ELECTRICAL ENGINEERING 1st Year / Semester I/II

				Effective from Session	2015-16		
Course Code	EE103	Title of The Course	BASIC ELECTRICAL ENGINEERING	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	• Knowledge and concept of D.C Circuit Analysis and Network Theorems Circuit. • Use of Steady State Analysis of Single-Phase AC Circuits AC fundamentals. • Knowledge and concept of Three Phase AC Circuits Three phase system and measuring devices. • Basic concepts of Power System and Transformer • Study of Electromechanical energy conversion devices: AC/ DC Machines.

	Course Outcomes
CO1	Know about the concept of D.C Circuit Analysis and Network Theorems Circuit.
CO2	Steady State Analysis of Single Phase AC Circuits AC fundamentals.
CO3	Know about concept of Three Phase AC Circuits Three phase system and measuring devices
CO4	Layout of Power System and transformer
CO5	Know about Electromechanical energy conversion devices: AC/ DC Machines

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**D.C Circuit Analysis and Network Theorems** **Circuit concepts**: Concept of network, Active and passive elements, linear network, unilateral and bilateral elements, source transformation, Kirchhoff's Law: loop and nodal methods of analysis, star delta transformation. **Network theorems:** Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem.	8	CO1
2	**Steady State Analysis of Single Phase AC Circuits** AC fundamentals: Average and effective value of Sinusoidal waveform , form factor and peak factor,concept of phasors, phasors representation of sinusoidally varying voltage and current, analysis of series RLC circuits. Apparent, active and reactive powers, power factor, causes and problems of low power factor, power factor improvement, resonance, bandwidth and quality factor in series circuit.	8	CO2
3	**Three Phase AC Circuits** **Three phase system:** Its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply, line and phase voltage/current relationship. **Measuring Instruments:** Types of instruments: construction and working principle of PMMC, MI type instruments, induction type energy meter.	8	CO3
4	**Introduction of Power System:** General layout of electrical power system, standard generation, transmission and distribution voltage levels, concept of grid.**Magnetic circuit:** Concepts, analogy between electric and magnetic circuit. **Single Phase Transformer:** Principle of operation, construction, emf equation, equivalent circuit, losses, efficiency, Introduction to auto transformer.	8	CO4
5	**Electromechanical energy conversion devices:** **DC Machines:** Types, emf equation of generator and torque equation of motor, applications. Three Phase Induction Motor: Types, principle of operation, applications. Single Phase Induction Motor: Principle of operation and introduction to methods of starting, applications. **Three Phase Synchronous Machines:** Principle of operation of alternator, synchronous motor, applications.	8	CO5

References Books:

1. V.Deltoro, "Principle of Electrical Engg." PHI, 2009..
2. M.A Mallick, Dr. I. Ashraf, "Fundamental of Electrical Engg," CBS Publishers, 2010.
3. A. Hussain, "Basic Electrical Engg" Dhanpat Rai & sons, 2007
4. I J Nagrath,"Basic Electrical Engg" ,TMH, 2010.

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3	PSO4

CO																
CO1	3	3	2	1	1	3						3	3	3	2	3
CO2	3	3	3	2	1	1						2	3	2	2	3
CO3	3	2	1	1	2	2	3					3	2	2	2	3
CO4	3	2	2	2	3	3						2	3	2	2	3
CO5	3	1	1	1	1	2	1					2	3	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd Year/ 3rd Semester

				Effective from Session	16-17		
Course Code	EE201	Title of The Course	LINEAR NETWORK AND SYSTEMS.	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	**OBJECTIVE**

	Course Outcomes
CO1	For a given network, would be able to apply the knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits, Identify, formulate, and solve engineering problems in the area electrical circuits & systems.
CO2	For a given system with dc and ac circuits, describe the different network theorems, would be able to apply, solve and verify the solutions using modern tools for lifelong learning like MATLAB.
CO3	For given a system with two port networks described in standard form, would be able to characterize, modeling, analyze, and verify the network in terms of all network parameters.
CO4	For given a system with RL, RC, and RLC circuits, would be able to understand, perform, formulate, and solve the differential equations for RL, RC, and RLC circuits and analyze the characteristics of the system.
CO5	For given a system description, would be able to explore and apply to alternate system description, and implement using basic blocks for network transfer function in s-domain and Two port networks.

No.	Content	Contact Hrs.	Mapped CO
1	Kirchhoff's law, Source transformation, loops variable analysis, node variable analysis, Super Mesh and Super Node ,AC Network theorems: Superposition, Thevenin's, Norton's, Maximum power transfer theorems, Reciprocity, Millman's and Tellegen's theorem.	8	CO1
2	Transient and steady state analysis for R-L, R-C and RLC circuits. Series and parallel resonance (Transient and steady State), Initial value and final theorem Use of Laplace transform in circuit analysis, Solution of differential equations. Lap lace transform of complex waveform.	8	CO2
3	Concept of poles and zeros, Restrictions on pole and zero location for driving point function and transfer function, Positive real function: Definitions and properties, Hurwitz Polynomial, Synthesis of RC, LC and RL Networks using Cauer and Foster forms.	8	CO3
4	Two port networks, two port parameters, Inter-Conversion of two port Parameters, Interconnections of Two port networks, Reciprocity and Symmetry, Image impedance, Characteristic impedance, T-pie transformation.	8	CO4
5	Introduction to graph theory, Definitions- Graphs, Tree, Co- tree, Path and Loop, Concept of Planner and non planner network, Incidence, Cut-set, Tie-set matrices for planer network, loop and nodal analysis, Duality.	8	CO5
References Books:			
1. M.E.Van Valkenburg, Network Analysis, PHI			

2. J.A.Edminister, Electric Circuits, Schaum Series, PHI
3. W.H. Hayt and Jack.E.Kammerly, Engineering Circuit Analysis, Tata Mc Graw Hill
4. A.Hussain, Network and Systems, Khanna publications

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2	1		1	1	1		2	3	3	2	2
CO2	3	2	3	3	2	2	1	2		1		1	3	3	3	2
CO3	3	3	2	3	2	1							3	2	2	3
CO4	3	2	2	3	1			1		1		1	3	3	2	3
CO5	3	3	3	3	2	1		1		1			3	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd Year/3rd Semester

				Effective from Session				
Course Code	EE 203	Title of The Course	Electro Mechanical Energy Conversion-I	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	Knowledge and concept of D.C Circuit Analysis and Network Theorems Circuit. • Use of Steady State Analysis of Single Phase AC Circuits AC fundamentals. • Knowledge and concept of Three Phase AC Circuits Three phase system and measuring devices. • Basic concepts of Power System and Transformer • Study of Electromechanical energy conversion devices: AC/ DC Machines.

	Course Outcomes
CO1	Know about the concept of D.C Circuit Analysis and Network Theorems Circuit
CO2	Steady State Analysis of Single Phase AC Circuits AC fundamentals.
CO3	Know about concept of Three Phase AC Circuits Three phase system and measuring devices
CO4	Layout of Power System and transformer
CO5	Know about Electromechanical energy conversion devices: AC/ DC Machines

No.	Content	Contact Hrs.	Mapped CO
1	**Principle of EMEC Introduction**, Energy in electromagnetic system, Flow of energy in electromechanical devices, Energy in magnetic field and co-energy, Dynamics of electromechanical systems, singly excited systems, Doubly Excited. System, Force and torques in systems with permanent magnets. .	8	CO1
2	**D.C. Machines** Construction Features, EMF and Torque equations, Armature windings, Armature Reaction, Demagnetizing and cross magnetizing M.M.F., Interpole and compensating windings, Commutation, characteristics of D.C. generator.	8	CO2
3	Characteristics of D.C. motors, Starting of D.C. motors, Starter step calculation for a D.C. shunt motor, speed control of D.C. shunt motors, braking of D.C. motors, Losses, efficiency and testing of D.C. machines test on D.C. machines.	8	CO3
4	**Transformers** Review of Single Phase Transformers, Transformer Constructions and Practical Considerations, Equivalent circuit, Phasor diagram, Transformer testing, Efficiency and Voltage regulation, All day Efficiency, Per unit values, Autotransformer.	8	CO4
5	Three phase transformers connection, 3 to 6 phase conversion, Scott connection, Parallel operation of transformer, Three winding transformer, Tap changing transformer for special purposes.	8	CO5

References Books:

