss measurement by Wattmeter and Bridge methods.	6
	Instrument Transformers Theory and construction of Current Transformer (CT) and Potential Transformer (PT), ratio and phase angle errors and their minimization, Characteristics of CT's. &PT's., Testing of CT's & PT's.	8
	Cathode ray Oscilloscope (CRO) and Recorders Construction and working of cathode ray tube (CRT), Block diagram of CRO, measurement of voltage and frequency with CRO, basic CRO circuit, measurement of voltage, current, phase, frequency, time period. Dual track oscilloscope, specification of a CRO and their significance, front panel controls. Study of various recorders	6

Recommended Books-

1. A.K. Sawhney and Puneet Sawhney, A course in Electrical and electronic measurement and instrumentation, Dhanpat Rai and Co., 2012.
2. J.B Gupta, A Course in Electronic and Electrical Measurements & Instrumentation, S K Kataria and Sons, 1996.
3. Rajendra Prasad, Electronic Measurements and Instrumentation, S. Chand, 1984.

Subject Code : EET-514
Title of the course : Analog Devices and Circuits

L	T	P	Credits	Weekly Load
4	1	0	4.5	5

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Know the types of transistor biasing and analysis of configuration types.
CO 2: Know frequency response of amplifier and bandwidth of amplifier.
CO 3: Be conversant in the concept of feed-back and principle of oscillators.
CO 4: Analyse equivalent model of op-amp and block diagram of power supply.
CO 5: Explain voltage regulators and switched mode power supply.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2				M						M		
CO3			M	S								
CO4			M	M	M							
CO5						M			M	M		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basic Semiconductor Concepts and Devices:** Intrinsic and extrinsic semiconductors, diffusion and drift currents, p-n junction under open-circuit, reverse bias and forward-bias conditions, p-n junction in the breakdown region, Ideal diode, terminal characteristics of junction diode, Load-line analysis of diode circuits, Bipolar junction transistor- physical structure and modes of operation, Transistor as a switch, Transistor Biasing: common base (CB), common emitter (CE) and common collector (CC) Configurations,.	08
	Amplifiers: Bipolar Junction Transistor (BJT) as an amplifier, Frequency response of an amplifier, amplifier bandwidth and Concept of Cascaded Amplifiers. **Feedback And Oscillators:** Concept of feedback, positive and negative feedback, General feedback structure, Effect of positive and negative feedback on amplifier gain and bandwidth, advantages of negative feedback, Basic principles of sinusoidal oscillators, Oscillation criteria, Brief idea about LC and RC oscillators, Crystal Oscillators (No mathematical treatment).	08
Unit-2	**Operational Amplifiers (OP-amp):** Op-amp terminals, ideal Op-amp, equivalent model, Inverting and non-inverting configurations, Application of op-amps as summing amplifier, differentiator and integrator, Practical op-amps (non-ideal performance of op-amps).	08
	Power Supplies: Block diagram of power supply, Half-wave, Full-wave and Bridge rectifiers, passive filers, Regulators, Line regulation and load regulation, Zener diode as voltage regulator, Working of Switched Mode Power Supply (SMPS).	08

Recommended Books-

1. Bhargava and Kulshreshtha, "Basic Electronics and Linear Circuits", 4th Edition, Tata McGraw Hill, 1991.
2. Katre and Goyal, "Electronics Devices and Circuits", 3rd Edition, Techmax, 2014.
3. Boylestad and Nashelsky, "Electronic Devices Circuit Theory", Pearson Education, 2016
4. Jimmie J. Cathey, Schaum's Outline of Electronic Devices and Circuits, Second Edition, McGRAW-HIL
5. Jacob Millman, Christos Halkias and Chetan D Parikh., *Integrated Electronics: Analog And Digital Circuit Systems,* Mcgraw Hill Education , 2011.
6. Albert Malvino and David Bates, Electronic Principles, 7th Edition, Tata McGraw Hill

Subject Code : EET-515
Title of the course : Digital Electronics

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Know the types of number systems and various binary operations.
CO 2: Implement the Boolean algebra, coding-decoding, Multiplexing, de-multiplexing etc.
CO 3: Be conversant in the concept of latch, flip-flops, registers, counters and their types.
CO 4: Analyse VHDL, its truth table etc. and develop sequential circuit using VHDL.
CO 5: Employ A/D, D/A converters, Digital displays, memory and Programmable array.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2				M						M		
CO3			M	S								
CO4			M	M	M							
CO5						M			M	M		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Number System and Codes** Binary number system, octal number system, hexadecimal number system, Binary Coded Decimal (BCD) Code, Gray code, signed & unsigned binary numbers, 1's & 2's complement of a number, Floating point representation, Binary operations- addition, subtraction, multiplication, division, Parity for error detection, Check sum and Hamming Code for error detection and correction.	08
	Combinational Circuits Concept of positive and negative logic, Introduction to Boolean variables, Boolean theorems and De Morgan Theorem, Sum of product and Product of sum form of Logic expressions, Duality, Logical functions using Karnaugh map and Quine-McClusky methods, multiplexers, demultiplexers, encoders, decoders, adders, subtractors, parity generators, parity checkers, code converters.	08
	Sequential Logic Circuits Flip-flops, JK flip-flops, D flip-flops, T flip- flops, SR flip- flops, edge triggered and clocked flip-flops. Registers and Counters: Series and Parallel registers; Synchronous & Asynchronous counters, Up and Down counters, Ring counters & Mod- Counters. Design of Synchronous and asynchronous logic circuits	08

Unit-2	**Introduction to VHDL** Overview of digital design with very-high-speed integrated circuits (VHSIC), VHSIC hardware description language (VHDL), (HDL) format and Syntax, entity, Data representation in VHSIC Hardware Description Language (VHDL), Truth table using VHDL, Decision Control structure and Sequential Circuit using VHDL.	08
	Digital to Analog (D/A) and Analog to Digital (A/D) converters Introduction, weighted register Digital-to-Analog (*D/A)* converter, binary ladder, *D/A* converter, specifications for *D/A* converters, parallel *A/D* converter, successive approximation Analog-to-digital (*A/D)* converter single & dual slope *A/D* converter, *A/D* converter using voltage to frequency conversion, *A/D* converter using voltage to time conversion, countertype *A/D* converters.	08
	Semiconductor Memories Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write memories, content addressable memories, Programmable array Logic, programmable logic arrays and Programmable Logic Device, Field Array Programmable Gate array	08

Recommended Books-

1. Albert Paul Malvino, "Principles of Digital Electronics", 4th Edition, Tata McGraw Hill, 1991.
2. Anand Kumar, "Fundamentals of Digital Circuits", 3rd Edition, Prentice Hall of India, 2014.
3. D.P. Kothari and J.S. Dhillon, Digital Circuits and Design, Pearson Education, 2016
4. Morris Mano, "Digital Logic and Computer Design", 2nd Edition, Prentice Hall of India, 1991.
5. R.P. Jain, Modern digital Electronics, Tata McGraw Hill, 1999.
6. Ronald J. Tocci, Neal S. Widmer and Gregory L. Moss, "Digital Systems: Principles and Applications", 11th Edition, Prentice Hall of India, 2010
7. Thomas S. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education, 2013.

Subject Code : EEP-512
Title of the course : Circuit Theory Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Apply various circuit laws and network reduction techniques.
CO 2: Apply circuit analysis to DC and AC circuits using network theorems/ methods.
CO 3: Analyse the transient and steady-state response of series and parallel AC circuits.
CO 4: Acquire the knowledge of coupled circuits and resonance in various RLC networks.
CO 5: Be competent to handle three phase circuits, star-delta connections.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											W
CO2			S									M
CO3		S										
CO4	M					M						
CO5	S					S						S

To understand the practicability of **Circuit Theory**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. **Ohm's Law and Applications**: Ohm's law and its applications are investigated in this experiment. The V-I characteristic of linear resistors is derived. Applications of Ohm's law include voltage and current division. Measurements of the equivalent resistance of a resistive arrangement are performed.
2. **Analysis of Networks**: The purpose of this experiment is to introduce students to the nodal voltage and mesh current methods for solving circuits.
3. **Network theorems**: This experiment verifies some important network theorems: the Thévenin equivalent of a circuit, the maximum power transfer theorem, and the source superposition.
4. **First Order R-L and R-C Circuits**: The objective of this experiment is to observe the response of the first order R-C and R-L circuits. The experiment demonstrates a method for measuring the time constant.
5. **Second order RLC circuits**: This experiment demonstrates the response of a series and a parallel RLC circuit. The over-damped, critically damped and under-damped responses are derived for each circuit.
6. **Sinusoidal steady state**: This experiment demonstrates the properties of ac networks. The concept of impedance is discussed. Phasors are demonstrated through oscillograms.

Subject Code : EEP-513
Title of the course : Electrical and Electronics Measurement Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge of the characteristics of measuring instruments and their classification.
CO2: Be conversant in construction, working of measuring instruments and their proficient use.
CO3: Acquire knowledge various methods of electrical parameters measurement.
CO4: Be competent to handle various instruments for the measurement of electrical quantities.
CO5: Demonstrate Cathode Ray Oscilloscope (CRO) and recorders.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M		M				W
CO2	S		S	M		M		M		M		W
CO3	M				M	M						
CO4	M				M	M			M	M		M
CO5	M				M				M	M		M

To understand the practicability of **Electrical and Electronics Measurement**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To understand the principle of operation of various types of electromechanical measuring instruments.
2. a) To measure high value of DC current by a Low Range DC Ammeter and Shunt.
   b) To measure high value of DC voltage by a Low Range DC Voltmeter and Multiplier
3. a) To measure high value of AC Current by a Low Range AC Ammeter and Current Transformer.
   b) To measure high value of AC Voltage by Low Range Voltmeter
4. Measurement of resistance using Wheatstone Bridge.
5. To measure active and reactive power in 3 phase balanced load by one wattmeter method.
6. To measure the active power in three phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading.
7. To calibrate and use the Induction Energy Meter.
8. Measurement of resistance using Kelvin's Bridge.
9. Measurement of self-inductance using Anderson's Bridge.
10. Measurement of capacitance using Schering Bridge.
11. Plotting of Hysteresis loop for a magnetic material using flux meter.
12. Measurement of frequency using Wein's Bridge.
13. To analyze the working of Current and potential transformers and to find out ratio error.
14. Determination of frequency and phase angle using CRO.
15. Measurement of unknown voltage using potentiometer.
16. To find 'Q' of an inductance coil and verify its value using Q- meter.
17. Calibration of ac voltmeter and ac ammeter.
18. Measurement of form factor of a rectified sine wave and determine source of error if r.m.s.value is measured by a multi-meter.

Subject Code : EEP-511
Title of the course : Electrical Workshop

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Identify and utilize various electrical and electronic components.
CO 2: Draw basic electrical circuit drawings and perform calculations.
CO 3: Describe and construct practical lighting circuits in the electrical workshop.
CO 4: Perform basic maintenance and troubleshooting of house hold equipment, energy saving etc.
CO 5: Dismantle service and reassemble various household electrical appliances.
CO 6: Utilize single and three phase motors.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2		S										W
CO3						S				S	M	
CO4			S			M					W	
CO5	S					S			S		M	
CO6	S							S				M

To understand the practicability of **Electrical Workshop**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Demonstration and identification of common electrical materials such as wires, cables, switches, fuses, ceiling roses, battens, cleats and allied items, tools and accessories.
2. Study of electrical safety measures and demonstration about use of protective devices.
3. Identification of phase, neutral and earth of domestic appliances and their connection to two pin/three pin, plugs.
4. Lay out of complete wiring of a house (i) batten wiring (ii) plastic casing and capping.
5. Understanding the basic construction and circuit diagrams of common electrical appliances such as electric iron, electric kettle, ceiling fan/ table fan, electric mixer, electric Geyser, desert cooler etc.
6. Testing and rectification of simulated faults in above said electrical appliances.
7. Introduction to a Lead-acid battery and its working.
8. Installation of a battery and to connect it in series and parallel
9. Charging a battery and testing it with the help of hydrometer and cell tester.
10. Importance of three-phase wiring and its effectiveness.
11. Job I Laying out 3 phase wiring for an electric motor or any other 3 phase machine.
12. Estimating and costing of power consumption.
13. Connecting single-phase energy meter and testing it. Reading and working out the power consumption and the cost of energy.
14. Checking continuity of connection (with tester and lamp) location of faults with a multimeter) and their rectification in simple machines and/or other electric circuits fitted with earthing.
15. Demonstration of dismantling, servicing and reassembling a table fan/ceiling fan/air cooler/mixer/electric iron, Electric heater, geyser, electric oven, air conditioner etc.

16. Dismantling, servicing serving and reassembling of any of the above electrical appliances.
17. Testing Single phase/three phase electrical motor by using voltmeters, ammeter, clip on meter, tachometer etc.
18. Reversing the rotation of a motor.

Recommended Books-

1. D K Sharma, Basic Electrical & Electronics Engineering, CBS publisher
2. H Partab, Electrical Gadgets,
3. R P Singh, Electrical Workshop: A text Book, I K International Publisher House Pvt. Ltd

Subject Code : EEP-517
Title of the course : Analog and Digital Electronics Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO 1: Know the types of number systems and various binary operations.
CO 2: Implement the Boolean algebra, coding-decoding, Multiplexing, de-multiplexing etc.
CO 3: Be conversant in the concept of latch, flip-flops, registers, counters and their types.
CO 4: Analyse VHDL, its truth table etc. and develop sequential circuit using VHDL.
CO 5: Employ A/D, D/A converters, Digital displays, memory and Programmable array.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2				M						M		
CO3			M	S								
CO4			M	M	M							
CO5						M			M	M		

To understand the practicability of **Analog and Digital Electronics**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Verification of the truth tables of TTL gates.
2. Verify the NAND and NOR gates as universal logic gates.
3. Design and verification of the truth tables of Half and Full adder circuits.
4. Design and verification of the truth tables of Half and Full subtractor circuits.
5. Verification of the truth table of the Multiplexer 74150.
6. Verification of the truth table of the De-Multiplexer 74154.
7. Design and test of an S-R flip-flop using NOR/NAND gates.
8. Verify the truth table of a J-K flip-flop (7476)
9. Verify the truth table of a D flip-flop (7474)
10. Operate the counters 7490, 7493.
11. Design of 4 bit shift register (shift right).
12. Design of modulo-4 counter using J K flip flop.