1. Electric Machines, M.A.Mallick, IK International Pvt. Ltd New Delhi,2009
2. Electrical Machinery, Fitzgerald, Kingsley (McGraw Hill),6th Edition,2020
3. Electrical Machines and their Applications, J Hind Marsh,4th Edition,1984
4. Fundamental of Electrical Machines, B.R. Gupta & V. Singhal ,New Age International Pub.,2005
5. Electric Machinery and Transformers, I.L.Kosow, PHI,2007
6. Electrical Machine, I J Nagrath and D P Kothari ,TMH,2004

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	1	3						3	3	2	1	3
CO2	3	3	3	2	1	1						2	3	2	2	2
CO3	3	2	1	1	2	2	3					3	2	2	1	3
CO4	3	2	2	2	3	3						2	3	3	1	2
CO5	3	1	1	1	1	2	1					2	3	1	2	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd YEAR/3rd YEAR

				Effective from Session		2016-17		
Course Code	EE-205	Title of The Course	Solid State Devices & Circuit	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	

	Course Outcomes
CO1	Analyze and designing concept of special purpose diodes for different types of operation for industrial application purpose. Understand the advancement in conductivity of semiconductors material. Analysis the different regions in which BJT operates and their applications as a switches, amplifiers etc.
CO2	Understand the advancement in transistors like JFET, MOSFET, PMOS, NMOS, CMOS etc. and their various types' applications in Industries. Analyze the frequency response of these devices as different amplifier applications. To Understand how the gain of amplifier effected with frequency changes and their applications.
CO3	To develop and analyze the performance of small signal amplifiers and large signal amplifiers (Power amplifiers) . To understand and implement the various power amplifier in applications as transmitter and receiver in communication purpose.
CO4	Developing the concept of feedback amplifiers, their different topologies and Implement it for various applications. To analyze their stability and their responses for different applications.
CO5	To analyze the design considerations of the active and passive filters. How to develop the various orders of filters and their industrial applications. To understand the constructional difference and working of various types of oscillators. How the oscillators can be developed and their use in industries.

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Special Diodes, LED, Zener, Varactor, Schottky barrier, photo diode, and tunnel diode: their constructions and characteristics. Bipolar Junction Transistors, biasing of BJT, equivalent circuit, Transistor as a switch, cut off and saturation region, complete static characteristics of BJT, Darlington pair.	8	CO1
2	Field Effect transistor: Structure and physical operation. Enhancement and depletion types MOSFET, Classification of MOS: NMOS, PMOS and CMOS I/V characteristics, Biasing of FET, Low and high frequency response of common source and common emitter configuration, Common base and Common gate cascade configurations, CC-CE cascade	8	CO2
3	Small signal amplifiers: BJT and MOSFET, Frequency response improvement, Classification of amplifiers: Class A, Class B, Class C amplifiers, Power amplifiers, push pull amplifiers, DC amplifier, coupling methods.	8	CO3
4	Basic concept, General feedback structure, properties of negative feedback, four basic feedback topologies: series-series, series-shunt, shunt-series and shunt-shunt, determination of Loop gain, stability analysis, wave shaping circuits.	8	CO4
5	Active filters, Oscillators, condition for oscillation, Basic principles of sinusoidal oscillator, RC oscillators, Phase Shift oscillator, Wein bridge oscillator, Hartley and Colpitt's oscillator, Crystal Oscillator, Operational amplifier: Characteristics and application	8	CO5

Text books:

1. A.S. Sedra and K.C. Smith, "Microelectronic circuits", Oxford University Press (India). 2. B.P. Singh & R. Singh, Electronics Devices & Integrated Circuits, Pearson.

2. Millman, J. and Grabel, A., 'Microelectronics',/McGraw Hill.

References Books:
1. Bell, David A,’Electronic Devices & Circuits’,Prentice Hall (India) 4th Edition.
2. Nair, B. Somanathan, ‘Electronics Devices & Applications’,Prentice-Hall (India)
3. Neamen, Donald A., ‘Electronic Circuit Analysis & Design’,Tata McGraw Hill.
4. Sedra, ‘Micro Electronics Circuits’, Oxford University Press.

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	2	3	3	1	1	1		2	2	2	2	2	2
CO2	3	3	2	3	2	3	2						2	2	1	2
CO3	3	2	3	2	2	2	1	1			1	1	2	3	2	2
CO4	3	1	1	1	2	2	2						2	2	1	2
CO5	3	1	1	1	2	2	2						2	3	1	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd YEAR/3rd SEMESTER

				Effective from Session				
Course Code	EE-207	Title of The Course	Fundamentals of EMFT	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	• To understand the students about Coordinates systems. To develop ability for analysis of three-dimensional space and obtain the solution of electromagnetic problems by Vector theorems and Operators. • To analyze the electrostatics problems by applying fundamental law's. • To realize and examine the magneto statics problems and response the behavior of magnetic fields in different magnetic materials • To recognize the concepts of Gauss Law and Maxwell equation by investigation in real time domain . To learn the Concepts of Displacement Current and Wave Propagation. • To execute the analysis of Guided Waves and transmission lines by various parameters and propagation constant .

	Course Outcomes
CO1	Given a physical quantity, students shall be able to **represent** this in vector and scalar form, **identify** type of system**, apply** vector algebra, and **formulate** the expression in different coordinates and **solve** using vector theorems.
CO2	Given a electrostatic problems of passive elements with sources, student shall be able to **analyze** and **evaluate** the problems using Gauss laws and Divergence theorem.
CO3	For a given magneto-static situation , student shall be able to generate its analytical response by Biot Savart's law and **examine**, **analyze** and **evaluate** the characteristics by Maxwell's Equation and Boundary Conditions
CO4	For a given Time varying function, students shall be able to identify its characteristics and for Wave Propagation , **select** suitable **design** of application of Maxwell's equation, **develop** various combination for Power by Pyonting Vector and explain the functions of its main components.
CO5	Given a Guided Waves and Transmission line, student shall be able to **define** its parameters**, solve/ analyze,** and **modify** its form

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Review of scalar and vector field, Co-ordinates systems and their transformation (Cartesian, cylindrical and spherical). Vector representation of surfaces, Del operator, Gradient of Scalar, Divergence of vector and Divergence theorem, Curl of vector and Stocks Theorem, Laplacian of Scalar. .	8	CO1
2	**Electrostatic Fields:** Coulombs law and field Intensity, Electric flux density, Gauss's law and its application, Electric potential, Electric dipole and flux lines, Energy density. Introduction to conductors, Dielectrics polarization, Continuity equation, boundary conditions, Poisson's and Laplace's equation.	8	CO2
3	**Magneto-static Fields:** Biot-Savarts Law, Ampere's circuit law, Magnetic flux density, Magnetic scalar and vector potentials. Force due to magnetic fields, Lorentz-force equation, Magnetic torque and moment Magnetization in material, Boundary conditions, Energy density.	8	CO3
4	**Time-Varying Fields & Wave propagation:** Faraday"s law, displacement current, Maxwell's equation in integral and point form, Time varying potential, Time Harmonic Fields. Propagation of uniform plane waves in free space, dielectric and conductors, Pyonting theorem and power flow, Reflection of plane wave at Normal Incidence.	8	CO4
5	**Guided waves & Transmission line:**	8	CO5

	Introduction to guided waves, Rectangular waveguide. Transmission line parameter, Transmission line equations, Characteristic impedance, propagation constant (for lossless lines and Distortion-less lines), Input impedance, reflection coefficient, Standing wave ratio and Power. Open and short circuited lines.		

References Books:

1. Elements of Electromagnetics- "M.N.O. Sadiku", oxford University Press

2. Electromagnetic waves and Radiating systems- E.C.Jorden, D.G.Balmein

3. Engineering Electromagnetics- "W.H.Hayt & J.A. Buck", TMH.

4. Electromagnetic- J.F.D.Kraus, R.C.Keith

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	1							2			2
CO2	3	3	1	1	2								1	2	1	2
CO3	3	3	1	1	2								1	3		2
CO4	3	3	2	1	2								1	2		2
CO5	3	3	2	2	2		1	1				1	2	2		3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2^{nd} Year/ 3^{rd} Semester

			Effective from Session		**2016-17**		
Course Code	EE 209	Title of The Course	Electrical Measurement & Measuring Instruments	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objective	To understand the measurement system, measurement methods and errors, measurement of electrical quantities To understand three phase power measurement; working of thermocouple, electrostatic and rectifier type instruments; energy meter and instrument transformer To understand measurement of low, medium and high resistances, use of ac bridges and Q meter To understand use of ac potentiometer; measurement of speed, frequency and power factor To understand digital measurement of electrical quantities; CRO and its application