Subject Code : EET-521
Title of the course : Network Analysis and Synthesis

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Analyze waveforms, signals, signal superposition and Fourier transform.
CO 2: Apply Laplace transforms for analyzing the networks in time and frequency domain.
CO 3: Learn the characteristics of Attenuators and various types of Filters.
CO 4: Understand the fundamental concepts of network analysis and synthesis of two-port passive networks.
CO 5: To synthesize an electrical network from a given impedance/admittance function.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S									M		
CO2			S									
CO3	S											
CO4		S	M									
CO5			S									W

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Representation of continuous and discrete time signals, shifting and scaling operations, linear, time-invariant and causal system, Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Z-Transform	12 Hrs
	Time and Frequency Domain Analysis Representation of basic circuits in terms of generalized freq. & their response, Laplace transform its properties and applications, Laplace transform of shifted functions, transient & steady response, Time domain behaviors from poles and zeros, Convolution Theorem.	12 Hrs
Unit-2	**Filters Synthesis** Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T section, IT section, terminating half section. Pass bands and stop bands. Design of constant-K, m-derived filters.	12 Hrs
	Network Synthesis Composite filters, Network functions, Impedance & Admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros. Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for Two-terminal network, Foster and Cauer forms.	12 Hrs

Recommended Books: -

1. Behrouz Peikari, Fundamentals of Network Analysis & Synthesis, Jaico Publishing House, 2006.
2. Gabor C. Temes, Jack W. LaPatra, Introduction to Circuit Synthesis and Design (Networks and Systems), 1st edition, McGraw Hill Book, 1977.
3. L. Weinberg, Network Analysis and Synthesis (Electrical & Electronic Engineering), McGraw-Hill Inc., 1962.
4. Van Valkenberg , Modern Network Synthesis, New Age International Publishers, 1984.
5. Vasudev K. Aatre, Network Theory and Filter design, 2nd edition, New Age International Publishers

Subject Code : EET-522
Title of the course : Asynchronous Machines

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Interpret the basics of Induction machine, rotating field, torque etc.
CO 2: Know the construction, operation and characteristics of poly-phase induction machine.
CO 3: Implement the starting methods, speed control techniques for induction motor.
CO 4: Analyse the operation, use and characteristics of induction generator.
CO 5: Employ design and operation of Linear Induction Machines, various single phase motors.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											W
CO2		S	M									
CO3		M	S			M						
CO4	S											
CO5			S			S						W

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basic Concepts** Field distribution of space distributed three-phase winding, concept of rotating field, production and concept of asynchronous and synchronous torques, analogy between induction motor and transformer.	06
	Poly-phase Induction Machines Constructional features, concept of slip, operation, rotor frequency, current and power, equivalent circuit, phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, starting torque, crawling and cogging, cage motors(double cage and deep bar motor.	08
	Starting Methods : Various methods of starting	04
	Speed Control Speed control: (i) control of speed of rotating field, (ii) control of slip speed, Effect of voltage injection in rotor circuit of slip ring induction motor, Motor tests for estimation of equivalent circuit parameters.	06
Unit-2	**Induction Generator** Isolated and Grid mode operation, method of excitation, performance characteristics of three-phase self-excited induction generator.	08
	Linear Induction Machines Construction, principle of operation and applications.	08

	Single-phase Motors Double revolving field theory, types of single phase motors, characteristics and equivalent circuit. Shaded pole motor: working principle, characteristics, applications.	08

Recommended Books-

1. A.E. Fitzgerald, C. Kingsley and S.D. Umans, 6th Edition, Electric Machinery, Tata McGraw Hill, 2002.
2. E.H. Langsdorff, Principles of A.C. Machines, Tata McGraw Hill, 2004.
3. I.J. Nagrath and D.P. Kothari D.P, Electric Machines, 4th Edition, Tata McGraw Hill, 2010.
4. M.G. Say, Alternating Current Machines, 5th Edition, Sir Isaac pitman & Sons Ltd, 1983
5. P.S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers, 2011.

Subject Code : EET-523
Title of the course : Electrical Power Transmission and Distribution

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Acquire the knowledge of generation, transmission and distribution of electric power.
CO 2: Analyse the performance of various types of conductors used in overhead transmission lines
CO 3: Learn about types of overhead line insulators and methods used for improving string efficiency.
CO 4: Describe mechanical design of transmission lines and the concept of corona loss and its effects.
CO 5: Analyse tariff and load curve, classification of indoor and outdoor substation and selection of site.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S		M					M				
CO3			M	M								
CO4	S		M	W				M				
CO5				M	M	S						M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Generation of Electric Power- Brief description of Thermal, hydro nuclear and gas power plants & other non-conventional power plants. Transmission and Distribution Systems- DC 2 –wire and 3 – wire systems, AC single phase, three phase and 4-wire systems, comparison of copper efficiency. Distribution Systems: primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at one and both ends, ring distribution, submains and tapered mains, voltage drop and power loss calculations, voltage regulators	06
	Overhead Transmission Lines Types of Conductors, Line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent circuits of short, medium & long lines. Line Performance: regulation and efficiency of short, medium and long lines, Series and shunt compensation, Introduction to FACTS	08
	Overhead Line Insulators Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance	06
	Mechanical Design of Transmission Lines Different types of tower, sag-tension calculations, sag-template, string charts, vibrations & damaging Corona-corona losses, radio & audio noise, transmission line – communication line interference	08
Unit-2	**Tariffs & Load Curves** Definition & different tariffs for domestic, commercial, industrial application,	10

	Different Load and Load duration curves. Curves their significance, load factor, diversity factor	
	Introduction to Substations Introduction, Classification of indoor & outdoor sub-stations, Advantages & Disadvantages, Selection & location of site, Study of various substation components	10

Recommended Books-

1. C.L. Wadhwa, "Electric Power Systems", Second Edition, Wiley Eastern Limited, 1985.
2. Edwin L. Harder, "Fundamentals of Energy Production", John Wiley and Sons, 1982.
3. I.J. Nagrath and D.P. Kothari, "Power System Engineering", Tata McGraw Hill, 1995.
4. James J. Burke, "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekker 1996.
5. John J. Grainger and William D. Stevenson, JR., "Power System Analysis", McGraw Hill, 1994.
6. M.V. Deshpande, "Elements of Electric Power Station Design", A.H. Wheeler and Co. Allahabad, 1979.

Subject Code : EET-524
Title of the course : Signals and Systems

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Interpret signals, convolution and learn various properties.
CO 2: Understand noise, interference and their reduction methods.
CO 3: Be conversant in Fourier Series, Fourier Transform along with their basic properties
CO 4: Analyze sampling, restructuring, sampling theorem, aliasing, digital signal processing.
CO 5: Study Laplace and Z-transform, their basic properties, region of convergence, inverse Laplace and Z-transform, rational system functions.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S		S									
CO3		S		M								W
CO4	S			M						M		
CO5	S	M		M								

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction:** Introduction to Signals and Systems, System Properties, Convolution of Signals, Linear Shift Invariant Systems and their Properties, Correlation, effects of noise and interference on the measurement system, noise sources and coupling mechanism , method of reducing effects, reliability , choice and economics of the measurement system.	12
	Inroduction to transforms: Introduction to Transforms, Fourier Series and Fourier Transform, Convergence of Fourier Transform, Properties of Fourier Transform.	12
Unit-2	**Sampling and reconstruction of the signal:** Sampling Theorem, Sampling/Reconstruction of Signals, Realistic Sampling, Aliasing, Introduction to Digital Signal Processing, Advantages and disadvantages of digital signal processing over analog signal processing	12
	Laplace and Z-transforms: Introduction to Laplace Transform and Z-Transform, Region of Convergence, Properties of Laplace and Z Transform, Inverse Laplace and Z Transforms, Rational System Functions.	12

Recommended Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, *Signals and Systems*, Pearson Education,2007.
2. Edward W Kamen & Bonnie's Heck, *Fundamentals of Signals and Systems*, Pearson Education, 2007.

Subject Code : EET-525
Title of the course : Microprocessor and Application

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO 1: Acquire knowledge of history & basics of Microprocessor, their 8, 16, 32 & 64 bit architecture.

CO 2: Employ 8085 microprocessor, its internal architecture, timing diagrams & interrupts.

CO 3: Analyse 8086 microprocessor, its internal architecture, instruction format, addressing modes and program development tools.

CO 4: Develop programs for 8086 microprocessor with conditional jump, timing and delay loops etc.

CO 5: Learn basics of 8086 system connections, its interfacing, and 8259 interrupt controller, 8254 timer/counter, A/D and D /A converter application.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M								
CO2			M						W			
CO3			M	M								
CO4	M	M										W
CO5	S			M		M		W				

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction to Microprocessors** Types of computers, Microprocessor Evolution and types, Central Processing Unit (CPU) operation and terminology, idea of 8- bit, 16-bit, 32-bit and 64- bit Microprocessors from Intel, Motorola and Zilog and their comparisons.	08
	Introduction to 8-bit Microprocessor 8085 Microprocessor architecture, Instruction format, Addressing Techniques, classification of instructions, and overview of the 8085 instruction set. Simple programs.	08
	Introduction to 16-bit Microprocessor 8086 Internal Architecture, Instruction Format, Addressing modes, program development steps, and 8086 instruction set, Assembler directives, Assembly language, program development tools.	08
Unit-2	**Programming of 8086** Simple sequence programs, jumps, flags, conditional Jumps, IF THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.	08
	8086 System Connections, Timing, Troubleshooting Pin-diagram, max/min. modes, timing diagrams, use of logic analyzer to observe Bus Signals, troubleshooting a simple 8086 based system**,** 8086 Interrupts, responses & applications.	08
	Interfacing of 8086	08

	Memory Interfacing, Programmable parallel ports & handshake, 8254 software-programmable timer/counter, 8259 A priorities Interrupt Controller, Interfacing a Microprocessor to Keyboards and alphanumeric displays, Digital to Analog (D/A) converter operation, interfacing and applications, Analog to Digital (*A/D)* converter specifications	

Recommended Books-

1. Brey, Barry B. Bray, The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing, 8th Edition, Prentice Hall (India), 2008.
2. Hall, Douglas V., Microprocessors and interfacing: Programming and Hardware, 2nd Edition, Tata McGraw Hill, 2007.
3. Gaonkar, Ramesh S., Microprocessor Architecture, Programming and Applications with the 8085, 5th Edition, Penram International, 2011.
4. Ram B., Fundamentals of Microprocessors and Microcomputers, 8th Edition, Dhanpat Rai & Sons, 2012.
5. Ray A.K. and Bhurchandi K.M., Advanced Microprocessors and Peripherals, 2nd Edition, Tata McGraw Hill, 2006.

Subject Code : EEP-525
Title of the course : Microprocessor Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Develop and Run assembly language programmes on microprocessor kits.
CO 2: Be competent in interfacing a Microprocessor to Keyboards and alphanumeric displays
CO 3: Develop programs for 8086 microprocessor with conditional jump, timing and delay loops etc.
CO 4: Interface 8253 programmable interval timer and DAC with 8085 microprocessor.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M								
CO2			M						W			
CO3	M	M										W
CO4	S			M		M		W				

To understand the practicability of **Microprocessor**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
3. To perform multiplication and division of two 8 bit numbers using 8085.
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program to arrange an array of data in ascending and descending order.
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
7. To write a program to initiate 8251 and to check the transmission and reception of character.
8. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
9. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular wave.
10. Serial communication between two 8085 through RS-232 C port.

Subject Code : EEP-526
Title of the course : Electrical Machines Lab-1

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO 1: Understand construction and working principle of single phase and auto transformers.

CO 2: Acquire the knowledge of three phase transformers, different type of winding connection, parallel operation and testing of transformers.

CO 3: Explain construction and working principle of DC generator and various method of improving commutation.

CO 4: Describe the construction, working principle and characteristics of DC motor.

CO 5: Learn various method of starting and braking of DC motor.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M									
CO2		W	M			M						
CO3				S	M			W				
CO4				S	M			W				
CO5	S		M			M						W

To understand the practicability of **Electrical Machine-I**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To start the DC and AC motors with various types of starters.
2. To perform speed control of a DC motor using field control and armature control method.
3. To draw the open circuit characteristics (OCC) of a DC shunt generator.
4. To draw the Load characteristic of a DC shunt generator.
5. To perform Load test on a single phase transformer.
6. To perform Open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit, voltage regulation and efficiency.
7. To perform parallel operation of two single phase transformers.
8. To study the various connections of three phase transformer.
9. To perform Scott connections on three phase transformer to get two phase supply.
10. To study the constructional details of direct current (DC) machine and to draw sketches of different components.
11. To measure armature and field resistance of direct current (DC) shunt generator and to obtain its open circuit characteristics.
12. To perform Swinburne's test (no load test) to determine losses of direct current (DC) shunt motor
13. To perform load-test on 3 ph. Induction motor & to plot torque versus speed characteristics.
14. To perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent circuit. Parameters and to draw circle diagram.
15. To start a 3 phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit. and to plot torque –speed characteristics.

Subject Code : EET-611
Title of the course : Synchronous and Special Electric Machines

L	T	P	Credits	Weekly Load
3	1	0	4	3.5

Course Outcomes:

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

CO1: Simulate the steady-state and transient state performance of synchronous machines to identify performance measures

CO2: Validate and identify the machine parameters.

CO3: Select the appropriate AC motor for different large power application.

CO4: Analyze the stability of single machine – infinite bus system and form the grid to supply large load.

CO5: Choose the appropriate fractional horse power motor as per the usage in daily life.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M		M	S							M
CO2		S		S								W
CO3	S			M								
CO4	S	S										M
CO5	S											M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**General Aspects** Construction & working principle of synchronous machines, Excitation systems, production of sinusoidal Electro motive force(EMF), flux &Magneto motive force phasors in syn. machines; cylindrical & salient pole rotors.	06
	Windings Classification of windings, pitch factor, distribution factor. EMF equation.	04
	Alternators Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open circuit characteristics, short circuit characteristics, short circuit ratio, short circuit. Effect of variation of power factor on voltage. Determination of voltage regulation: EMF method, Magneto motive force(MMF) method. Zero power factor (ZPF) method, Alternator on infinite bus bar, operating characteristics, operation at constant load and variable excitation, power flow through inductive impedance, Power-angle characteristics of syn. machines:- cylindrical & salient pole. Two reaction theory of salient pole machines, power factor control.	12
	Parallel Operation of Alternators Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing, Hunting and damper windings.	10

Unit-2	**Synchronous Motors** Operating characteristics, power-angle characteristics, conditions for maximum power developed, V-curves and inverted V-curves, methods of starting, synchronous motors applications, and synchronous condensers.	10
	Transients Transients Analysis, transient reactances & time constants from equivalent circuits, synchronous machine reactances & their determination, Short circuit. Oscillogram, Synchronisation with the grid system, Qualitative introduction to the transient stability of the synchronous machines.	10
	Single-phase Synchronous Motors Reluctance & Hysteresis motors	06
	Special Purpose Machines Construction, principle of operation and applications of stepper motors and Servo motors, Universal Motor: construction, principle of operation and applications.	06

Recommended Books-

1. A.E. Fitzgerald., C. Kingsley and S.D. Umans, Electric Machinery ,6th Edition, Tata McGraw-Hill, 2005
2. E.H. Langsdorff ,Principles of A.C. Machines , Tata McGraw-Hill
3. I.J. Nagrath. and D.P. Kothari, Electrical Machines, 4th edition,Tata McGraw-Hill Education Pvt. Ltd., 2010
4. P.S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers,2011
5. M. G. Say, Alternating Current Machines, Sir Isaac pitman & Sons Ltd.,1958

Subject Code : EET-612
Title of the course : Linear Control System

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO1: Acquire the basic knowledge of control engineering and its scope.

CO2: Analyze the mathematical model of a system and determine the response of different order systems.

CO3: Solve the steady state and transient analysis of a system.

CO4: Analyze the stability analysis of a system.

CO5: Be competent to analyze closed loop control design problems

CO6: Design compensating networks.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						M
CO2		S	M									
CO3			S									
CO4				S								
CO5			S									
CO6			S						M			

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introductory Concepts** Plant, Systems, Servomechanism, regulating systems, Disturbances, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Block diagrams, some illustrative examples.	08
	Modelling Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical, mechanical analogies. Use of Laplace transforms, Transfer function, concepts of state variable modelling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.	08
	Time Domain Analysis Typical test – input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion.	08
Unit-2	**Root Locus Technique** The extreme points of the root loci for positive gain. Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot loop transfer function. Frequency response specifications, Relative stability, Relation between time and frequency response for second order systems. Log. Magnitude versus Phase angle plot, Polar Plot, Nyquist	08

	criterion for stability, Bode Plot.	
	Compensation: Necessity of compensation, series and parallel compensation, compensating networks, applications of lag and lead-compensation.	08
	Control Components Error detectors – potentiometers and synchros, servo motors, A.C and D.C techno generators, Magnetic amplifiers.	08

Recommended Books-

1. Benjamin C. Kuo, Automatic Control System, 8th edition, John Wiley & Sons, 2002.
2. I. J. Nagrath and M. Gopal, Control System Engineering, New Age, 2009.
3. K. Ogata, Modern Control Engineering, 5th edition, Prentice Hall (PHI), 2010.
4. Richard C. Dorf and Robert H. Bishop, Modern Control System, 12th edition, Addison –Wesley, Pearson, New Delhi, 2011.

Subject Code : EET-613
Title of the course : Industrial Electronics and Drives

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Explain the need and role of power electronic switches, their properties and characteristics.
CO 2: Analysis and design of AC-DC converters, AC-AC converters and DC-DC converters.
CO 3: Study of sinusoidal analysis of resonant converters and its applications.
CO 4: Analysis and design of inverters which consist of half and full bridge, single and three phase etc.
CO 5: Know topologies for harmonic reduction or true sine wave inverters.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S			M						M
CO2			S									
CO3		S									M	
CO4		S				W						
CO5				S	M							

Theory:

Unit	Main Topics and Course outlines	Hour(s)
Unit-1	**Basics Concepts** Need of switching and role of power electronic switches, properties and characteristics of various power Electronic switches i.e. power Diode, Thyristor, Gate Turn Off (GTO), Power transistor, Power Metal Oxide Semiconductor Field Effect Transistor (MOSFET), Insulated Gate Bipolar Transistor (IGBT), Metal Oxide Semiconductor (MOS) controlled Thyristor, Static Induction Devices, their firing and protection circuits, selection criteria of these switches for various applications, Basic concept of Phase control, Power quality indices.	09
	AC-DC Converters Analysis and design of Converters : Un-controlled and controlled, Half wave and Full wave, Half controlled and full controlled, Single Phase and three phase, with R, RL and RLC Load, with and without Freewheeling Diode, Effect of Source Impedance on Converters, Dual converters.	09
	AC-AC Converters Analysis and design of AC controllers: single phase and three phase; Cyclo-converters: Single phase and three phase, Matrix converters.	06
Unit-2	**DC-DC Converters** Analysis and design of DC-DC converters i.e. Buck, Boost, Buck-Boost; Isolated and non-isolated; push-pull, half bridge, full bridge, Flyback, Cuk, Single Ended Primary Inductor Converter (SEPIC) Zeta and Luo, in continuous conduction and discontinuous conduction modes of operation, review of choppers.	09
	Resonant Converters Converter Classification, Sinusoidal analysis of resonant converters, series and parallel	06

	resonant converters, soft switching, Zero Voltage Switching/Zero Current Switching (ZVS/ZCS) concepts and applications, quasi-resonant converters, topologies operation and control.	
	DC-AC Converters (Inverters) Analysis and design of Inverters: Voltage source and current source, single phase and three phase, Half Bridge and Full Bridge; Line Commutated & Forced Commutated; Series and Parallel; for square wave and Pulse Width Modulation (PWM) controlled outputs, Topologies for Harmonic Reduction or true sine wave Inverters	09

Recommended Books:

1. B K Bose, Modern Power Electronics and AC drives, 1st edition, PHI, 2001
2. M H Rashid, Power Electronics Handbook, Academic Press, 2001
3. Ned Mohan, Undeland & Robbins, Power Electronics: Converters, Applications and Design, 3rd edition, John Wiley and Sons, 2002
4. Nihal Kularatna, Power Electronics design handbook, 1st edition, Newnes Publishers, 1998
5. R. W. Erickson, Fundamentals of Power Electronics, 2nd edition, Kluwer Academic Publishers, 2000.

Subject Code : EET-614
Title of the course : Power System Protection

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Understand the principle of protective schemes and various faults in the Power System Scenario.

CO 2: Acquire the knowledge about various designs of circuit breakers on the basis of arc quenching phenomena.

CO 3: Be competent in use of static and digital relays.

CO 4: Examine the protection of feeders, alternators and other power system components with various protective relays.

CO 5: Know about various types of grounding systems and methods of protection against over voltages.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2			S		M							M
CO3	M				S				W			
CO4	S		S							M		S
CO5	S					W						M

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Types of faults, short circuit current, percentage reactance and base KVA, per unit quantities, method for short circuit calculations, symmetrical components, sequence impedances,	5
	Circuit Breakers Theory of arc interruption, circuit breaker, circuit breaker ratings, restriking voltage, transients, current chopping, duties of switch gear, automatic switch, air circuit breaker, bulk oil CB, minimum oil CB, air blast CB, SF6 CB, vacuum and DC circuit breakers.	5
	Protective Relays Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay, Negative sequence relay, introduction to static and up-based relays.	6
	Protection Of Feeders Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.	5
Unit-2	**Protection Of Generators** Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection.	6
	Protection Of Transformers	5

	Types of fault on transformers, percentage differential protection, restricted earth fault protection Gas relays	
	Protection Against Over Voltage And Earthing Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.	5
	Static & Digital Relays Classification of static relays, amplitude and phase comparators, block-spike and block-average comparators, rectifier type relays, Introduction to digital relay: basic principles, Application of microprocessors and computers	5

Recommended Books-

1. A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatanagar, A Textbook on Power System Engineering, Dhanpat Rai & Co., 2013.
2. Badri Ram and D.N. Vishwakarma, Power system Protection & Switchgear, Tata McGraw Hill. 2001.
3. C.L. Wadhawa, A Course in Electrical Power, 6th Edition, New Age international Pvt. Ltd, 2010.
4. M.V. Deshpande, Switchgears & Protection, Tata McGraw Hill, 1993.
5. Sunil S. Rao, Switchgear Protection and Power Systems, 13th Edition, Khanna Publishers.

Subject Code : EET-615
Title of the course : Generation and Control of Electric Power

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Understand the economics of power system operation with thermal and hydro units.
CO 2: Apply various methods of solution to solve the problem of economic dispatch with various constraints.
CO 3: Analyse the hydroelectric plant models and their scheduling problems.
CO 4: Realize the requirements and methods of real and reactive power control in power system.
CO 5: Practice the control of generator units, like frequency control or voltage control and various controllers.
CO 6: Be competent to handle the power system security issues and contingency analysis.
CO 7: Employ the concept of optimal power flow in A/C and D/C systems.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S						S				M	S
CO2			S		M	S				M	S	
CO3		S				M					M	S
CO4		S	M									
CO5	S			W	M							
CO6	S	S				M						M
CO7		S			M							M

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction to Power Generation Units:** Characteristics and its variations,	08
	Economic Operation of Power Systems Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, minimum and maximum power generation limits.	08
	Economic Dispatch Economic dispatch problem with and without transmission line losses, Unit Commitment, their solution methods. Environmental aspects in Economic dispatch.	08
	Hydrothermal Co-ordination Hydro- Scheduling, Plant models, scheduling problems, Hydrothermal scheduling problems and its approach.	08
Unit-2	**Power System Control** Power system control factors, interconnected operation, tie-line operations, Reactive power requirements, during peak and off peak hours, Elementary ideas of load frequency and voltage, reactive power control; , block diagrams of P-f and Q-V controllers, automatic load frequency control (ALFC), Static and Dynamic performance characteristics of ALFC and automatic voltage regulator (AVR) controllers, Excitation systems.	12

	Power System Security Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming.	10
	Power flow analysis in AC/DC systems General, modelling of DC links, solution of DC load flow, discussion, per unit system for DC quantities, solution techniques of AC-DC power flow equations.	10

Recommended Books-

1. A.J. Wood and B. Wollenberg, Power Generation, Operation and Control, 2nd Edition, John Wiley, NY, 1996.
2. Hadi Saadat, Power System Analysis, 2nd Edition, Tata McGraw Hill Edition, 2002.
3. I.J. Nagrath and D.P. Kothari, Power System Engineering, 2nd Edition, Tata McGraw Hill, 2007.
4. J. Arrilaga and B.C. Smith, AC-DC Power System Analysis, Press, London,1998.
5. J.S. Dhillon & D.P. Kothari , Power System Optimisation, 2nd Edition., PHI, 2010.
6. O.L. Elgerd, Electric Energy Systems Theory: An Introduction, 2nd Edition, Tata McGraw Hill, 1983.
7. P. Kundur, Power System Stability & Control, Third Reprint, Tata McGraw Hill, 2007.
8. P.S.R. Murthy, Power System Operation and Control, Tata McGraw Hill, 1984.
9. W.D. Stevenson, JR. and John J. Grainger, Power System Analysis, McGraw Hill, 2007.

Subject Code : EET-616
Title of the course : High Voltage Engineering

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Know the necessity of EHV AC Transmission, its power handling capacity and major problems.
CO 2: Learn modern trends in HVDC Transmission and its application.
CO 3: Acquire the knowledge about various types of insulation systems and their breakdown phenomenon.
CO 4: Understand the design and operation of high-voltage testing equipment including AC, DC and impulse generators.
CO 5: Analyse the design of equipment used for high voltages and the testing methods using such equipment.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M		W						M
CO2			M		S	M						
CO3	S											W
CO4			S					M				
CO5			S		M							S

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Extra High Voltage (EHV) Transmission and Corona Loss** Need for EHV Transmission. Use of bundled conductors, corona characteristics of smooth bundled conductors with different configurations, Corona loss. Factors affecting the corona loss, Radio interference due to corona. Shunt and series compensation in EHV lines. Tuned power lines. Insulation Co-ordination.	08
	HVDC Transmission Advantages, disadvantages and economics of HVDC Transmission system. Types of D.C. links, converter station equipment, their characteristics.	08
	Insulating materials used in High Voltage Engineering Applications of insulating materials used in power transformers rotating machines, circuit breakers, cables, power capacitors.	08
	Conduction and breakdown in Gases, Liquids & Solid Dielectrics Solids - Intrinsic, electromechanical and thermal breakdown composite dielectrics, solid dielectrics used in practice. Liquids: - Conduction and breakdown in pure and commercial liquids, suspended particle theory, cavitation and bubble theory, stressed oil volume theory, Liquids used in practice. Gases: - Ionization process, Townsend's current growth equations, Ist and 2nd ionization coefficients. Townsend's criterion for breakdown. Streamer theory of breakdown, Pashen's law of Gases, Gases used in practice.	08

Unit-2	**Generation of High Voltages** D.C., A.C. (Power frequency and High frequency) Impulse voltage and impulse current Generation Tripping and contact of Impulse Generator.	12
	Test procedures in High Voltage Engineering Laboratory Testing of cables, insulators, bushings, circuit breakers and transformers.	12

Recommended Books-

1. C. L. Wadhwa, High Voltage Engineering, 3rd Edition, New Age International, 2007
2. Edward Wilson Kimbark, HVDC Transmission, Wiley-Interscience
3. E. Kuffel and M. Abdullah, High Voltage Engineering, Pergamon Press, 1970
4. Rakesh Das Bagamudre, Extra High Voltage AC Transmission Engineering, New Age International Publishers.
5. R.S. Jha, High Voltage Engineering, Dhanpat Rai
6. V. Kamaraju and M.S. Naidu, High Voltage Engineering, Tata McGraw-Hill Education

Subject Code : EEP-613
Title of the course : Industrial Electronics and Drives Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO 1: Analyse the characteristics of Diode, Diac, Triac and Thyristor

CO 2: Analyse the design and working of AC-DC converters, AC-AC converters and DC-DC converters.