	Course Outcomes
CO1	Adopt the methods of measurement, investigate the errors in measurement, analyze and rectify; perform analog measurement of electrical quantities; contribute in related development
CO2	Perform three phase power measurement; use thermocouple, electrostatic, rectifier type instruments, energy meter and instrument transformer for measurement; identify errors in energy meter and adopt remedies; adopt extension of instrument range using instrument transformer; contribute in related development
CO3	To perform measurement of low, medium and high resistances; perform measurement of inductance and capacitance using ac brides; adopt use of Q meter, contribute in related development
CO4	To adopt use of ac potentiometer; perform measurement of speed, frequency and power factor; contribute in related development
CO5	To perform digital measurement of electrical quantities; adopt application of CRO, dual trace and dual beam oscilloscopes; contribute in related development

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Philosophy of measurement: Methods of measurement, measurement system, classification of instrument system, characteristics of instrument and measurement system, error in measurement and its analysis. Analog measurement of electrical quantities: PMMC type Instruments, Moving Iron type Instruments, Electrodynamics type Instruments' three phase wattmeter, error and remedies in wattmeter.	9	CO1
2	Power measurements in three phase system, Thermocouple, electrostatic and rectified type ammeter and voltmeter, Energy meter, error and remedies in energy meter. Instrument transformer and their application in the extension of instruments range.	8	CO2
3	Measurement of parameter: Different methods of measurement of low, medium and high resistances, measurement of inductance and capacitance with the help of AC bridges, Q-meter.	7	CO3
4	AC Potentiometer: Polar type and co-ordinate type AC potentiometer, application of AC potentiometers in electrical measurement. Measurement of speed, frequency and power factor.	8	CO4
5	Digital measurement of electrical quantities: concept of digital measurement, block diagram, study of digital voltmeter, frequency meter, Cathode ray oscilloscope: Basic CRO circuit (block diagram), cathode ray tube (CRT), and its components, application of CRO in measurement, Lissajous pattern, Dual trace and dual beam oscilloscopes.	8	CO5

References Books:

1. E.W. Golding & F.C. Widdis, "Electrical measurement & Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India.
2. A.K. Sawhney, "Electrical &Electronics Measurement & Instrument", Dhanpat Rai &Sons, India.
3. M.B. Stout ,"Basic Electrical Measurement" Prentice hall of India, India.
4. Forest K. Harries," Electrical Measurement", Willey Eastern Pvt. Ltd. India.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	2	2		3
CO2	3	3	1	2	3							2	2			3
CO3	3	1	1		3							2	2			3
CO4	3	1	1		3							2	2			3
CO5	3	1	1		3							2			2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd Year/ 3rd Semester

			Effective from Session	2016-17				
Course Code	EE 211	Title of The Course	Electro Mechanical Energy Conversion II		L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE		3	1	0	4

Objective	Knowledge of principle of operation of three phase ac motors □ Identify different ac motors on the basis of characteristics □ Analyze different ac machines □ To evaluate the performance of ac machines □ Knowledge of parallel operation of ac generators

	Course Outcomes
CO1	Knowledge of different types of three phase induction machines
CO2	Analyze the induction machines performance under loading condition
CO3	Evaluate the performance of single phase ac machines
CO4	Knowledge of three phase synchronous machines
CO5	Evaluate the performance of synchronous machines

No.	Content	Contact Hrs.	Mapped CO
1	**Three phase Induction Machine** I: Constructional features, Rotating magnetic field, Principle of operation Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator & its applications. .	9	CO1
2	**Three phase Induction Machine- II:** Starting, Deep bar and double cage rotors, Cogging & Crawling, Speed Control (with and without EMF injection in rotor circuit).	7	CO2
3	**Single phase Induction Motor:** Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor. AC Commutator Motors: Universal motor, single phase a.c.series compensated motor, stepper motors.	8	CO3
4	**Synchronous Machine I:** Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and Phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient .	8	CO4
5	**Synchronous Machine II:** Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics. **Synchronous Motor:** Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser.	8	CO5

References Books:

1. D.P. Kothari & I.J. Nagrath , 'Electric Machines', Tata Mc Graw Hill,2004.
2. Ashfaq Hussain ,'Electric Machines', Dhanpat Rai & Company,2010.
3. Fitzerald ,A.E., Kingsley and S.D.Umans, 'Electric Machinery', MC Graw Hill,2014.
4. P.S.Bimbhra, 'Electrical Machinery', Khanna Publishers,2003
5. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', Khanna Publishers ,1995
6. M.G.Say, 'Alternating Current Machines', Pitman & Sons,3rd Edition, 1995.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1									2		2	3
CO2	3	2		1									2	3	2	2
CO3	3	1										2	2	3	2	3
CO4	3	2										1	2	3	2	3
CO5	3	2					1						2	3	3	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

			Effective from Session				
Course Code	**EE 213**	Title of The Course	**Numerical Analysis and Applications**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	• Knowledge of principle of operation of three phase ac motors • Identify different ac motors on the basis of characteristics • Analyze different ac machines • To evaluate the performance of ac machines • Knowledge of parallel operation of ac generators

	Course Outcomes
CO1	Knowledge of different types of three phase induction machines
CO2	Analyze the induction machines performance under loading condition
CO3	Evaluate the performance of single phase ac machines
CO4	Knowledge of three phase synchronous machines
CO5	Evaluate the performance of synchronous machines

No.	Content	Contact Hrs.	Mapped CO
1	**Errors and approximations** Error definitions, accuracy and precision, round off and truncation errors, estimation, error propagation. **Roots of equations**- Bracketing methods, open methods like Newton- Raphson, Secant etc. **Finite differences**- Forward differences, Back ward differences, Central differences.	8	CO1
2	**Solutions of simultaneous linear algebraic equations** Methods of elimination, Gauss elimination, Methods of Relaxation, iterative method Matrix inversion, Gauss seidel, LU decomposition methods.	8	CO2
3	**Curve fitting** Least squares regression- Linear, Polynomial, Nonlinear. Interpolation, Ordinary difference operators E&D, Fourier series approximation.	8	CO3
4	Numerical differentiation, Numerical integration- Newton cotes, Gauss quadratures.	8	CO4
5	**Numerical solutions for ordinary differential equations** Methods of successes approximation, Euler, Modified Euler, Runge-Kutta, Adaptive Runge-Kutta, Miline method,	8	CO5

References Books:

1. J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, Springer-Verlag, ISBN 0-387-90420-4

2. L.N. Trefethen and D. Bau, Numerical Linear Algebra, Society of Industrial and Applied Mathematics

3. C.T. Kelley, Iterative methods for linear and nonlinear equations, Society of Industrial and Applied Mathematics

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1									1		1	2
CO2	3	2					1							2		2
CO3	3	1										2		2		3
CO4	3	2										1	2		2	2
CO5	3	2					1							3		2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd Year/4th Semester

				Effective from Session	EE-2016-17		
Course Code	EE217	Title of The Course	**Signal System Analysis**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objectives	• Demonstrate an understanding of the fundamental properties of linear systems • Uses of transform analysis and convolution, to analyze and predict the behavior of linear time invariant systems.

	Course Outcomes
CO1	Understand mathematical description and representation of continuous and discrete time signals and systems.
CO2	Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Understand and resolve the signal in frequency domain using Fourier series and Fourier transforms.
CO4	Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.
CO5	Analyze the discrete time signals and system using DTFT, DFT and Z

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Formalizing Signals:** Continuous-time/discrete-time, Periodic/non-periodic, even/odd, energy/power, deterministic/ random, Unit step, Unit ramp, Unit impulse, Sinusoid, complex exponential signals. **Signal Properties:** Periodicity, absolute integrability, determinism and stochastic character. **System properties:** Linearity, additivity and homogeneity, Scaling, shift invariance, causality. **Continuous and discrete time linear shift invariance system:** The impulse response and step response, convolution, input-output behavior. .	8	CO1
2	**Fourier Transform Analysis** Fourier series representation, Exponential and compact trigonometric form of Fourier series, Fourier symmetry, Fourier Transform, convolution/ multiplication and their effect in frequency domain, magnitude and phase response, Fourier domain duality, inverse Fourier transform, Application to circuit analysis, Dirichlet's condition.	8	CO2
3	**Discrete Fourier Transform** Discrete time Fourier transform (DTFT), Discrete Fourier transform (DFT), Parsevals theorem, properties convergence, Sampling theorem and its implication, Reconstruction: Ideal interpolator, zero order hold, aliasing and its effect, Relation between continuous and discrete time system.	8	CO3
4	**Laplace Transform** Laplace Transform for continuous time signals and systems: The notion of Eigen function of LSI system, region of convergence, system functions, poles and zeros of system functions and signals Convolution theorem, Laplace domain analysis, Waveform synthesis, solution to differential equation and system behavior.	8	CO4
5	**Z-Transform Analysis:** Z Transform for discrete time signal and system, Eigen function , region of convergence ,system function, poles and zeroes of system sequences, Z domain analysis, solution of difference equation, pulse transfer function	8	CO5

Text Books:

1. S.H. Saeed, Faizan Arif Khan, "Basic System Analysis'' 2nd Edition, Katson Publishing Delhi.
2. A.V. Oppenhiem, A.S. Wilsky and I.T. young, "Signals & Systems", Prentice Hall, 1983
3. M E Van-Valkenberg; "Network Analysis", Prentice Hall of India.
4. A. Anand Kumar, "Signals & Systems", PHI
5. Choudhary D. Roy, "Network & Systems", Wiley Eastern Ltd.