CO 3: Learn the applications of resonant convertors and its sinusoidal analysis

CO 4: Analyse the design and working of inverters which consist of half and full bridge, single and three phase etc.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		S			M						M
CO2			S									
CO3		S									M	
CO4		S				W						

To understand the practicability of **Industrial Electronics and Drives**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To plot and comment on V-I Characteristics of Diode and Diac.
2. To plot and comment on V-I Characteristics of Thyristor and Triac.
3. To turn on Thyristor with various methods.
4. To use various commutation techniques and protection circuits of Thyristor.
5. To observe and comment on the waveforms of a single phase Full Wave Thyristor converter with R, RL and RLC load. Also comment on the operation with and without freewheeling diode.
6. To observe and comment on the waveforms of a single phase half controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without freewheeling diode.
7. To observe and comment on the waveforms of a single phase full controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without freewheeling diode.
8. To observe and comment on the waveforms of a three phase half controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without freewheeling diode.
9. To observe and comment on the waveforms of a three phase full controlled Thyristor Bridge converter with R, RL and RLC load. Also comment on the operation with and without freewheeling diode.
10. To observe and comment on the waveforms of a single phase Bridge inverter with PWM controlled output. Also comment on its operation for true sine wave output.
11. To observe and comment on the waveforms of non-isolated DC-DC converter in buck/boost mode under CCM and DCM operation.
12. To observe and comment on the waveforms of an isolated DC-DC converter in buck/boost mode under CCM and DCM operation.
13. To observe and comment on the waveforms of resonant converters in ZVS/ZCS mode.

Subject Code : EEP-611
Title of the course : Electrical Machines Lab-II

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO1: Simulate the steady-state and transient state performance of synchronous machines to identify performance measures

CO2: Validate and identify the machine parameters.

CO3: Select the appropriate AC motor for different large power application.

CO4: Analyze the stability of single machine – infinite bus system and form the grid to supply large load.

CO5: Choose the appropriate fractional horse power motor as per the usage in daily life.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M		M	S							M
CO2		S		S								W
CO3	S			M								
CO4	S	S										M
CO5	S											M

To understand the practicability of **Electrical Machines-II**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. Regulation of alternator by EMF/ MMF methods
2. Operation of alternator on infinite busbar
3. V-curve for synchronous motor
4. Load test on three phase and single-phase induction motor
5. No load and blocked rotor tests on three phase induction motors
6. Speed control of three-phase induction motors
7. Load test on synchronous induction motor
8. Load test on three phase induction generators
9. Study and control of stepper motor
10. Study on brushless alternator.
11. Measurement of transient and sub-transient reactance in direct and quadrature axis.
12. Predetermination of performance characteristics of three-phase induction motor using computer.
13. To perform load test on 1 ph. Induction motor & plot torque –speed characteristics.
14. To perform no load & short circuit. Test on 3- phase alternator and draw open circuit and short circuit characteristics.

Subject Code : EEP-614
Title of the course : Power System Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Analyse the performance of transmission line
CO 2: Analyse the performance of various protective devices like relays and circuit breakers.
CO 3: Be competent in use of static and digital relays.
CO 4: Analyse the radial feeder performance.
CO 5: Learn about different types of faults on transmission line.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2			S		M							M
CO3	M				S				W			
CO4	S		S							M		S
CO5	S					W						M

To understand the practicability of **Power System**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To analyse the performance of a transmission line. Also compute its ABCD parameters.
2. To analyse the characteristics of over current and earth fault protection.
3. To study the operating characteristics of fuse. (HRC or open type)
4. To find the earth resistance using three spikes
5. To use over current static relay.
6. To study the different types of faults on transmission line demonstration panel/model.
7. To analyse the radial feeder performance when
   (a) Fed at one end.
   (b). Fed at both ends
8. To study the performance of under voltage and over voltage relay.
9. To study the characteristics of bimetal mini circuit breakers.
10. To study the characteristics of Distance Relay.
11. To find the breakdown strength of transformer oil.

Subject Code : EET-621
Title of the course : Electromagnetic Field Theory

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Understand vector analysis, curl, gradient, divergence and laws of static electric field.

CO 2: Analyse steady and time varying magnetic field, basic laws, vector representation, steady state equation, Poynting Vector etc.

CO 3: Interpret EM wave propagation in homogeneous, conducting and dielectric mediums.

CO 4: Differentiate reflection & refraction of EM waves by perfect conductor, dielectric and insulator.

CO 5: Analyse Transmission line travelling & standing waves, characteristic impedance, reflection coefficient.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										W
CO2		M		M								
CO3				M		W				S		
CO4				M						W		
CO5				M		M				M		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Review of Vector Analysis** Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, stoke's theorem, green's theorem and Helmholtz theorem.	5
	Static Electric Field Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equipotential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.	5
	Steady Magnetic Field Magnetic induction and Faraday's laws Ampere's work Law in differential vector form, magnetic field due to volume distribution of current and the Dirac-delta function, ampere's force law magnetic vector potential, Analogies between electric and magnetic fields, steady state equation of continuity.	6
	Time Varying Fields Maxwell's Equations Equation of continuity for time varying fields, Inconsistency of ampere's law, Maxwell's equations in integral and differential form for static and time varying fields, conditions at a Boundary surface, Concept of Poynting vector, Poynting Theorem, Interpretation of ExH	5

Unit-2	**Electromagnetic Waves Propagation** Solutions for free-space conditions, electromagnetic waves in a homogeneous medium, propagation of uniform plane-wave, relation between E & H in a uniform plane-wave, wave equations for conducting medium, Maxwell's equations using phasor notation, wave propagation in a conducting medium, conductors, dielectrics, wave propagation in good conductor and good dielectric, depth of penetration, polarization	6
	Reflection Of Electromagnetic Waves Electromagnetic wave Reflection by Perfect Conductor -normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator –Oblique incidence;. reflection at the surfaces of a conductive medium, surface impedance	5
	Refraction of Electromagnetic Waves Electromagnetic wave refraction at the surface of a perfect conductor & perfect dielectric (both normal incidence as well as oblique incidence), Brewester's angle and Total internal reflection, and applications	5
	Trasmission Line Theory Transmission line as a distributed circuit, transmission line equation, travelling & standing waves, characteristic impedance, input impedance of terminated line, reflection coefficient, Voltage Standing Wave Ratio (VSWR), Smith's chart and its applications.	5

Recommended Books-

1. Jordan C. Edward and Balmain G. Keith, Electromagnetic Waves and Radiating Systems,2nd Edition, Prentice-Hall Inc, 1968.
2. John D. Kraus, Electromagnetics, 5th Edition, McGraw-Hill Publishers, 2005.
3. Joseph A. Edminister, Schaum's Theory and Problems of Electromagnetics, 4th Edition, McGraw-Hill, 2013.
4. Narayan N. Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson Education, 2004.
5. Hayt, Engineering Electromagnetics, 7th Edition, Tata McGraw-Hill, 2012.

Subject Code : EET-622
Title of the course : Non-Linear and Discrete Control System

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO 1: Construct state space models from transfer function models.
CO 2: Solve linear time-invariant and time varying control system.
CO 3: Access the controllability and observability of a control system.
CO 4: Recognize features of nonlinear system and analysis of non-linear systems using describing function and phase plane method.
CO 5: To characterize the Lyapunov stability properties of state space systems
CO 6: Study of discrete control system and its analysis

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			S									M
CO2		S										
CO3		M	S									
CO4				S								S
CO5		S										M
	S											S

Theory

Unit	Main Topics & Course Outline	Hours(s)
Unit-1	**State space analysis & design:** Review of state space representation for linear continuous time system, solution of linear time invariant state equations, controllability and observability, solution of state equation for discrete system, state space analysis of discrete time systems, pole placement techniques	08
	Non-linear control systems: Introduction to non-linear feedback control system, different types of non linearities, and special features of non-linear systems: limit cycles, jump resonance and sub harmonics resonance etc. Definition of describing function (DF), D.F.'s for various non-linearities, DF analysis of non-linear control systems, stability analysis using Limit cycles, and jump resonance.	08
	Phase Plane Analysis: Phase-plane analysis for non linear systems. Singular points, Construction of phase-plane plots for non -linear systems.	08
Unit-2	**Liapunov's Stability Analysis:** Introduction, Concept of local, global and asymptotic stability, Liapunov's Stability criterion, The direct method of Liapunov and the linear systems, Methods of constructing Liapunov function for non-linear system.	08

	Discrete time control systems: Basic elements of a discrete data control system & its advantages over the continuous time systems A/D and D/A conversions, Spectrum analysis of sampling process and signal reconstruction Sample and hold device, Z-transforms, Inverse Z- Transform, Pulse transfer function, Pulse transfer functions of cascaded elements, Pulse transfer function of close loop system. Modified Z-transform, Stability analysis of close loop systems in Z-domain, Stability criterion by Jury's test, Schur-cohn method, Stability analysis by bilinear transformation and Routh's stability criterion, state space representation of discrete time systems.	16

Recommended Books-

1. B.C. Kuo, Digital Control System, Pearson Education,1992
2. I.J. Nagrath and M Gopal, Control Systems Engineering ,New Age International Publishers,2006
3. K. Ogata, Modern Control Engineering, 5th Edition,PHI,2010
4. M. Gopal, Digital Control Engineering, Willey Eastern,1998

Subject Code : EET-623
Title of the course : Power System Analysis

L	T	P	Credits	Weekly Load
3	1	0	3.5	4

Course Outcomes:

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

CO1: Understand steady state analysis of power system.

CO2: Develop algorithms of load flow analysis using Newton Raphson method and iterative methods.

CO3: Perform symmetrical and unsymmetrical short circuit analysis to understand the effects of different faults.

CO4: Gain knowledge on transient stability analysis and the associated solution techniques

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	S	M										
CO3		S	M		S							
CO4	S		S									

Theory

Unit	Main Topics & Course Outlines	Hour(s)
Unit-1	**System Modelling** System modelling of synchronous machines, transformers, loads etc, per unit impedance, single line diagram of electrical networks, single phase impedance diagrams corresponding to single line diagram. Formation of impedance and admittance matrices for the electrical networks.	12
	Load Flow Studies Data for the load flow studies, Swing Bus, Formulation of simultaneous equations, Iterative solutions by the Gauss-Seidal Method & Newton Raphson Method.	12
Unit-2	**Fault Analysis** Transients on transmission line, short circuit of synchronous machine, selection of circuit breakers, Algorithm for short circuit studies, Symmetrical Component transformation, construction of sequence networks of power systems. Symmetrical faults, Analysis of Unsymmetrical Faults: LG(Line-Ground), LL(Line-Line), LLG (Line-Line-Ground)faults.	12
	Power System Stability Steady state stability, Dynamics of a synchronous machine, Power angle equations, Transient stability, equal area criterion, Numerical solution of swing equation, factors effecting transient stability.	12

Recommended Books-

1. Glenn W Stagg. and H.Elabiad, Computer Aided Power System Analysis , kalonchito,2010
2. G. Kusic, Computer Aided Power System analysis.,2nd Edition,CRC Press Taylor and Francis group, 2008
3. I.J Nagrath and D.P Kolthari, Modern Power System Analysis, McGraw Hill,2003

4. I.J Nagrath and D.P Kothari., Power System Engineering, 2 Edition, McGraw Hill Education India Private Limited;2007
5. J Arrillaga. and C.P Arnold., Computer Aided Power System , Bogdan Vicol,2014
6. O.I Elgerd, Electric Energy Systems Theory, McGraw-Hill,1971
7. W.D Stevenson., Elements of Power System Analysis, McGraw Hill,1994

Subject Code : EET-624
Title of the course : Process Dynamics and Control

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Analyze and formulate mathematical model of real time engineering process plant.
CO2: Design and implement closed loop controller for different process parameters.
CO3: Demonstrate the working of various control valve and their selection criteria.
CO4: Understand the operation of Proportional (P), Integrator (I), Derivative (D), and PID controllers, and be able to simulate and tune them using classical methods.
CO5: Implement feedback, feed forward, ratio, and cascade control architectures.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S							S				M
CO2		S	S		W							
CO3			S						M			
CO4			M		S					W		
CO5	S	M										

Theory

Unit	Main Topics & Course Outline	Hour(s)
Unit-1	**Introduction to process control** Introduction, Basic components, diagrammatic representation, symbol and Terminology, process control block diagram	04
	Process dynamics and mathematical modelling Process variables, mathematical modelling of liquid, gas, and thermal, mechanical and chemical systems, Linearizing techniques, Liquid level control in a tank, Dynamics of manometer, response of non-interacting and interacting first-order elements in series, Mixing process, Heat transfer process, Distillation column.	06
	Controller principles Control system parameters – discontinuous controller modes – two position modes – multi-position mode – floating control mode – continuous controller modes – proportional controller mode – integral control mode – derivative control mode – composite controller modes – PI, PD, and three mode controller.	08
Unit-2	**Closed loop response and controller tuning** Single and combined modes in closed loop, static error, velocity error. Dynamic behaviour of feedback control processes for different modes, IAE, ISE, IATE criteria, Tuning of controllers, closed loop method – ultimate method – damped oscillation method – process reaction curve method – open loop tuning – variation on the open loop fit – Ziegler Nichols method – frequency response method – comparing tuning methods – integral criteria in tuning	06
	Controller Hardware Electronic and digital controller's - design considerations and implementation, single and composite modes of controllers, Direct digital control (DDC)-	06

	components, benefits, digital controller realization.	
	Final Control Final control operation – signal conversion (analog and digital electrical signals) – Actuators (electrical, pneumatic and hydraulic) – Control valve classification and types, selection criteria for control valves, function (mechanical, electrical and fluid valves).	06
	Multiple loop Control Schemes On-off Controllers, Cascade and Feed forward Controllers, Split Range Controllers, ratio controls, Single loop, multi loop & self-tuning controllers, set point control (SPC)	06
	Multi loop Interaction: Introduction features and examples of Multi Input Multi Output (MIMO) Process, Design of cross controllers, Relative gain array and selection of control loop.	06

Recommended Books-

1. B.G.Liptak, Process Control: Instrument Engineers' Handbook, 3rd edition, Butterworth Heinemann, 1995.
2. B. Wayne Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall, 2002.
3. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Process Dynamics and Control, 3rd edition, John Wiley & Sons, 2010.
4. F.G. Shinskey, Process Control Systems: Application, Design and Tuning, 4th edition, McGraw Hill Higher Education, 1996.
5. George Stephonopolous , Chemical Process Control : An Introduction To Theory And Practice,1st edition, PHI, 2008
6. Gregory K. Mcmillan, Douglas M. Considine, Process/Industrial Instruments and Controls Handbook, 5th edition, McGraw-Hill Professional, 1999.
7. Krishna Kant, Computer based Industrial Control, 2nd edition, PHI, 2010.
8. Peter Harriott, Process Control, 1st edition, Mcgraw Hill Education, 2001.
9. Surekha Bhanot, Process Control: Principles and Applications, Oxford University Press, 2008.

Subject Code : EET-625
Title of the course : Electrical Power Utilization and Traction

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Acquire the knowledge of different type of electrical heating and welding methods.
CO 2: Understand the construction and working principle of control devices, need and objective of electrochemical process,
CO 3: Know about various electrical circuits used in refrigeration, air conditioning and water Coolers.
CO 4: Analyse the various method of illumination and electric traction system.
CO 5: Understand control action of traction motor, train lighting, railway signalling and train tracking system.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						M
CO2		S	M									
CO3			S	M		M						W
CO4	S		W			M						
CO5				S				M	M			

Theory

Unit	Main Topics &Course Outlines	Hour(s)
Unit-1	**Electric Heating** Introduction, Advantages of electrical heating, Heating methods like Resistance heating – Direct resistance heating, indirect resistance heating, electric ovens, different types of heating materials, temperature control of resistance furnaces, design of heating element, domestic water heaters and other heating appliances. Induction heating – Principle, core type and coreless induction furnaces. Electric arc heating – Direct and indirect arc heating, arc furnaces. Dielectric heating –Principle and applications in various industrial fields.	(5 Hrs)
	Electric Welding Welding methods–Electric arc wielding and resistance wielding. Modern wielding techniques like ultrasonic wielding and laser welding	(3 Hrs)
	Electrochemical Process Need of electro-deposition. Applications of Faraday's laws in Electro-deposition. Factors governing electro-deposition. Objectives of electroplating. Equipments and accessories for electroplating plant, Electroplating on non-conducting material, Principle of anodizing and its applications.	(2 Hrs)
	Control Devices Construction and working of push button, limit switches, float switches pressure switches, contactors, thermostats, timers, relays Application of above devices in Automatic water level controller, reverse forward operation of 3-ph induction motor, Temperature controller in electric furnace, Air compressor circuit.	(3 Hrs)
Unit-	**Electrical Circuits**	(3 Hrs)

	Used in Refrigration, Air conditioning & Water coolers:- Brief description of vapour compression refrigeration cycle. Description of electrical circuits used in –Refrigerator, Air Conditioner, Water Cooler	
	Illumination Definitions of flux, solid angle, luminous intensity, illumination, luminous efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor; Laws of illumination. Calculation of number of light points for interior illuminations; Calculation of illumination at different points, considerations involved in simple design problems and illumination schemes, indoor and outdoor illumination level. different sources of light: differences in incandescent and discharge lamps – their construction and characteristics; fittings required for filament lamp, mercury lamp, fluorescent lamp, sodium lamp, halogen lamp, compact fluorescent lamp, metal halide lamp, electroluminescent lamp-LEDs, types, LASERs .Comparison of all above luminaries. Main requirements of proper lighting, absence of glare contrast and shadow. Principles of street lighting.	(8 Hrs)
	Electric Traction Advantages of electric traction. Traction systems – i) Steam engine drive, ii) electric drive, iii) diesel electric drive. Introduction to metro system, mono rail system. Systems of track electrification: D.C. system, single phase low frequency A.C. system, 3 phase low frequency A.C. systems, composite systems – kando systems, single phase A.C. to D.C. system Different accessories for track electrification such as overhead wires, conductor rail system, current collector- pentagraph .Electrical block diagram of an electric locomotive with description of various equipments and accessories.	(8 Hrs)
	Traction Mechanics Speed time curves, trapezoidal and quadrilateral speed-time curves, average and schedule speed. Tractive efforts. Specific energy consumption. Mechanics of train movement, coefficient of adhesion.	(8 Hrs)
	Traction Motors Control of Traction Motors, Train Lighting: Desirable characteristic of traction motors. Suitability of D.C. series motor, A.C. series motor,3 phase induction motor and linear induction motor for traction. Control of traction motors, Series-parallel control, Shunt and bridge transition. Electrical breaking, Regenerative breaking in traction, Suitability of different motors for braking. Train lighting system and Rosenberg generator. Railway signalling:- history, necessity, block system route relay interlock and necessity. Electromechanical systems for route relay interlock. Introduction to train tracking system, types. Anti-collision system-brief treatment only	(8 Hrs)

Recommended Books-

1. BIS, IEC standards for Lamps, Lighting Fixtures and Lighting, Manak Bhavan, 2nd edition, New Delhi, 2000
2. C. L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, Eastern Wiley Ltd, 1989
3. E. O. Taylor and V.V.L. Rao, Utilization of Electrical Energy, Orient Longman,1971

Subject Code : EET-626
Title of the course : Power Quality

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO1: Undertake the purpose of monitoring in power quality.
CO2: Understand the voltage dips and voltage swells.
CO3: Learn the harmonics measurement and harmonics elimination.
CO4: Learn the various power quality measuring equipments and power conditioning.
CO5: Learn about various active and passive filters.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						M
CO2		S	M									
CO3			S	M		M						W
CO4	S		W			M						
CO5				S				M	M			

Theory

Unit	Main Topics &Course Outlines	Hour(s)
Unit-1	**Overview and definition of power quality (PQ):** Sources of pollution, and regulations, Power quality problems rapid voltage fluctuations voltage unbalance, Voltage dips and voltage swells, Short duration outages,	(5 Hrs)
	Definitions Voltage sag analysis and mitigation: Sag caused by motor starting, Sag caused by utility fault clearing, Sag mitigation, Sag magnitude and duration calculations in single-phase systems, Equipment performance in presence of sag, Computers	(3 Hrs)
	Harmonics: Effects-within the power system, Interference with communication Harmonic measurements. Harmonic elimination.	(2 Hrs)
Unit-2	**Harmonic distortion:** Power system harmonics: harmonic analysis, Harmonic sources-the static converters, Transformer magnetization and non-linearities, Rotating machines, arc furnaces, Fluorescent lighting. Introduction to power converters, Fourier analysis, Total harmonic distortion, rms and average value calculations, Arcing and saturable devices, Effects of harmonic distortion, characteristics.	(3 Hrs)
	Principles for controlling harmonics: Locating sources of harmonics, Passive and active filters, Harmonic filter design.	(8 Hrs)
	Monitoring power quality: Monitoring essentials, Power quality measuring equipment, Current industry trends.	(8 Hrs)
	Power Conditioning: Electric power conditioning, Active and passive filters, IEEE, IEC, ANSI standards, Power Acceptability Curves, Various standards	(8 Hrs)

Recommended Books-

1. Beaty, H. and Santoso,S., Electrical Power System Quality , Mc Graw Hill (2002)
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, Eastern Wiley Ltd,1989
3. Kennedy, B., Power Quality Primer, McGraw Hill (2000).

Subject Code : EET-627
Title of the course : Power System Operation and Control

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO1: Understand the economic operation of power system.
CO2: Understand the power system control factors and Tie Line operations.
CO3: Learn the network sensitivity and generation dispatch.
CO4: Learn the various power control equipments and power conditioning.
CO5: Learn the power flow analysis in AC/DC systems.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						M
CO2		S	M									
CO3			S	M		M						W
CO4	S		W			M						
CO5				S				M	M			

Theory

Unit	Main Topics &Course Outlines	Hour(s)
Unit-1	**Introduction to Power Generation Units:** Characteristics and its variations, **Economic Operation of Power Systems:** Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, minimum and maximum power generation limits.	(5 Hrs)
	Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment and solution methods. Hydrothermal scheduling: fixed-head and variable head, Short- term and Long-term,	(3 Hrs)
	Power System Security: Factors affecting security, Contingency analysis, Network sensitivity, correcting the generation dispatch by using sensitivity method and linear programming.	(2 Hrs)
Unit-2	**Power System Control:** Power system control factors, interconnected operation, tie-line operations, Reactive power requirements, during peak and off peak hours, Elementary ideas of load frequency and voltage, reactive power control; block diagrams of P-f and Q-V controllers,	(3 Hrs)
	ALFC control, Static and Dynamic performance characteristics of automatic load frequency control (ALFC) and automatic voltage regulator (AVR) controllers, Excitation systems.	(8 Hrs) (8 Hrs)
	Power flow analysis in AC/DC systems: General, modelling of DC links, solution of DC load flow, discussion, per unit system for DC quantities, solution techniques of AC-DC power flow equations.	(8 Hrs)

Recommended Books-

1. Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw Hill (2007).
2. Stevenson W.D. and Grainger J.J., Power System Analysis, McGraw Hill (2007).
3. Arrillaga J. and Smith Bruce, AC-DC Power System Analysis, IEE Press
4. Elgerd, O.I., Electric Energy Systems Theory: An Introduction. 2nd Ed., Tata McGraw Hill, 1983.
5. Dhillon J.S., Kothari D.P., Power System Optimisation, 2nd Ed., Prentice Hall India, 2010

Subject Code : EEO-621
Title of the course : Elements of Power System

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Apply knowledge transmission and distribution System.
CO2: Know about conductor materials and transmission line types.
CO3: Learn line parameters and effect of earth on capacitance.
CO4: Select the cable type and and the maximum current capacity.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		W									M
CO2						S	S					M
CO3			S				M	S	M		S	M
CO4									M		S	M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Supply System:** Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission & distribution, economic size of conductors - Kelvin's law, Radial & mesh distribution networks, Voltage regulation	6
	General: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency	6
	Transmission Line Parameters : Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors	6
Unit-2	**Performance Of Transmission Lines:** Representation of short transmission line, medium length line (nominal T & II circuits). Long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation	6
	Underground Cables: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines	6

Recommended Books-

1. Nagrath, I.J. and Kothari, D.P., Power System Engineering, Tata McGraw Hill (2007).
2. Stevenson W.D. and Grainger J.J., Power System Analysis, McGraw Hill (2007).
3. Arrillaga J. and Smith Bruce, AC-DC Power System Analysis, IEE Press
4. Elgerd, O.I., Electric Energy Systems Theory: An Introduction. 2nd Ed., Tata McGraw Hill, 1983.
5. Dhillon J.S., Kothari D.P., Power System Optimisation, 2nd Ed., Prentice Hall India, 2010

Subject Code : EEP-623
Title of the course : Power System Analysis Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO1: Understand steady state analysis of power system.
CO2: Develop algorithms of load flow analysis using Newton Raphson method and iterative methods.
CO3: Perform symmetrical and unsymmetrical short circuit analysis to understand the effects of different faults.
CO4: Gain knowledge on transient stability analysis and the associated solution techniques

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	S	M										
CO3		S	M		S							
CO4	S		S									

To understand the practicability of **Power System Analysis**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To perform short circuit analysis – symmetrical faults
2. To perform short circuit analysis – unsymmetrical faults
3. To perform transient stability analysis
4. Power plot – relay co-ordination
5. To perform harmonic analysis
6. To compute solution of load flow problem by Gauss-seidal method
7. To compute solution of load flow problem by Newton-Raphson method
8. To compute solution of load flow problem by fast decoupled method
9. To compute solution of economic load dispatch by Lamda iterative method
10. Hand on experience on Simulink

Subject Code : EEP-625
Title of the course : Control System Laboratory

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO1: Analyse the performance of various controllers
CO2: Analyze the mathematical model of a system and determine the response of different order systems.
CO3: Solve the steady state and transient analysis of a system.
CO4: Study the characterstics of AC Servomotor, Synchro-Transmitter and Receiver.
CO5: Be competent in using MATLAB or LAB VIEW software to analyze closed loop control design problems
CO6: Design compensating networks.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S					M						M
CO2		S	M									
CO3			S									
CO4				S								
CO5			S									
CO6			S						M			

To understand the practicability of **Control System**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To determine response of first order and second order systems for step input for various values of constant 'K' using linear simulator unit and compare theoretical and practical results.
2. To analyse and compare the performance of P, PI and PID temperature controller for an oven.
3. To study and calibrate temperature using resistance temperature detector (RTD)
4. To design Lag, Lead and Lag-Lead compensators using Bode plot.
5. To study DC position control system
6. To obtain output V/S input characteristics of synchro-transmitter and receiver.
7. To determine speed-torque characteristics of an A.C. servomotor.
8. To analyse the performance of servo voltage stabilizer at various loads using load bank.
9. To study behaviour of separately excited dc motor in open loop and closed loop conditions at various loads.
10. To implement PID Controller

Software based experiments (Use MATLAB, LABVIEW software etc.)

11. To determine time domain response of a second order system for step input and obtains performance parameters.
12. To convert transfer function of a system into state space form and vice-versa.
13. To plot root locus diagram of an open loop transfer function and determine range of gain 'k' for stability.
14. To plot a Bode diagram of an open loop transfer function.
15. To draw a Nyquist plot of an open loop transfers functions and examine the stability of the closed loop system.

Title of the course : Industrial Training

L	T	P	Credits	Weekly Load
-	-	-	**8**	-

Course Outcomes:

After successful completion of industrial training, the students should be able to

CO 1: Implement the project requiring individual and teamwork skills.

CO 2: Correlate the theoretical concepts with the real life industrial environment.

CO 3: Gather and analyse the scientific information.

CO 4: Communicate their work effectively through writing and presentation.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				S			S			S	
CO2							S			S	S	
CO3			S									
CO4									S		S	

Objective of the programme is to

1. Enrich the students with a basic understanding of the Electrical Engineering, towards developing a holistic perspective to understand various practical issues and latest trends in the field.
2. Familiarize and provide “hands on” training experience with the requisite simulation, design, and analytical tools and techniques.
3. Achieve a long term goal of transforming themselves into a brilliant blend of theoretician and practicing engineer.
4. Introduce the way of troubleshooting various engineering faults related to respective fields.
5. Make the students able to present work in written, oral or formal presentation formats.

Subject Code : EEO-711
Title of the course : Electrical Special Machines

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: Simulate the steady-state and transient state performance of synchronous machines to identify performance measures

CO2: Validate and identify the machine parameters.

CO3: Select the appropriate AC motor for different large power application.

CO4: Analyze the stability of single machine – infinite bus system and form the grid to supply large load.