References Books:

1. David K. Cheng; "Analysis of Linear System", Narosa Publishing
2. Donald E. Scott, "Introduction to circuit Analysis" Mc. Graw Hill
3. B. P. Lathi, "Linear Systems & Signals" Oxford University Press, 2008.
4. I. J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, "Signals and Systems", Tata Mc. Graw Hill

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2		1			1	1		1	2			3
CO2	3	3	2	2					1	1		1		2		2
CO3	3	3	2	2		1			1	1		1			2	2
CO4	3	3	2	2		1			1	1		1		2		2
CO5	3	3	2	2		1	1		1	1		1		2		2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 2nd Year/4th Semester

			Effective from Session	2016-17			
Course Code	EE221	Title of The Course	**Electrical Engineering Materials**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objectives	▪ To apply the knowledge of material science engineering. ▪ To understand the impact of realistic constraints such as economic, environmental, safety, reliability, manufacturability and sustainability. ▪ To know the properties of conducting, insulating, dielectric and magnetic materials from electrical engineering point of view. ▪ To realize the potential of semiconducting devices with their application. ▪ To learn latest techniques, skills, and modern engineering tools necessary for electrical engineering fabrication processes.

	Course Outcomes
CO1	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances, devices, instruments and in the applications associated with generation, transmission and distribution of electric power.
CO2	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances, devices, instruments and in the applications associated with generation, transmission and distribution of electric power.
CO3	To provide students with a moderate level understanding of the physics behind the semiconductors.
CO4	To provide students with a thorough understanding of the electrical properties and characteristics of various materials used in the electrical appliances , devices , instruments and in the applications associated with generation, transmission and distribution of electric power.
CO5	An understanding of the electrical engineering material science essential for them to work in different fabrication based industries and also motivate them to do innovative characterization based research while going for higher studies and also to work in R & D with scientific enthusiasm

No.	Content	Contact Hrs.	Mapped CO
1	**Classification of Materials:** Metals and alloys, polymers, conducting materials, characteristic of good conductors, commonly used conducting materials, smart materials, fuel cell, super alloys, memory alloys, degradation of materials, .	8	CO1
2	**Dielectrics, Insulating and Conducting Materials** Dielectric strength, factor affecting strength, polarization, dielectric loss, Types of capacitor, Insulating & Dielectric Materials - Properties of insulating materials, classification of insulating materials, Piezoelectricity, Ferro electricity, Principle and Applications of Optical Fiber, Material for OH lines and UG cables, Fuse, soldering, Effect of temperature on transformer oil	8	CO2
3	**Semiconductors and their Applications** Types of semiconductor, direct and indirect band gap, semiconductor application and advantages of semiconducting devices, photo conducting cell, Hall effect generator, MHD generator, LEDs, photodiode, Introduction to LCD .	8	CO3
4	**Magnetic Materials and their Applications:** Basic concepts and definitions, origin of magnetism, dia, Para, Ferro, anti Ferro, ferri magnetism, Curie Temperature, Hysteresis and its significance, soft and hard magnetic materials, ferrites, silicon steel, their properties and uses, magnetic resistance.	8	CO4
5	**Fabrication and Characterization of Materials:** Planar process,, lithography, etching, spin coating, sputtering, CVD, carbon nanotube, nanowires (synthesis, properties and applications), Material characterization techniques such as scanning electron microscopy, transmission electron microscopy, Scanning tunneling microscopy, atomic force microscopy, differential scanning calorimetry.	8	CO5

References Books:

1. A. J. Dekker, Electrical Engineering Materials, PHI.
2. C.S Indulkar & S.Thiruvegada, An introduction electrical Engg Materials, S. Chand & Co.
3. S.O Kasap, Principles of Electronic Materials & Devices, TMH
4. L.V Azaroff, Introduction to Solids, Mc Grow Hill Company
5. Charles Kittle, Quantum theory of Solids, John Wiley and Sons

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1									2	3		1
CO2	3	2											3	3		1
CO3	3	2		2								3	1	3		1
CO4	2	1										3	2	2		2
CO5	3		3									1	3	3		

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year/5th Semester

				Effective from Session	2017-18		
Course Code	**EE301**	Title of The Course	**CONTROL SYSTEMS**	L	T	P	C
Pre- Requisite	Linear Network& Systems EE 201	Co-Requisite	None	3	1	0	4

Objectives	• To learn the concept of transfer function and mathematical modeling of systems. • To get the knowledge of first order and second order system. • To gain information of the system. • To evaluate the stability of the system using Nyquist stability criterion • To design the compensator and also study of state space analysis.

	Course Outcomes
CO1	To learn the concept of transfer function and mathematical modeling of systems.
CO2	To get the knowledge of first order and second order system.
CO3	To gain information of the system.
CO4	To evaluate the stability of the system using Nyquist stability criterion
CO5	To design the compensator and also study of state space analysis.

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Input/ Output Relationship** Introduction to control system, Open and closed loop control system, Mathematical modeling of physical systems, Transfer function of electrical and mechanical system, Analogous systems, Block Diagram Reduction Algebra and signal flow graph, Mason's gain formula.	8	CO1
2	**Time Domain Analysis** Time domain criteria; Test Signals; Transient and steady state response of first and secondorder feedback systems; Performance indices; Response analysis with proportional, Proportional- Derivative (PD) controller, Proportional-Integral (PI) controller and Proportional- Integral –Derivative (PID) controller.	8	CO2
3	**Stability, Algebraic Criteria and Frequency response Analysis** Asymptotic and conditional stability, Routh Hurwitz criterion, Frequency response analysis, Correlation between time and frequency domain specifications, Resonant peak,Resonant frequency, Bandwidth, Cutoff frequency, Polar plots, Bode plots.	8	CO3
4	**Root Locus Technique and Stability in Frequency Domain** The root locus concepts, Construction of root loci, Nyquist stability criterion, Relativestability, Gain margin, Phase margin, Constant M and N circles.	8	CO4
5	**Introduction to Design and State variable technique** Design through compensation Techniques; Realization of Lag, Lead, And Lag-Lead compensation; Design of closed loop control system using root locus and bode plot compensation. Introduction to State variable analysis, State space representation, Stateequations, State transfer matrices, Controllability and observability.	8	CO5

References Books:

B. C. Kuo, "Automatic Control system", Wiley, 9th Edition, 2014.

I. J. Nagrath & M. Gopal, "Control system Engineering", New Age International, 4th Edition, 2015.

K. Ogata, "Modern Control Engg.", PHI, 4th Edition, 2002.

S. K. Bhattacharya, "Control system Engg.", Pearson Education, 2nd Edition, 2008.

S. Hasan Saeed, "Automatic control system", Kataria and sons, New Delhi, 8th Edition, 2016

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1									2	1	2	3
CO2	3	2		1									3	2	3	3
CO3	3	2										1	3	1	2	3
CO4	1	3		2								1		2		3
CO5	2	2	3									1	1		2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

				Effective from Session			
Course Code	**EE 303**	Title of The Course	**POWER ELECTRONICS**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	

	Course Outcomes
CO1	Understand and analyze the concept, design, technique, advancement and application of Bipolar junction transistor, Power Metal oxide semiconductor field effect transistor, Insulated gate bipolar junction transistor, operation of Silicon controlled rectifier (SCR), Firing circuits of Thyristor, Turn on methods of a Thyristor and Thyristor turn-off process.
CO2	Understand and analyze the concept, design, technique, advancement and application of Protection of Thyristor, Series and parallel operation of SCR, Gate turn off (GTO) thyristor. Understand and analyze the concept and knowledge advancement in Gate characteristic of an SCR, Dynamic characteristics of SCR, Two transistor analogy, Rating of an SCR
CO3	Understand and analyze the concept, design, technique, advancement and application of single phase half wave and full wave controlled rectifiers with different types of load, Effect of source impedance on the performance of full wave converter, Dual converter, three phase converters and cyclo-converters
CO4	Understand and analyze the concept, design, technique, advancement and application of Single phase bridge inverters (half and full wave), Pulse width modulation (PWM) inverters, Series inverter, Parallel inverter, Mc-Murray half bridge inverter, Three phase inverter.
CO5	Understand and analyze the concept, design, technique, advancement and application of choppers, chopper circuits, Multi quadrant choppers, Commutation of choppers, Switched mode power supplies.