CO5: Choose the appropriate fractional horse power motor as per the usage in daily life.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M		M	S							M
CO2		S		S								W
CO3	S			M								
CO4	S	S										M
CO5	S											M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**General Aspects** Construction & working principle of synchronous machines, Excitation systems, production of sinusoidal Electro motive force(EMF), flux &Magneto motive force phasors in syn. machines; cylindrical & salient pole rotors.	06
	Windings Classification of windings, pitch factor, distribution factor. EMF equation.	04
	Alternators Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open circuit characteristics, short circuit characteristics, short circuit ratio, short circuit. Effect of variation of power factor on voltage. Determination of voltage regulation: EMF method, Magneto motive force(MMF) method. Zero power factor (ZPF) method, Alternator on infinite bus bar, operating characteristics, operation at constant load and variable excitation, power flow through inductive impedance, Power-angle characteristics of syn. machines:- cylindrical & salient pole. Two reaction theory of salient pole machines, power factor control.	12
	Parallel Operation of Alternators Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing, Hunting and damper windings.	10

Unit-2	**Synchronous Motors** Operating characteristics, power-angle characteristics, conditions for maximum power developed, V-curves and inverted V-curves, methods of starting, synchronous motors applications, and synchronous condensers.	10
	Transients Transients Analysis, transient reactances & time constants from equivalent circuits, synchronous machine reactances & their determination, Short circuit. Oscillogram, Synchronisation with the grid system, Qualitative introduction to the transient stability of the synchronous machines.	10
	Single-phase Synchronous Motors Reluctance & Hysteresis motors	06
	Special Purpose Machines Construction, principle of operation and applications of stepper motors and Servo motors, Universal Motor: construction, principle of operation and applications.	06

Recommended Books-

1. A.E. Fitzgerald., C. Kingsley and S.D. Umans, Electric Machinery ,6th Edition, Tata McGraw-Hill, 2005
2. E.H. Langsdorff ,Principles of A.C. Machines , Tata McGraw-Hill
3. I.J. Nagrath. and D.P. Kothari, Electrical Machines, 4th edition,Tata McGraw-Hill Education Pvt. Ltd., 2010
4. P.S. Bimbhra, Electrical Machinery, 7th Edition, Khanna Publishers,2011
5. M. G. Say, Alternating Current Machines, Sir Isaac pitman & Sons Ltd.,1958

Subject Code : EET-711
Title of the course : Microcontroller and PLC

L	T	P	Credits	Weekly Load
4	0	4	4	4

Course Outcomes:

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

CO 1: Learn basics of 8051 micro-controller, its architecture and timing diagrams.

CO 2: Develop the basic of programming of 8051 microcontroller; create assembly language programs for various operations.

CO 3: Analyse the design of 8051 Microcontroller with its memory details, subroutines, serial data etc.

CO 4: Demonstrate the application of 8051 microcontroller, details of multiple interrupts, serial data communication.

CO 5: Practise Programmable Logic Devices, Field Programmable Gate Array with their architecture and design.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M								W
CO2	M	M	W									
CO3			S	M					M			
CO4						M					M	
CO5			M	M		M						

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Microprocessor, Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts	12
	8051 Assembly Language Programming Instruction format and addressing techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions), The mechanics of programming, assembly language programming process, programming tools and techniques,	12
Unit-2	**8051 Microcontroller Design** Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding I/O, memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission	12
	Microcontroller Applications Interfacing keyboards, displays, Digital to Analog (D/A) and Analog to Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to Programmable Logic Devices (PLDs) and Field Programmable Gate Array (FPGA)- architecture, technology and design issues, implementation of 8051 core.	12

Recommended Books-

1. Dunning Gary, Introduction to PLCs, Tata McGraw Hill
2. John B Peatman, Design with Micro Controller, Tata McGraw Hill, 1988
3. Kenneth J Ayola, The 8051 Micro Controller- Architecture, Programming and Application, 2nd Edition, Penram International Publication, 1996.
4. Kumar Rajesh, Module on PLCs and their Applications, NITTTR Chandigarh
5. Mazidi M. A. and Mazidi J. G., The 8051 Micro-controller & Embedded System, Pearson Education, 2007.
6. Otter, Job Dan, Programmable Logic Controller, P.H. International, Inc, USA
7. Ray A. K. and Bhurchandi K. M., Advanced Microprocessors & Peripherals; Architecture, Programming& Interfacing, 2nd Edition, Tata McGraw Hill, 2006.
8. Surekha Bhanot, Process Control, Oxford Higher Education, 2008.

Subject Code : EET-712
Title of the course : Communication Systems

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Develop basics of communication system, various modulation systems & techniques.
CO 2: Be conversant in analog AM transmitters, its type and FM transmitter.
CO 3: Employ data analog AM receivers, FM detection & receivers, analyse noise in them.
CO 4: Know data representation, transmission, its modes, channels, encoding and exchange.
CO 5: Analyse digital communication, Modulation techniques, medium of communication.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M						S		M
CO2				M		M				M		
CO3			M							M		
CO4				S	M							
CO5				M		M				S		

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Base Band Signals and Systems** Introduction, Elements of communication system, Noise and its types, Noise figure and Noise factor, Noise equipment temperature, Modulation & Demodulation, Mixing, Need of modulation, Types of modulation systems, Amplitude Modulation (AM), Frequency Modulation (FM), their sidebands, Comparison, Sampling theorem, Different Pulse Modulation techniques- Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) and Pulse Code Modulation (PCM), Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Introduction to Fourier series and Fourier transform of periodic signals.	08
	Analog Communication: Transmitters Block diagram explanation of low and high level AM transmitter, AM broadcast transmitter, Double Side Band (DSB) transmitter, Single Side Band (SSB) transmitter, and Independent Sideband transmitter, Block diagram explanation of Reactance tube, and Armstrong FM transmitters, Stereophonic FM broadcast transmitter.	10
	Analog Communication: Receivers AM diode detector, characteristics of radio receiver, Sensitivity, Selectivity, Fidelity, and Image rejections, Classification of radio receivers, Tuned Radio Frequency (TRF) receiver and Super Heterodyne receiver, Block diagram explanation of AM receiver, AM receiver using Phase Locked Loop (PLL), DSB and SSB receiver, Independent sideband receiver, AM broadcast receiver, Noise in AM systems, FM detection, Block diagram explanation of FM receiver and Stereophonic FM broadcast receiver, Noise in FM systems.	10
Unit-2	**Data Communication** Concepts Data representation, Data transmission, Modes of data transmission, Signals	10

	encoding, Transmission channel, Directional capability of data exchange.	
	Digital Communication Wire pairs, Microwave, Coaxial cables, Satellite communication, Optical fibers, Modulation techniques AM, FM, PM, Digital modulation method Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Multilevel modulation, Synchronous and asynchronous modulation, Modems and Line Drivers, Data multiplexing techniques- Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Statistical Time Division Multiplexing (STDM), Multiplexed common carrier system, Multiplexing satellite signals concentrations, Data compression Hoffman code Adaptive scanning, Facsimile Compression.	10

Recommended Books-

1. A.P. Godse, U.A. Bakshi, Communication Engineering , Technical Publications
2. J.S. Chitode, Communication Engineering, 1st Edition, Technical Publications.
3. Simon Haykin, Analog communication system , Prentice hall.

Subject Code : EET-713
Title of the course : Digital Signal Processing

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO 1: Employ the properties of signals; learn their types, ADC, DAC, convolution, sampling etc.
CO 2: Develop Z-transform for signal analysis and exercise its properties.
CO 3: Exercise Discrete Fourier-Transform and its properties for signal analysis.
CO 4: Implement digital filters, know their various types and design principles.
CO 5: Analyse application of DSP in audio-image processing, biomedical, power system etc.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S									M		W
CO2	M			M								
CO3		M	M	M								
CO4			M	M		M		W				
CO5	S	M		M	M	M						

Theory:

Unit	Main Topics and Course outlines	Hour(s)
Unit-1	**Discrete Time Signals And System** Signals**,** Systems and signal processing. Classification of signals, Concept of frequency in continuous and discrete time signals, linearity, causality, frequency domain representation, convolution and its properties, quantization, aliasing, sampling theorem, Analog to Digital Converter (ADC) and Digital to Analog Convereter (DAC); Correlation of discrete time signals.	06
	Z-Transform Z-transforms, properties of Z-transforms, Rational Z-transforms, Inverse Z-transform, Analysis of linear time invariant systems in Z-domain.	06
	Fourier Transform Discrete Fourier series representation, properties of Discrete Fourier Transform (DFT), Fourier representation of finite duration sequences, linear convolution using DFT, Fast Fourier Transform (FFT) and its advantages.	12
Unit-2	**Digital Filters** Introduction to digital filters, Digital filter classification, implementation techniques, Basic network structure of IIR and FIR system.	04
	Digital Filter Design General considerations, Design of Finite Impulse Response (FIR) filters, and Infinite Impulse Response (IIR) filters from analog filters, Frequency transformations, Comparison of IIR & FIR filters.	08
	Applications of DSP Digital Signal Processing (DSP) architecture, number system, peripherals and Instruction sets, General purpose I/O functionality, Interrupts Applications of DSP to Audio and	12

	image processing, Telemedicine and biomedical applications, Control of Electrical power system and Drives	

Recommended Books:

1. A.V. Oppenheim and R.W. Schafer**,** Digital Signal Processing**,** Prentice Hall (India), 1975.
2. E.C. Ifeachor and B.W. Jervis, Digital Signal Processing, A practical Approach, Pearson Education, 2003
3. H.A. Toliyat and S. Campbell, DSP-Based Electromechanical Motion control, 1st Edition, CRC Press, 2003.
4. Proakis G. John and Manolakis K. Dimitris **,** Digital Signal Processing: Principles, algorithms & Applications, 4th Edition, Prentice Hall (India), 2013**.**
5. R.G. Lyons, Understanding Digital Signal Processing, 3rd Edition, Pearson Education, 2011.
6. Steven W. Smith, The Scientist and Engineer's Guide to Digital Signal Processing, California Technical publishing, 1998.

Subject Code : EET-714
Title of the course : Soft Computing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Apply a soft computing methodology for a particular problem.
CO 2: Exercise fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
CO 3: Implement genetic algorithms to combinational optimization problems.
CO 4: Utilize neural networks to pattern classification and regression problems.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S				M				M		W
CO2	S	S	M	S	S	M				M		M
CO3	S	S	S	S	S	M				M		M
CO4	S	S	S	S	S	M				M		M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Fuzzy Logic-I (Introduction):** Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.	08
	Fuzzy Logic –II (Fuzzy Membership, Rules): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzificataions, Fuzzy Controller, Industrial applications.	08
	Genetic Algorithm(GA): Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.	08
Unit-2	**Neural Networks-1(Introduction & Architecture):** Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions,Neural network architecture: single layer and multilayer feed forward networks, recurrent networks.Various learning techniques; perception and convergence rule,Auto-associative and hetro-associative memory.	08
	Neural Networks-II (Back propagation networks): Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications.	08
	Neuro Fuzzy Modelling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.	08

Recommended Books-

1. E.Goldberg Davis, "*Genetic Algorithms: Search, Optimization and Machine Learning*", Addison Wesley, N.Y., 1989.

2. J.Ross Timothy, "*Fuzzy Logic with Engineering Applications*", McGraw-Hill, International Editions, Electrical Engineering Series, Singapore, 1997.
3. J.S.R.Jang, C.T.Sun and E.Mizutani, "*Neuro-Fuzzy and Soft Computing*", PHI, 2004, Pearson Education 2004.
4. R.Eberhart, P.Simpson and R.Dobbins, "*Computational Intelligence - PC Tools*", AP Professional, Boston, 1996.
5. S. Rajasekaran and G.A.V.Pai, "*Neural Networks, Fuzzy Logic and Genetic Algorithms*", PHI, 2003.

Subject Code : EET-715
Title of the course : Sensors and Signal Conditioning

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: Acquire knowledge of measurement characteristics.
CO 2: Recognize different type of sensors and their working principle along with applications.
CO 3: Understand the concept of signal conditioning and amplification.
CO 4: Converse with data acquisition and data transmission
CO 5: Acquire knowledge of interface standards and their interfacing

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2		M	S									
CO3					S					M		
CO4					M					S		
CO5			S			S		M			W	

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** General Concept of Measurement: Basic block diagram stages of generalized measurement system state characteristics; accuracy, precision, resolution, reproducibility, sensitivity, zero drift, linearity, Dynamic characteristics, zero order instrument first order instrument, time delay.	12
	Sensors Sensors and Principles: Resistive sensors, Potentiometer and strain gauges, Inductive sensors: Self-inductance type, mutual inductance type, Linear Variable Differential Transformer (LVDT), Capacitive sensors, piezoelectric sensors thermocouples, thermistors, radiation pyrometry, Fibre optic sensors, Bio – Sensors, temperature sensor, photo electric sensors, pressure and flow sensors.	12
Unit-2	**Signal Conditioning** Signal conditioning: Amplification, Filtering, Level conversion, Linearisation, Buffering, sample and hold circuit, quantization, multiplexer/ demultiplexer, analog to digital converters, digital to analog converters.	12
	Data acquisition Data acquisition and conversion: General configuration, single channel and multichannel data acquisition system, Digital Filtering, data logging data conversion, introduction to digital transmission systems, PC based data acquisition system.	06
	Interfacing: Interface systems and standards: Block diagram of a typical interface IEEE 488 standard bus British Standard interface (BS 4421) CAMAC Interface MEDIA interface RS-232C standard.	06

Recommended Books-

1. A.K. Sawhney, Puneet Sawhney A Course in Electrical and Electronic Measurements and Instrumentation , 11th Edition, Dhanpat Rai, 2012
2. B.C. Nakra, K.K. Chaudhary, Instrumentation: Measurements & Analysis, 3rd edition, Tata McGraw Hill Education, 2010.
3. E.O. Doeblin, Measurement Systems, 5th edition McGraw Hill, 2010
4. Rangam, Sarma & Mani, Instrumentation -Devices and Systems, TMH

Subject Code : EET-716
Title of the course : Biomedical Instrumentation

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Understand nervous, circulatory and respiratory system and also its origin of bio-potentials.
CO 2: Know various bioelectric signals and electrodes for EEG, EMG and ECG.
CO 3: Have competency in the measurements of cardiovascular, electrical activity of brain and respiratory system.
CO 4: Acquire the knowledge medical imaging, computerized ultrasonic diagnosis and types, X-Rays and computerized tomography.
CO 5: Learn physiological parameters and components of biotelemetry system and also its applications

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				M		S						M
CO2	M			M		M						
CO3		S				M						W
CO4				M	S			W				
CO5								S		M		