No.	Content	Contact Hrs.	Mapped CO
1	Power Transistors I Classification of power transistors, Bipolar junction transistor (BJT), Power Metal oxide semiconductor field effect transistor (MOSFET), Insulated gate bipolar junction transistor (IGBT), Basic principle of operation of Silicon controlled rectifier (SCR), Voltage vs Current characteristics of SCR, Firing circuits of Thyristor, Turn on methods of a Thyristor, Thyristor turn-off process.	8	CO1
2	Power Transistors II :Protection of Thyristor, Gate characteristic of an SCR, Dynamic characteristics of SCR, Series and parallel operation of SCR, Two transistor analogy, Rating of an SCR, Gate turn off (GTO) thyristor.	8	CO2
3	Controlled Rectifiers Analysis of single phase half wave and full wave controlled rectifiers with different types of load, Effect of source impedance on the performance of full wave converter, Dual converter, Introduction to three phase converters and cyclo-converters.	8	CO3
4	Classification of inverters, Single phase bridge inverters (half and full wave), Pulse width modulation (PWM) inverters, Series inverter, Parallel inverter, Mc-Murray half bridge inverter, Three phase inverter.	8	CO4
5	Choppers :Principle of choppers, Analysis of chopper circuits, Multi quadrant choppers, Commutation of choppers, Switched mode power supplies.	8	CO5

References Books:

1.M. H. Rashid, "Power Electronics: Devices, Circuits and applications", Pearson, 4th edition, 2014.

2. J. M. Jacob, "Power Electronics: Principles and applications", Thomson Press (India) Ltd; 1st edition, 2006.

3. Vedam Subramanium, "Power Electronics: Devices, Converters, Application", New Age Int. (P) Ltd., 2nd edition, 2012.

4. Ned Mohan, "Power Electronics: Converters, Applications and Design", Wiley, 3rd edition, 2002.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	3	3	2	2	2	1	1	2	3	2	3	3
CO2	3	3	2	1	3	3	2	2	2	1	1	2	3	2	2	2
CO3	3	3	2	1	3	3	2	2	2	1	1	2	2	2	2	3
CO4	3	3	2	1	3	3	2	2	2	1	1	2	2	3	2	2
CO5	3	3	2	1	3	3	2	2	2	1	1	2	3	3	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year

				Effective from Session		2017-18	
Course Code	**EE305**	Title of The Course	**COURSE: DIGITAL CIRCUITS AND SYSTEMS**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	To understand number representation and conversion between different representation in digital electronic circuits. Became familiar with the digital signal, positive and negative logic, Boolean algebra, logic gates, logical variables, the truth table, number systems, codes, and their conversion from one to others. To analyze logic processes and implement logical operations using combinational logic circuits. To understand competence in Combinational Logic Problem formulation. To understand concepts of sequential circuits and to analyze sequential systems in terms of state machines. To understand competence in analysis of synchronous and asynchronous sequential circuits. To understand characteristics of memory and their classification. To understand concept of Programmable Devices, PLA, PAL, PLD and FPGA and implement digital system. To impart how to design Digital Circuits.

	Course Outcomes
CO1	Convert different type of codes and number systems which are used in digital communication and computer systems. Develop a digital logic and apply it to solve real life problems.
CO2	Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
CO3	Analyze, design and implement combinational and sequential logic circuits.
CO4	Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
CO5	Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.
CO6	Classify different semiconductor memories. Assess the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.

No.	Content	Contact Hrs.	Mapped CO
1	**Introduction** Digital systems, Logic Circuits, Review of positional number system, Fixed and floating Numbers, Binary coded decimal (BCD) codes, Gray Codes, Parity Check Codes. Standard representation of logic functions: Sum of Products (SOP) and Product of Sums (POS) forms, Simplification of switching functions: Karnaugh-Map (K-Map). .	8	CO1
2	**Logic Families** Introduction to different logic families; Transistor Transistor Logic (TTL) and Complimentary - Metal oxide semiconductor (C-MOS) inverter: circuit description and operation; Structure and operations of TTL and C-MOS gates; Electrical characteristics of logic gates: Logic levels, noise margins, propagation delay and power consumption.	8	CO2
3	**Combinational logic systems, Modules and their applications** Basic logic operation and logic gates, Decoder, Encoder, Multiplexer, De-multiplexer, Parity circuits and comparators, Arithmetic modules: Adder and Subtractor	8	CO3
4	**Sequential logic systems, Modules and their applications** Sequential Circuits: Latches and Flip-flops, Transition, Excitation table, Excitation maps and equations, Counters, Shift register, 555 timers, Multivibrator.	8	CO4

5	**Memory and Programmable logic devices** Read only memory, Read/write memory: Static Random Access Memory (SRAM) and Dynamic Random Access Memory (DRAM), Programmable Logic Arrays (PLAs) and Programmable Array Logic (PALs) and their application, Sequential Programmable Logic Devices (PLDs) and their application, Introduction to Field Programming Gate Array.	8	CO5

References Books:

1. R.P. Jain, “Modern Digital Electronics”, TMH, 4^{th} Edition, 2010.
2. Morris Mano, “Digital Design”, PHI, 3^{rd} Edition, 2014.
3. R. J. Tocci, “Digital Systems”, PHI, 4^{th} Edition, 2016.
4. Malvino and Leach, “Digital principles and applications”, TMH, 8^{th} Edition, 2014.
5. J. M. Yarbrough, “Digital Logic-Application and Design”, PWS Publishing, 5^{th} Edition, 2006
6. B. S. Nai, “ Digital Electronics and Logic Design”, PHI, 7^{th} Edition, 2012

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2		1	2	1		1		1	2	2		2
CO2	2	3		2	2	1	3		1	1	1	1	2	3	2	2
CO3	3	3	3	2	2						1	1	3	3	3	3
CO4	2	3	3	2		2	2		1	2	3		2	2	3	3
CO5	1	2	2	2	2	2		3	1		1		2	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year

				Effective from Session		2017-18		
Course Code	**EE-307 / EEE-307**	Title of The Course	**POWER SYSTEM – I**	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	• To get knowledge of Power System Components and Transmission Lines • To get knowledge of inductance and capacitance of Over-Head Transmission Lines • To attain knowledge of Corona and Overhead line Insulators • To study about Mechanical Design of transmission line and Insulated cables • To have the knowledge of Electrical Design of Transmission Line and Neutral grounding

	Course Outcomes
CO1	Understand the Power System Components and Transmission Lines
CO2	Analyse the inductance and capacitance of Over-Head Transmission Lines
CO3	Understand the phenomenon of Corona and Overhead line Insulators
CO4	Having knowledge of Mechanical Design of transmission line and Insulated cables
CO5	Design Electrical Transmission Line and Neutral grounding

No.	Content	Contact Hrs.	Mapped CO
1	**Power System Components and Transmission Lines** Single line Diagram of Power system, Brief description of Power System Elements: Synchronous machine, transformer, transmission line, busbar, circuit breaker and isolator. Different kinds of supply system and their comparison, Choice of transmission voltage. Transmission Line Configurations, Types of conductors, Resistance of line, Skin effect, Kelvin's law, Proximity effect.	8	CO1
2	**Head Transmission Lines** Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines; Representation and performance of short, medium and long transmission lines; Ferranti effect; Surge impedance loading.	8	CO2
3	**Corona and Overhead line Insulators** Phenomenon of corona, Corona formation, Calculation of potential gradient, Corona loss, Factors affecting corona, Methods of reducing corona and interference, Electrostatic and electromagnetic interference with communication lines. Types of insulators and their applications, Potential distribution over a string of insulators, Methods of equalizing the potential, String efficiency.	8	CO3
4	**Mechanical Design of transmission line and Insulated cables** Centenary curve, Calculation of sag & tension, Effects of wind and ice loading, Sag template. Type of cables and their construction, Dielectric stress, Grading of cables, Insulation resistance, Capacitance of single phase and three phase cables, Dielectric loss, Heating of cables.	8	CO4
5	**Electrical Design of Transmission Line and Neutral grounding** Design consideration of Extra High Voltage (EHV) transmission lines, Choice of voltage, Number of circuits, Conductor configuration, Insulation design and selection of ground wires. Necessity of neutral grounding, Various methods of neutral grounding, Earthing transformer,Grounding practices.	8	CO5

References Books:

1. W. D. Stevenson, "Element of Power System Analysis", McGraw Hill, 4th revised edition,1982.
2. C. L. Wadhwa, "Electrical Power Systems", New age international Ltd , 6th Edition, 2010.
3. L.P. Singh, "Advance Power System Analysis & Dynamics", New Academic Science, 6th edition, 2012.
4. Ashfaq Hussain, "'Power System", CBS Publishers and Distributors, 5th Edition, 2010.

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1								1	2	1	2	3
CO2	3	3		1								1	2	3	2	3
CO3	3	3	1	2								1	2	3	2	3
CO4	3	2	3				3		3	2	2	1	2	3	2	3
CO5	3	1	3	2	2	2			3	2	2	2	2	3	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

				Effective from Session				
Course Code	EE311	Title of The Course	POWER SYSTEM-II		L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE		3	1	0	4

Objectives	• Representing elements of a power system including generators, transmission lines, and transformers. • Understand the functioning of a synchronous machine and represent it with simple models. • Perform Fault analysis for a balanced three-phase power system . • Analyze multi-node power systems using an admittance matrix or impedance matrix representation of the power system factor the admittance matrix to obtain a solution of the network voltages. • Understand the formulation of the power flow problem, and have the ability to cast any given system in this framework. • Solve power flow problems by the application of Newton method & Gauss seidel. • Perform Steady-state analysis for a balanced three-phase power system,Reflection and Transmission of travelling waves under different line loadings • Protection of equipments and line against travelling waves

	Course Outcomes
CO1	Representation of Elements in Electric Power System in Per-Unit system and Analysis of Symmetrical faults.
CO2	Analysis of Unsymmetrical faults.
CO3	Understanding the formulation of the power flow problem and to cast any given system in this framework
CO4	Understanding the concept of steady state and transient stability.
CO5	Need of Protection of equipments and line against travelling waves.

S.No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Representation of Power System Components: Synchronous machines, Transformers, Transmission lines, Single line diagram, Impedance and reactance diagram, Per unit System, Transient in R-L series circuit. Symmetrical fault analysis: Calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions	8	CO1
2	Symmetrical components: Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks. Unsymmetrical faults: Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance. Formation of Zbus using singular transformation and algorithm	8	CO2
3	Load Flows: Introduction, bus classifications, nodal admittance matrix, development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method.	8	CO3
4	Power System Stability: Stability, Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method, Factors affecting steady state & transient stability and methods of improvement.	8	CO4
5	Traveling Waves: Wave equation for uniform transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings, Protection of equipments and line against traveling waves.	8	CO5

References Books:

1.W.D. Stevenson, Jr. “ Elements of Power System Analysis”, Mc Graw Hill 4th edition

2. C.L. Wadhwa, “Electrical Power System”, New Age International, 2009

3. Chakraborthy, Soni,Gupta & Bhatnagar, “Power System Engineering”, Dhanpat Rai & Co. ,2008

4. T.K Nagsarkar & M.S. Sukhija, “Power System Analysis” Oxford University Press, 2007.

5. Hadi Sadat; “Power System Analysis”, Tata McGraw Hill. 2nd Edition, 2002.

6.D.Das, “ Electrical Power Systems” New Age International, 2006.

7. P.S.R. Murthy “ Power System Analysis” B.S. Publications,2007.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2								2	2	3	3	2	3
CO2	3	3	2	2	2								3	3	2	2
CO3	3	3	1	2	2							2	3	3	2	3
CO4	3	2	3	2	3					2	2		3	2	1	3
CO5	3	3	3			2	1				2	2	3	2	1	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Yer/5th Semester

			Effective from Session	17-18			
Course Code	**EE-313/ EEE-313**	Title of The Course	**Microprocessor and Peripheral Devices**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objectives	• Knowledge of I/O devices and memories • To get knowledge of architecture of 8085 and 8086 • To attain knowledge of different instruction set of 8085 and 8086 • To study about different types of Programmable Peripheral Interface • To have the knowledge of analog to digital and digital to analog converter chips

	Course Outcomes
CO1	Understand the basics of microprocessor
CO2	Understand the architecture of 8085 and 8086
CO3	Knowledge of instruction set of 8085 and 8086
CO4	Knowledge of programmable peripheral interface
CO5	Knowledge of analog to digital and digital to analog converter

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Introduction of Microcomputer System:** General definition of minicomputer, microprocessor, CPU (central processing unit), I/O (Input -output) devices, clock, memory, bus architecture, tri-state logic, address bus, data bus and control bus. Semiconductor Memories: Development of semiconductor memory, internal structure and decoding, memory read and write timing diagrams, ROM (Read-only memory), RAM *(*Random-access memory).	8	CO1
2	**Architecture of 8-bit Microprocessor:**Introduction to 8085 and 8086 microprocessor, Pin description and their internal architecture. Operation and Control of Microprocessor: Timing and control unit, memory read/write machine cycles, Input-output read/write machine cycles, interrupt acknowledge machine cycle.	8	CO2
3	**Instruction Set:** Addressing modes- Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, unspecified flags and instructions, assembly language programming, assembler directives, subroutines.	8	CO3
4	**Interfacing:** Interfacing of memory chips, Interfacing of Input-output devices, Input-output addressing, Input-output memory mapped schemes, 8255 Programmable Peripheral Interface, 8257 Direct memory access Controller, 8259 Interrupt priority Control, 8253/8254 Programmable timer/counter with modes of operation. Interrupts: Interrupt structure of 8085 microprocessor.	8	CO4
5	**Programmable Peripheral Interface:** Intel 8255 pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, analog to digital converter and digital-to-analog converter chips and their interfacing. Programmable Interval Timer: Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter read methods.	8	CO5

References Books:

1.B.Ram, "Fundamentals of Microprocessor and Microcomputer", Dhanpat Rai Publication, 4th Edition.2008

2. M.Rafiquzzaman, "Microprocessors and Applications", John Wiley & Sons ,2008

3. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, reprinted 2008

4. Gaonkar R.S.,"Microprocessor Architecture,Programming and Applications", 6th Ed., Penram International, 2013.

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3			1	1	1	1					3	3	3	2	3
CO2	3	2	2	2	2	1						3	3	3	2	3
CO3	3	2	2	2	2	1						3	3	2	2	2
CO4	3	2	2	2	2	1	1					3	2	2	2	2
CO5	3	1	1	1	1	1	1					3	3	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year

			Effective from Session	2017-18			
Course Code	**EE323**	Title of The Course	**PROCESS INSTRUMENTATION**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	• Knowledge of different process ant its characteristics. • Understanding of different control loops used in process. • Study and analysis of feedback control system and its applications. • Applications and design of multi-loop control system. • Concepts and design of multivariable control systems.

	Course Outcomes
CO1	Know about different process ant its characteristics.
CO2	Understand different control loops used in process
CO3	Use feedback control system.
CO4	Design of multi-loop control system.
CO5	Design of multivariable control systems.

No.	Content	Contact Hrs.	Mapped CO
1	**Process characteristics:** Incentives for process control; Process Variables types and selection criteria; Process degree of freedom; The period of Oscillation and Damping; Characteristics of physical System: Resistance, Capacitance and Combination of both; Elements of Process Dynamics; Types of processes: Dead time, single and multi-capacity, self-regulating and non self-regulating, interacting and non interacting, linear / non-linear; Selection of control action.	8	CO1
2	**Analysis of Control Loop:** Steady state gain; Process gain; Valve gain; Process time constant; Variable time Constant; Transmitter gain; Linearizing an equal percentage valve; Variable pressure drop; Analysis of Flow Control, Pressure Control, Liquid level Control, Temperature control; Single Line Process Controller: features, faceplate, functions; Multi Line Process Controller: features, faceplate, functions; Comparison of Single Line Process Controller and Multi Line Process Controller. Scaling: Types of scaling, Examples of scaling.	8	CO2
3	**Feedback Control:** Basic principles, Elements of the feedback Loop, Block Diagram, Control Performance Measures for Common Input Changes, Selection of Variables for Control Approach to Process Control. Factors in Controller Tuning; Determining Tuning Constants for Good Control Performance; Correlations for tuning Constants; Fine Tuning of the controller tuning Constants; The performance of feedback Systems; Practical Application of Feedback Control: Equipment Specification, Input Processing, Output Processing.	8	CO3
4	**Multi-Loop System:** Cascade control; Feed forward control; Feedback-feed forward control; Ratio control; Selective Control; Split range control: Basic principles, Design Criteria, Performance, Controller Algorithm and Tuning, Implementation issues, Examples and any special features of the individual loop and industrial applications.	8	CO4
5	**Multivariable Control:** Concept of Multivariable Control, Interactions and its effects; Modeling and transfer functions; Influence of interaction on the possibility of feedback control; Important effects on multi variable system behavior; Relative Gain Array; Effect of interaction on stability and multi-loop control system; Multi-loop control performance through loop paring; Tuning; Enhancement through decoupling; Single loop enhancements.	8	CO5

References Books:

1. Donald P. Eckman, "Automatic Process Control", Wiley India Edition, Wiley India Pvt. Ltd,2009

2. F. G. Shinskey, "Process control Systems", McGraw Hill, 4th Edition, 1996.

3.P. W. Murrill, "Fundamentals of Process Control Theory", International Society of Automation, 3rd Edition, 2012.