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Physiological systems of body** Brief description of nervous, circulatory and respiratory systems, the body as a control system, the nature of bioelectricity, the origin of biopotentials.	06
	Bio electric Signals and Electrodes Electro conduction system of the heart, the Electrocardiography (ECG) Waveform, Neuron potential, muscle potential, electrodes for biophysical sensing, Skin-contact-impedance, electrodes for Electroencephalography (EEG), Electromyography (EMG) and ECG, electrical conductivity of electrode jellies and creams.	06
	Cardiovascular measurements The standard lead system, the ECG preamplifier; ECG machines, Cardiac monitors, , blood pressure measurements, direct and indirect, blood flow measurements, phonocardiography, defibrillators, pacemakers	06
	Measurements of Electrical Activity in Brain Anatomy of Human Brain and Nerve Cell, EEG electrodes and the 10-20 system, EEG amplitude and frequency bands, simplified block diagram, preamplifiers and EEG system specifications, EEG diagnostic uses and sleep patterns, visual and auditory evoked potential recordings, EEG system artifacts.	06
Unit-2	**Electromyography (EMG)** Muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, signal conditioning and processing, Block	06

	diagram & description of Electromyography (EMG).	
	Respiratory System Measurements Respiratory anatomy, parameters of respiration, regulation of respiration, respiratory system measurements, respiratory transducers and instruments, spirometry.	06
	Medical Imaging Introduction to Medical Imaging, Computers in Medical Imaging, Computerized Ultrasonic Diagnosis and types, X-Rays, Computerized Tomography, Computerized Emission Tomography	06
	Biotelemetry Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Applications of telemetry system in patient care.	06

Recommended Books-

1. John G. Webster, Medical Instrumentation, 3rd edition WSE, 2007
2. Joseph J Carr, John M. Brown, Introduction to Biomedical Equipment Technology, , 4th edition PE, 2000
3. L Cromwell, Biomedical instrumentation and measurement, 2nd edition, Prentice Hall (India), 1990
4. RS Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003

Subject Code : EET-717
Title of the course : HVDC Transmission & FACTS

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Understand the concept of High Voltage DC (HVDC) transmission in power system.
CO 2: Comprehend the knowledge on operation, modelling and control of HVDC link.
CO 3: Analyse the operation of HVDC conversion technology.
CO 4: Perform steady state analysis of AC/DC system.
CO 5: Know about various HVDC simulators & fundamental requirements of HVDC transmission line design
CO 6: Acquire the knowledge of various Flexible AC Transmission Systems (FACTS) devices for shunt and series compensation.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M								M
CO2			S		M							
CO3				S	M							
CO4		S		M					S			
CO5					S			M			M	
CO6	S		M	M								M

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**DC power transmission technology** Introduction, comparison of AC and DC transmission, application of DC transmission, description of DC transmission system, Configurations, planning for HVDC transmission, modern trends in DC transmission. Introduction to Device: Thyristor valve, valve tests, recent trends.	06
	Analysis of High Voltage Direct Current (HVDC) converters Pulse number, choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, characteristics of a twelve-pulse converter, detailed analysis of converters with and without overlap.	06
	Converter and HVDC system control General, principles of DC link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, power control, higher level controllers, telecommunication requirements.	06
	Converter faults and protection Introduction, converter faults, protection against over-currents, over-voltages in a converter station, surge arresters, protection against over-voltages.	06

Unit-2	**Smoothing reactor and DC line** Introduction, smoothing reactors, DC line, transient over voltages in DC line, protection of DC line, DC breakers, Monopolar operation, effects of proximity of AC and DC transmission lines.	06
	Reactive power control Introduction, reactive power requirements in steady state, sources of reactive power, static var systems and reactive power control during transients. Harmonics and filters: Introduction, generation of harmonics, design of AC filters, DC filters, carrier frequency and RI noise.	06
	Component models for the analysis of ac/dc system General, converter model, converter control, modelling of DC network, modelling of AC networks.	06
	Power Transmission control Fundamental of ac power transmission, transmission problems and needs, the emergence of flexible AC Transmission systems (FACTS), FACTS controller & consideration. **Shunt & Series Compensation:** Shunt Static Var Compensator (SVC) principles, configuration, & control, Fundamental of series compensation, principle of operation, Application of Thyristor Controlled Series Capacitor (TCSC) for different problems of power system **Unified Power Flow Controllers (UPFC):** Basic operating principles & characteristics, control UPFC installation applications, UPFC model for power flow studies.	06

Recommended Books-

1. C. L. Wadhwa, High Voltage Engineering, 3rd Edition, New Age International, 2007
2. Edward Wilson Kimbark, HVDC Transmission, Wiley-Interscience
3. E. Kuffel and M. Abdullah, High Voltage Engineering, Pergamon Press, 1970
4. Ghosh,A. and Ledwich,G., Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers (2005).
5. Hingorani, N.G. and Gyragyi,L., Understanding FACTS :Concepts and Technology of Flexible AC Transmission System, Standard Publishers and Distributors (2005).
6. K.R. Padiyar, FACTS Controllers in Power Transmission & Distribution, New Age International Publisher, 2007.
7. Miller T.J.E., Reactive Power Control in Electric Systems, John Wiley
8. Rakesh Das Bagamudre, Extra High Voltage AC Transmission Engineering, New Age International Publishers.
9. R.S. Jha, High Voltage Engineering, Dhanpat Rai
10. V. Kamaraju and M.S. Naidu, High Voltage Engineering, Tata McGraw-Hill Education

Subject Code : EET-718
Title of the course : Data Acquisition System

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO 1: Analyze various data acquisition systems, their components and applications.

CO 2: Learn methods of data transmission, transmission channels and different type of modulation.

CO 3: Describe construction and working principle of digital to analog converters and analog to digital converters.

CO 4: Acquire knowledge of block diagram, classification and working principle of different telemetry system.

CO 5: Understand the construction and working principle of display system and recorders.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M			M							
CO2	S				M					S		
CO3			M	S						M		
CO4					S	M		M		S		
CO5			M				S					W

Theory:

Unit	Main Topics and Course Outline	Hour(s)
Unit-1	**Data Acquisition Systems:** Block diagram of data acquisition System & its applications, Analog& digital acquisition systems, signal conditioning of the inputs, single channel data acquisition, multi-channel DAS, computer based DAS, uses of data acquisition systems, use of recorders in digital systems & block diagram of digital data recording system, data logging system, compact data logger , modem digital data acquisition,digital transducer.	08
	Data Transmission System: Methods of data transmission, transmission channels & media, Modulation & demodulation, amplitude, frequency &phase modulation, Comparison between frequency & amplitude, pulse modulation (PAM, PDM, PFM, POM), delta modulation, adaptive data modulation &Companding, digital data codes, error correcting & error detecting codes, Asynchronous & synchronous data transmission, pulse code formats used in data transmission, radio link, frequency division &time division multiplexing, time division multiplexing using mechanical commutator, electronic time division multiplexing system, block diagram of AM frequency division multiplexing system.	08
	Digital Instruments: Digital to analog converters, analog to digital converters, electromechanical ADC, Digital Transducers.	06
Unit-2	**Introduction to Telemetry Principles:** Definition, generalized block diagram of Telemetry System, Classification of Telemetry system, Working principle, salient features and applications of the following Telemetry System: DC Voltage, current and position telemetry system, Pulse telemetry System, Introduction to Satellite telemetry And Fibre Optic telemetry system	08

	Modems, Transmitters and receivers: Modems Introduction, Transmitters, Transmission Techniques, Inter stage Coupling, Receiver, Introduction to Antennas	08
	Display Systems: Construction, principle of operation and salient features of various kinds of display devices	05
	Recorders: Working principle, Construction, operation and salient features of Strip Chart Recorder, X-Y strip chart recorder and magnetic recorder	05

Recommended Books-

1. AK, Sawhney. *Electrical and Electronic Measurement and Instrumentation*. Dhanpat Rai and Sons, 1993.
2. D, Patranabis. *Telemetry Principles*. Tata McGraw Hill., 1999.
3. EL, Gruenberg. *Handbook of Telemetry & Remote Control*. Tata McGraw Hill., 1967.
4. HS, Kalsi. *Electronic Instrumentation*. Tata McGraw Hill, 2010.

Subject Code : EEP-713
Title of the course : Software and Simulation Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: Utilise Microsoft Excel and MATLAB for plot, arithmetic operations etc.
CO 2: Design programs in MATLAB for various calculations on electrical signal.
CO 3: Be competent in the basics of SIMULINK and model designing for analysis.
CO 4: Analyse series & parallel RLC circuit for steady state, transient behaviour for AC, DC
CO 5: Simulate steady state, transient behaviour of diode bridge rectifier, DC motor and Transformer.
CO 6: Model the speed control of DC machine & Transformer and learn LABVIEW basics.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M		M							W
CO2		M	M	W								
CO3			M		M						S	
CO4	S	S										
CO5		M		S	W							
CO6	S		M									S

To understand the practicability of **Software and Simulation**, the list of experiments is given below to be performed (at least 10) in the laboratory.

1. To perform various arithmetic operations in Microsoft Excel and create various types of 2D plots.
2. To create arrays and matrices in MATLAB and perform various arithmetic operations.
3. To write a programme in MATLAB for getting the desired data (largest, smallest, a range etc) from a set.
4. To write a programme in MATLAB for creating various types of 2D plots (single and multiple) from a set of data.
5. To measure and plot the Instantaneous, RMS and average values of current/voltage, power, power factor, crest factor, frequency and various other waveform parameters while simulation of behaviour of basic circuit components supplied from a DC and an AC source in MATLAB.
6. To simulate the steady state and transient behaviour of circuits having a pure resistance or pure inductance or pure capacitance supplied from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.
7. To simulate the steady state and transient behaviour of circuits having RL, RC and RLC series combinations fed from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.
8. To simulate the steady state and transient behaviour of circuits having RL, RC and RLC parallel combinations fed from a DC and an AC source in MATLAB. Plot their source and load current and voltage waveforms and comment on it.

9. To simulate the steady state and transient behaviour of a diode bridge rectifier (single phase and three phase) in MATLAB for R and RL load. Plot their current/voltage waveforms at source, diodes and load and comment on it.
10. To simulate the steady state and transient behaviour of DC Motors (shunt, series and compound) in MATLAB. Plot various current/voltage waveforms and characteristics and comment on it.
11. To simulate the steady state and transient behaviour of Transformers (single phase/three phase) in MATLAB. Plot various current/voltage waveforms and comment on it.
12. To simulate the steady state and transient behaviour of a single phase center tapped transformer based diode rectifier in MATLAB for R and RL load. Plot their current/voltage waveforms at source, diodes and load and comment on it.
13. To simulate the speed control of DC Motors (shunt, series and compound) in MATLAB using variable AC source and diode bridge rectifier and by armature and field control methods. Plot various current/voltage waveforms and comment on it.
14. To model a multiphase transformer using single phase/three phase Transformers in MATLAB and simulate its steady state and transient behaviour. Plot various current/voltage waveforms and comment on it.
15. Introduction to LabView and examples.

Recommended Books:

1. Fitzgerald, Kingslay and Umans, Electric Machinery, 6th Edition, McGraw Hills, 2002
2. Hanselman & Littlefield, Mastering MATLAB 7, 1st Edition, Prentice Hall, 2004.
3. Pratap Rudra, Getting Started with MATLAB, Oxford University Press, 2010.

Subject Code : EEP-714
Title of the course : Innovative Skill Lab

L	T	P	Credits	Weekly Load
0	0	2	1	2

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

CO1: Implement the project requiring individual and teamwork skills.
CO2: Use research based knowledge in the field of electrical engineering and multi-disciplinary areas.
CO3: Carry out design calculations and implementations in the area of project.
CO4: Communicate their work effectively through writing and presentation.
CO5: Handle professional responsibilities and respect for ethics.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S				S			S			S
CO2											S	S
CO3	S		S	S	S		S					S
CO4										S		S
CO5								S				S

Objective of the programme is to:
1. Make the students capable of designing and implementing their own views on technical knowledge gained during the entire course duration.
2. Make them able to present their innovative thoughts on a practical platform.
3. Utilize the available resources in various manners.
4. Make them proficient in using various electrical equipments.
5. Provide a platform for diverse innovative creation in a competitive environment.

Subject Code : EEP-715
Title of the course : Minor Project

L	T	P	Credits	Weekly Load
0	0	4	2	4

Course Outcomes:

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

CO 1: Implement the project requiring individual and teamwork skills.
CO 2: Use research based knowledge in the field of electrical engineering and multi-disciplinary areas.
CO 3: Carry out design calculations and implementations in the area of project.
CO 4: Communicate their work effectively through writing and presentation.
CO 5: Handle professional responsibilities and respect for ethics.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S				S			S			S
CO2											S	S
CO3	S		S	S	S		S					S
CO4										S		S
CO5								S				S

Objective of the programme is to:

1. Make students able to demonstrate the ability to collaborate with others as they work on intellectual projects.
2. Provide a platform to the students to implement their technical skills on a given/selected task.
3. Design solutions for real life problems using engineering knowledge.
4. Prepare a Written Report on the Study conducted for presentation .
5. Final Seminar, as oral Presentation before respective Project Coordinator.