4. G. D. Considine, "Process Instrumentation and control Handbook", McGraw Hill, 5th Edition,1993

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	3	1				1	3	2	2	2	2
CO2	3	2	2	1	3	2	1				1	2	2	3	2	3
CO3	3	2	2	1	3	3	3				1	3	2	3	2	3
CO4	3	2	3	2	3	3	3				1	3	2	3	2	3
CO5	3	3	3	3	3	3	2				1	3	2	3	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

			Effective from Session		2017-18		
Course Code	**EE325**	Title of The Course	**CONVENTIONAL & CAD OF ELECTRICAL MACHINES**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objective	• To develop knowledge on principles of design of static and rotating machines. • To understand the fundamental concepts of design process, designing of main dimensions & cooling systems of transformers and rotating machine. • To provide advanced knowledge and understanding about the construction and design of the electrical machines. • To provide the basis and the methodologies to correct a design of the electrical machines (transformers, rotating (AC machines and DC machines). • To understand the design optimization of the electrical machine for industrial, automotive and aerospace applications.

	Course Outcomes
CO1	Student understands the basic concept of design, limitations faced in the designing process, and classification & importance of Insulating materials.
CO2	Student is able to understand the design concepts of transformers and know about how to design the core, yoke & windings.
CO3	Upon completing the course, student is able to understand the factors affecting the size of rotating machines and design of core & armature in DC machines along with selection of frame size.
CO4	Student is able to understand the rotor design of Induction motor and field system design of Synchronous machines & DC machines along with problem solving techniques related to design.
CO5	Student understands the importance of Computer aided design and different approaches based on their applications along with the concept of optimization.

No.	Content	Contact Hrs.	Mapped CO
1	**Basic Considerations** Basic concept of design, Limitation in design, Standardization, Modern trends in design and manufacturing techniques, Classification of insulating materials. Calculation of total magnetomotive force (m.m.f) and magnetizing current. .	8	CO1
2	**Transformer Design** Output equation; Design of core, yoke and windings; Overall dimensions; Computation of no load current to voltage regulation; Efficiency and cooling system designs	8	CO2
3	**Design of rotating machines I** Output equations of rotating machines, Specific electric and magnetic loadings, Factors affecting size of rotating machines, Separation of main dimensions, Selection of frame size, core and armature design of dc machines.	8	CO3
4	**Design of rotating machines II** Core and armature design of 3-phase ac machines, Rotor design of three phase induction motors, Design of field system of Direct Current (DC) machine and synchronous machines, Estimation of performance from design data.	8	CO4
5	**Computer Aided Design:** Philosophy of computer aided design, advantages and limitations; Computer aided design approaches analysis; Synthesis and hybrid methods; Concept of optimization and its general procedure; Flow charts and 'c' based computer programs for the design of transformer, DC machine, three phase induction and synchronous machines.	8	CO5

References Books:

1. A. K. Sawhney, **"**A Course in Electrical Machine Design**"**, Dhanpat Rai & Sons, 6th Edition, 2006.
2. K.G. Upadhyay, "Conventional and Computer Aided Design of Electrical Machines",Galgotia Publications, 1st edition, 2004
3. M.G. Say, "The Performance and Design of AC Machines", Pitman & Sons, 2nd Edition 1952
4. A.E. Clayton and N.N. Hancock, "The Performance and Design of D.C. Machines", Pitman &Sons.
5. S.K. Sen, "Principle of Electrical Machine Design with Computer Programming", Oxford and IBM Publications

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2									3	3	3	2	2
CO2	3	3	2	2	2						2		3	3	2	2
CO3	3	3	1	2	2						2	2				
CO4	3	2	3	2	3					2	2					
CO5	2	2	2			2	2									

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year/6th Semester

				L	T	P	C
			Effective from Session			2017-18	
Course Code	**EE333**	Title of The Course	**ADVANCED CONTROL SYSTEMS**	L	T	P	C
Pre- Requisite	Control System EE-301	Co-Requisite	NONE	3	1	0	4

Objective	• To learn the concept of state space analysis of continuous system. • To get the knowledge of state equations, controllability and observability • To design the state observer and controller using pole-placement approach • To gain information on non-linear control system • To evaluate the stability of the system using Lyapunov's stability analysis

	Course Outcomes
CO1	Students will be able to understand different state model of a system, and have the knowledge to find its solution.
CO2	Students will be industry ready by analysis of controllability and observability of the dissimilar system.
CO3	Students will be industry ready by designing the State observer and controller using pole-placement approach
CO4	Students will be able to understand nonlinear system models, and analyse its stability.
CO5	Students will be able to analyse system's stability using Lyapunov stability analysis.

No.	Content	Contact Hrs.	Mapped CO
1	**State Space Analysis of Continuous System** Introduction, Concept of state, Sate variable description, State space representation, statevariable representation of continuous system, Conversion of state variable models to transfer function and vice-versa.	8	CO1
2	**State Equations, Controllability and Observability** Characteristic equation, state transition matrix, Solution of state equations, Concept of controllability and Observability, Controllable, observable and diagonal canonical form.	8	CO2
3	**Pole-Placement Design and State observer** Concept of pole-placement, Stability improvement by state Feedback, State regulatordesign, design of state observers and controller.	8	CO3
4	**Non-linear Control System** Types and characteristics of non-linearity, phenomena related to non-linear systems. Phase plane analysis, types of phase portraits, singular points, construction of phase portraits, system analysis by phase-plane method, describing function and its applicationto system analysis.	8	CO4
5	**Lyapunov's Stability analysis** Concept of Lyapunov's stability, Stability of equilibrium state, asymptotic stability, Lyapunov's stability theorems for continuous systems, methods of generating Lyapunov'sfunction for continuous system, Stability analysis of non-linear system.	8	CO5

References Books:

M.Gopal, "Digital Control and State variable Methods", Tata Mc Graw Hill, 4th Edition, 2015

Ajit K.Madal, "Introduction to Control Engineering: Modelling, Analysis and Design" New Age International, 5th Edition, 2013.

K. Ogata, "Modern Control Engg.", PHI, 4th Edition, 2002.

S. K. Bhattacharya, "Control system Engg.", Pearson Education, 2nd Edition, 2008.

B.N. Sarkar "Advanced control system" PHI Learning Pvt. Ltd., 2013.

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1										2	2	2
CO2	3	2													3	2
CO3	3	2		2								1	2	2		3
CO4	1	2		3								1			2	3
CO5	2	2	3		2							1		2		3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year

			Effective from Session	2017-18			
Course Code	**EE335**	Title of The Course	**INDUSTRIAL AUTOMATION**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	• To improve quality, and reduce human involvement and possibility of human error. • To raise the level of safety for personal. • To reduce the work piece damage caused by manual handling.