Subject Code : EEO-711
Title of the course : Energy Conservation Practices

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Outcomes:

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

CO1: To acquire an in depth knowledge about the energy management and auditing
CO2: Recognize how energy can be conserved and managed in industries.
CO3: Acquire a comprehensive idea on tariffs in Transmission &Distribution systems.
CO4: Be conversant in utilization and effects of energy on Environment.
CO5: Be competent to handle the Energy auditing procedure.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										S	M
CO2		S					M					
CO3	M			S								
CO4	S											S
CO5		S	S									M

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basics of Energy Conservation** Need of energy conservation and energy audit; Energy Intensive processes, Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers; Cooling: Methods/ Techniques of Energy Saving in Ventilating systems and Air Conditioners; Lighting energy: methods/Techniques of efficient lighting; Cogeneration -Types and Advantages	08
	Efficiency improvement in Motors Losses in Electrical Machines, Methods to reduce these losses, Efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters; Energy Efficient Motors: Construction, operation and characteristics; Power factor improvement devices and soft starters/Variable Frequency Drives.	08
	Energy Conservation in Transmission and Distribution(T&D) Systems Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization; Amorphous Core Transformers	08
Unit-2	**Tariff and Energy Conservation in Industries** Energy cost and Recent Electricity Board tariffs, Application of Tariff System to reduce Energy bill, Energy Conservation by improving load factor and power factor;	06
	Energy and the Environment Environment and social concerns related to energy utilization, The green-house effect, Global Warming and its effect , Pollution, Acid Rains, Global Energy and environment Management	04

	Energy Audit Procedure of Energy audit, Selective Inventory Control analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. IE rules and regulations for energy audit, Electricity act 2003	14

Recommended Books-

1. Bureau of Energy Efficiency, Bureau of Energy Efficiency Handbooks.
2. C.L.Wadhwa, Generation Distribution & Utilization of Electrical Energy, New Age international,1989
3. G Petrecca ,Industrial Energy Management: Principles & applications, Kluwer Academic Publisher,1993

Subject Code : EET-721
Title of the course : Non-Conventional Energy Sources

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO1: Apply knowledge of India's power scenario, power system structure and related agencies.
CO2: Know how to harness power from conventional and renewable sources.
CO3: Select the site of conventional and renewable generation plants.
CO4: Select the methods and size of plant generating power for overall economy/ efficiency.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		W									M
CO2						S	S					M
CO3			S				M	S	M		S	M
CO4									M		S	M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Energy sources conventional and non-conventional, their availability, Recent trends in Power Generation, Interconnected Generation of Power Plants.	4
	Hydro Electric Generation Selection of site, basic definitions, capacity calculations, classification, elements of hydroelectric plant and operation of hydro-electric plant, hydro-electric generator choice of size and number of generating units,	5
	Thermal Power Generation Introduction, selection of site, basic parts and general layout of steam power plant and working, efficiency, fuels, fuel handling, combustion, ash handling and dust collection, draught systems, feed water turbo alternators merits and demerits of steam power plants,	5
	Nuclear And Diesel Electric Power Generation Feasibility of nuclear power station, nuclear fuels, fission process and conditions, constituents and layout of nuclear power plant, selection of site for diesel plant, plant layout, performance and thermal efficiency of diesel plant merits and demerits of plant	7
Unit-2	**Solar Power Generation** Solar radiations, solar energy collectors; flat plate and focusing type, energy balance equation and collector efficiency, photovoltaic cells applications of solar energy; solar pumping, solar furnace, solar cooking solar green houses	5
	Wind Power Generation Wind surveys, Basic principles of wind energy conversion, wind data and energy estimation, site selection, basic components of Wind Energy Conversion Systems(WECS), wind machines, schemes of wind power generation and control,	5
	Magneto Hydro Dynamic (MHD) Power Generation Basic principles of Magneto Hydro Dynamic (MHD), MHD systems types of MHD material, electrical conditions; voltage and power output, gas conductivity, analysis of	5

	constant area MHD generator, practical MHD generator, application.	
	Generation From Miscellaneous Sources Fuel cells, types and construction of fuel cells operation and characteristics, thermo-electric generation, Geothermal system, characteristic of geothermal resources, choice of generator set, electric equipment precautions low hydro-plants, choice of site, tidal energy, tidal power generation energy principles and components	6

Recommended Books-

1. A. Chakrabarti, M. L. Soni, P. V. Gupta and Bhatnagar U. S., Power System Engineering, Dhanpat Rai & Co. Pvt Ltd, 2009
2. B. R. Gupta, Generation of Electrical Energy, S. Chand Publishing, New Delhi, 2011
3. Christopher A. Simon, Alternate Source of Energy, Rowman and Little Field Publishers Inc., 2007.
4. C.L. Wadhwa, Generation, Distribution and Utilization of Electric Energy, New Age International, Publishers, 2007.
5. G.D Rai, Non-Conventional Energy Sources, Khanna Publishers, 2005.
6. S. Rao and B.B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 2005.
7. V.A. Venikov and E.V. Putyain, Introduction to Energy Technology, Mir Publishers, 1990.

Subject Code : EET-722
Title of the course : Electrical Machine Design

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO1: Discuss the basic considerations of Electrical machines.
CO2: Emphasis on magnetic and electric circuit of DC machines.
CO3: Study the different aspects of AC machines.
CO4: Study and formulate the mathematical problem of electromagnetic field equations

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											W
CO2		S										
CO3	S											M
CO4	S		M		S							

Theory

Unit	Main Topics and Course outlines	Hour(s)
Unit-1	**Basic Considerations** Constructional elements of transformers and rotating machines - classification of design problems - general design procedure - standard specifications - output coefficient- choice of specific electric and magnetic loading - separation of D and L for rotating machines.	6
	Magnetic And Electric Circuit Calculations MMF calculation - magnetization curve - magnetic leakage - MMF for air gap - effect of slot and ventilating ducts - MMF for teeth - leakage reactance - unbalanced magnetic pull -estimation of number of conductors per turn - coil slots - conductor dimension – slot dimension.	8
	DC Machines Armature winding - magnetic circuit - choice of number of poles - length of air gap – field system - interpoles - commutator – brushes	5
	Transformers Core Section windings- window dimension - overall dimension - cooling tubes	5
Unit -2	**Induction Machines** Choice of L/ π ratio - air gap length - cage rotor - dispersion coefficient - end ring current - wound rotor - slip rings.	6
	Synchronous Machines: Short circuit ratio - air gap length - salient pole rotor -cylindrical rotor.	6
	Introduction Conventional design procedures -Limitations -Need for field analysis based design.	4
	Mathematical Formulation Of Field Problems Development of torque/force -Electromagnetic Field Equations -Magnetic Vector/Scalar potential -Electrical Vector/Scalar potential- Stored energy in field problems – Inductances	8

Recommended Books-

1. A.K. Sawhney, A course in Electrical Machine Design, Dhanpat Rai & Sons, New Delhi,1996.
2. A. Shanmugasundaram, Electrical Machine Design Data Book, Wiley Eastern Ltd,1979
3. C. W. Trowbridge, An Introduction to Computer Aided Electromagnetic Analysis,Vector Field Ltd,1990
4. D.A. Lowther and P.P. Silvester, Computer Aided Design in Magnetics, Springer Verlag, New York, 1956.
5. E. Clayton Albert and N.N Hancock, The performance and Design of Direct Current Machines, Oxford & IBH Publishing Co., Pvt., Ltd., New Delhi, 1990
6. H.M. Rai, Principles of Electrical Machine Design, Sathyaprakashan , New Delhi,4th Edition,1995.
7. M.G. Say, Alternating Current Machines, ELBS & Pitman, London, 5th edition, 1992.
8. S.K Bhattacharya, “Electrical Machines”, 2nd Edition, Tata McGraw Hill, 1998.
9. Silvester and Ferrari, Finite Elements for Electrical Engineer, Cambridge University press, 1983
10. S.R.H. Hoole, Computer- Aided, Analysis and Design of Electromagnetic Devices, New York, Amsterdam, London, 1989.
11. S.J. Salon, Finite Element Analysis of Electrical Machines, Kluwer Academic Publishers, London, 1995.
12. User Manuals of COMSOL, MAGNET, MAXWELL & ANSYS. Software Packages

Subject Code : EET-723
Title of the course : Power Plant Engineering

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:

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

CO1: Apply knowledge of India's power scenario, power system structure and related agencies.
CO2: Know how to harness power from conventional and renewable sources.
CO3: Select the site of conventional and renewable generation plants.
CO4: Select the methods and size of plant generating power for overall economy/ efficiency.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		W									M
CO2						S	S					M
CO3			S				M	S	M		S	M
CO4									M		S	M

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Introduction** Energy sources conventional and non-conventional, their availability, Recent trends in Power Generation, Interconnected Generation of Power Plants.	4
	Hydro Electric Generation Selection of site, basic definitions, capacity calculations, classification, elements of hydroelectric plant and operation of hydro-electric plant, hydro-electric generator choice of size and number of generating units,	5
	Thermal Power Generation Introduction, selection of site, basic parts and general layout of steam power plant and working, efficiency, fuels, fuel handling, combustion, ash handling and dust collection, draught systems, feed water turbo alternators merits and demerits of steam power plants,	5
	Nuclear And Diesel Electric Power Generation Feasibility of nuclear power station, nuclear fuels, fission process and conditions, constituents and layout of nuclear power plant, selection of site for diesel plant, plant layout, performance and thermal efficiency of diesel plant merits and demerits of plant	7
Unit-2	**Solar Power Generation** Solar radiations, solar energy collectors; flat plate and focusing type, energy balance equation and collector efficiency, photovoltaic cells applications of solar energy; solar pumping, solar furnace, solar cooking solar green houses	5
	Wind Power Generation Wind surveys, Basic principles of wind energy conversion, wind data and energy estimation, site selection, basic components of Wind Energy Conversion Systems(WECS), wind machines, schemes of wind power generation and control,	5

	Magneto Hydro Dynamic (MHD) Power Generation Basic principles of Magneto Hydro Dynamic (MHD), MHD systems types of MHD material, electrical conditions; voltage and power output, gas conductivity, analysis of constant area MHD generator, practical MHD generator, application.	5
	Generation From Miscellaneous Sources Fuel cells, types and construction of fuel cells operation and characteristics, thermo-electric generation, Geothermal system, characteristic of geothermal resources, choice of generator set, electric equipment precautions low hydro-plants, choice of site, tidal energy, tidal power generation energy principles and components	6

Recommended Books-

1. A. Chakrabarti, M. L. Soni, P. V. Gupta and Bhatnagar U. S., Power System Engineering, Dhanpat Rai & Co. Pvt Ltd, 2009
2. B. R. Gupta, Generation of Electrical Energy, S. Chand Publishing, New Delhi, 2011
3. Christopher A. Simon, Alternate Source of Energy, Rowman and Little Field Publishers Inc., 2007.
4. C.L. Wadhwa, Generation, Distribution and Utilization of Electric Energy, New Age International, Publishers, 2007.
5. G.D Rai, Non-Conventional Energy Sources, Khanna Publishers, 2005.
6. S. Rao and B.B. Parulekar, Energy Technology: Non-Conventional, Renewable and Conventional, Khanna Publishers, 2005.
7. V.A. Venikov and E.V. Putyain, Introduction to Energy Technology, Mir Publishers, 1990.

Subject Code : EET-724
Title of the course : Energy Management Auditing

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO1: To acquire an in depth knowledge about the energy management and auditing
CO2: Recognize how energy can be conserved and managed in industries.
CO3: Acquire a comprehensive idea on tariffs in Transmission &Distribution systems.
CO4: Be conversant in utilization and effects of energy on Environment.
CO5: Be competent to handle the Energy auditing procedure.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										S	M
CO2		S					M					
CO3	M			S								
CO4	S											S
CO5		S	S									M

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Basics of Energy Conservation** Need of energy conservation and energy audit; Energy Intensive processes, Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers; Cooling: Methods/ Techniques of Energy Saving in Ventilating systems and Air Conditioners; Lighting energy: methods/Techniques of efficient lighting; Cogeneration -Types and Advantages	08
	Efficiency improvement in Motors Losses in Electrical Machines, Methods to reduce these losses, Efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters; Energy Efficient Motors: Construction, operation and characteristics; Power factor improvement devices and soft starters/Variable Frequency Drives.	08
	Energy Conservation In T&D Systems Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization; Amorphous Core Transformers	08
Unit-2	**Tariff and Energy Conservation in Industries** Energy cost and Recent Electricity Board tariffs, Application of Tariff System to reduce Energy bill, Energy Conservation by improving load factor and power factor;	06
	Energy and the Environment Environment and social concerns related to energy utilization, The green house effect, Global Warming and its effect , Pollution, Acid Rains, Global Energy and environment Management	04

	Energy Audit Procedure of Energy audit, Selective Inventory Control analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. IE rules and regulations for energy audit, Electricity act 2003	14

Recommended Books-

1. Bureau of Energy Efficiency, Bureau of Energy Efficiency Handbooks.
2. C.L.Wadhwa, Generation Distribution & Utilization of Electrical Energy, New Age international,1989
3. G Petrecca ,Industrial Energy Management: Principles & applications, Kluwer Academic Publisher,1993

Subject Code : EEP-721
Title of the course : Project Major

L	T	P	Credits	Weekly Load
0	0	8	4	8

Course Outcomes:

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

CO 1: Implement the project requiring individual and teamwork skills.
CO 2: Update recent knowledge in the area of project.
CO 3: Carry out design calculations and implementations in the area of project.
CO 4: Communicate their work effectively through writing and presentation.
CO 5: Handle professional responsibilities and respect for ethics.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
Cos	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S				S			S			S
CO2											S	S
CO3	S		S	S	S		S					S
CO4										S		S
CO5								S				S

The objective of Project Work is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment normally includes:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a Departmental Committee including external expert.

Subject Code : EEP-722
Title of the course : Seminar

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Outcomes:

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

CO 1: Communicate their work effectively through writing and presentation.
CO 2: Use research based knowledge in the latest area of technology.
CO 3: Engage in independent and life-long learning
CO 4: Implement the project requiring individual skills.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										S		
CO2	S			S								S
CO3												S
CO4									S			

Objectives of the programme is to

1. Familiarize the students with the outside professional environment.
2. Make the students able to use the resources for the given problem/assignment.
3. Update the students with modern trends of electrical engineering.
4. Develop own opinions, particularly on issues, based on critical and reasonable approach to the information available.
5. Make the students able to present work in written, oral or formal presentation formats.

Subject Code : EEP-723
Title of the course : Self Study Course (EE)

L	T	P	Credits	Weekly Load
0	0	0	1	0

Course Outcomes:

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

CO 1: Develop the competitive approach in solving problems of electrical engineering.
CO 2: Be fluent in various fields of electrical engineering
CO 3: Enhance the capability of time bound group study.
CO 4: Enhance inter disciplinary knowledge.

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		S								M
CO2	S		S									
CO3									S		S	M
CO4	S		S									M

Syllabus

Section 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Green's theorem. Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables. Complex variables: Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis. Numerical Methods: Solutions of nonlinear algebraic equations, Single and Multi-step methods for differential equations. Transform Theory: Fourier Transform, Laplace Transform, z-Transform.

Electrical Engineering

Section 2: Electric Circuits

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.

Section 3: Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits,Self and Mutual inductance of simple configurations.

Section 4: Signals and Systems

Representation of continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Applications of Fourier Transform, Laplace Transform and z-Transform.

Section 5: Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of dc motors; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Section 6: Power Systems

Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, GaussSeidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Section 7: Control Systems

Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Section 8: Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Section 9: Analog and Digital Electronics

Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

Section 10: Power Electronics

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to dc converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.