	Course Outcomes
CO1	Understand and analyze the concept, design, technique, advancement and application of Automatic Control, Proportional- Integral-derivative (PID) Control and their Tuning, Feed-forward and Ratio Control, Time Delay Systems and Inverse Response Systems
CO2	Understand and analyze the concept, design, technique, advancement and application of Different types of controllers, Single loop and Multi loop controllers, Hydraulic Control Systems, Industrial Hydraulic Circuit, Pneumatic Control Systems
CO3	Understand and analyze the concept, design, technique, advancement and application of Sequential and Programmable controllers, Architecture, Functional blocks, Programming of PLC: Relay logic and Ladder logic, Communication Networks for PLC, PLC based control of processes- Computer control of liquid level system, heat exchanger; Smart sensors.
CO4	Understand and analyze the concept, design, technique, advancement and application of Functional requirements and Components. General features, Functions and Applications, Benefits. Configurations of SCADA, Remote Terminal Unit Connections. Human Machine interface
CO5	Understand and analyze the concept, design, technique, advancement and application of Different architectures, Local control unit, Operator Interface, Engineering interface, Study of any one DCS available in market, Factors to be considered in selecting DCS

No.	Content	Contact Hrs.	Mapped CO
1	**Industrial Automation Systems:** Introduction, Architecture, Introduction to Automatic Control, Proportional- Integral-derivative (PID) Control and their Tuning, Feed-forward and Ratio Control, Time Delay Systems and Inverse Response Systems..	8	CO1
2	**Controllers:** Different types of controllers, Single loop and Multi loop controllers, Hydraulic Control Systems, Industrial Hydraulic Circuit, Pneumatic Control Systems	8	CO2
3	**Programmable logic Controllers (PLC):** Sequential and Programmable controllers, Architecture, Functional blocks, Programming of PLC: Relay logic and Ladder logic, Communication Networks for PLC, PLC based control of processes- Computer control of liquid level system, heat exchanger; Smart sensors.	8	CO3
4	**Supervisory Control and Data Acquisition (SCADA):** Introduction, Functional requirements and Components. General features, Functions and Applications, Benefits. Configurations of SCADA, Remote Terminal Unit Connections. Human Machine interface.	8	CO4
5	**Distributed Control System (DCS):** Evolution, Different architectures, Local control unit, Operator Interface, Engineering interface, Study of any one DCS available in market, Factors to be considered in selecting DCS	8	CO5

References Books:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, TF Edgar, FJ Doyle III. "Process dynamics and control," Wiley, 3rd edition 2010
2. Smith, C.A. and Corripio, A.B. "Principles and practice of automatic process control," Wiley, 3rd edition1997
3. Johnson, C.D. "Process control instrumentation technology," Prentice-Hall, 8th edition 2008
4. Kalsi, H.S “Electronic Instrumentation” McGraw Hill, 3rd edition 2010

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	3	2	3	3
CO2	3	3	1	2	3							2	3	2	3	3
CO3	3	1	1	2	3							2	3	2	3	3
CO4	3	1	1	2	3							2	3	2	3	3
CO5	3	1	1	2	3							2	3	2	3	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year

				Effective from Session		2017-18	
Course Code	**EE343**	Title of The Course	**RENEAWABLE ENERGY TECHNOLOGY**	**L**	**T**	**P**	**C**
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	1. To Give the basic knowledge of Nonconventional energy Resources sources. 2. To make aware the students about alternate resources of energy. 3. To provide the knowledge of decentralized energy supply to agriculture, industry, commercial and House-hold sector.

	Course Outcomes
CO1	Given an energy systems and quantifying energy students shall be able to represent this in comparison to various conventional Fossil fuels, identify type of system, apply vector algebra, and formulate the Remedies & alternatives for fossil fuels.
CO2	Given a Modelling of Solar Energy with sources, student shall be able to analyse theory of solar cells, solar radiation, solar characteristics and limitations.
CO3	For a Wind Energy Systems, student shall be able to generate its analytical response and resource assessment, analyse and evaluate the characteristics by Power Conversion Technologies.
CO4	For a given Hydro power, students shall be able to identify its characteristics and for Generation and Distribution, select suitable design of application of Mini and Micro-hydel Power with various combination for System
CO5	Given a Nuclear Energy system, student shall be able to define its fuel enrichment, different types of nuclear reactors, nuclear waste disposal, solve/ analyse, and modify Integrated Energy systems

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Introduction to energy systems and resources; Energy: sustainability & the environment, Quantifying energy & energy arithmetic, Electricity - a primer, Fossil fuels - past, present & future, Remedies & alternatives for fossil fuels, Energy efficiency and conservation, Introduction to renewable energy, availability, classification, relative merits and demerits.	8	CO1
2	Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy –Photo thermal, Photovoltaic, Present & Future Scope of Solar energy. Theory of solar cells, solar radiation, solar characteristics, limitations, solar thermal power plants, Solar Photovoltaic systems.	8	CO2
3	Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, classification of rotors, wind characteristics, Performance and limitations, various aspects of wind turbine design.	8	CO3
4	Hydro power: Hydro power: Potential, Hydropower Generation and Distribution, Mini and Micro hydel Power (MHP) Generation: Classification of hydel plants, Concept of micro hydel, merits, MHP plants: Components, design and layout, Turbines, efficiency, Status in India.	8	CO4
5	Nuclear Energy: Potential of Nuclear Energy, Nuclear Energy Technologies – Fuel enrichment, Different Types of Nuclear Reactors, Nuclear Waste Disposal and Nuclear Fusion. Hybrid energy systems - Integrated Energy systems, Diesel-PV, wind-diesel power, wind conventional grid, wind-Photovoltaic system.	8	CO5
References Books:			
B.H Khan, "Non-Conventional Energy Resources" Tata Mc Graw-Hill Pvt. Ltd., 2nd Edition,2009.			
G.D.Rai, "Non-Conventional Energy Resources" Khanna Publishers, 4th Edition, 2000.			
Freris, L.L. "Wind and Solar Power Systems" Prentice Hall, London, 1999			

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2										2	2	2	3
CO2	3	3	2	2	2								2	2	2	2
CO3	3	3	1									2	3	2	2	3
CO4	3	3	3	2	3					2	2		2	3	2	3
CO5	3	3	3			2	1						2	2	2	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 3rd Year/6th Semester

				Effective from Session		2017-18		
Course Code	**EE345/ EEE-345**	Title of The Course	**POWER ELECTRONICS BASED CONVERTERS DESIGN**	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	• Knowledge and concept of non-isolated DC-DC converters. • Analysis & Design of Isolated Converters. • Knowledge and concept of AC Regulators. • Analysis & Design of Self Driven Inverters. • Designing of Soft switching Converters

	Course Outcomes
CO1	Know about the concept of non-isolated DC-DC converters.
CO2	Analyze & Design Isolated Converters.
CO3	Know about concept of AC Regulators.
CO4	Analyze & Design Self Driven Inverters.
CO5	Design Soft switching Converters.

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	Limitations of Linear power supplies; Switched Mode Power Conversion; Analysis & Design of Non-isolated DC-DC Converters: Buck, Boost, Buck-boost operations in CCM and DCM.	8	CO1
2	Analysis & Design of Isolated Converters: Forward, Push-Pull, Half Bridge, Full Bridge, Flyback, Cuk, SEPIC, High-Boost Topologies.	8	CO2
3	Review of AC Regulators and Cyclo-converters; Voltage control and Harmonic minimization in inverters, square wave operation; Multilevel Inverter.	8	CO3
4	Analysis & Design of Self Driven Inverters, Driven Inverter, Quasi-Square Wave Inverter;PWM, PWM with Harmonic Elimination; Matrix Converter.	8	CO4
5	Soft switching Converters - Switching loss, hard switching, soft switching; Resonant Converter, basic principles of ZVS, ZCS, and ZVZCS.	8	CO5

References Books:
1. Ned Mohan, Tore M, Undelnad, William P, Robbins (3rd Edition), “Power Electronics:Converters, Applications and Design,” Wiley 2002.
2. L. Umanand, Power Electronics - Essentials and Applications; Wiley India Pvt. Ltd
3. P.C Sen.,’ Modern Power Electronics ‘, Wheeler publishing Co, First Edition, New Delhi,1998.
4. M H Rashid, Power Electronics - Circuits, Devices and Applications; PHI, New Delhi.
5. Philip T Krein: Elements of Power Electronics; published by Oxford University Press.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	3	1					3		2	2	3
CO2	3	2	3	1	3	3	1					3	2	3	2	3
CO3	3	1	1	1	1	3	1					3		3	2	3
CO4	3	2	3	1	3	3	1					3	2	3		3
CO5	3	2	3	3	3	3	2					2	2	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

			Effective from Session	2018-19			
Course Code	EE/EEE401	Title of The Course	Power system Protection	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	To learn the basics of relays. To get the knowledge of relay application. To gain the knowledge of protection of Transmission line. To study the different types of circuit breaker. To gain the knowledge of protection of Alternator.

	Course Outcomes
CO1	Learn the basics of relays
CO2	Acquire knowledge of relay application
CO3	Acquire knowledge of protection of Transmission line.
CO4	Knowledge the different types of circuit breaker.
CO5	Gain the knowledge of protection of Alternator..

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to power system:** Introduction to protective system and its elements, Function of protective relaying, Protective zones, Primary and backup protection, Desirable qualities of protective relaying, Basic terminology. **Relays**: Electromagnetic, Attraction and induction type relays; Thermal relay; Gas actuated relay .	8	CO1
2	**Relay Applications and characteristics:** Amplitude and phase comparators, Over-current relays, Directional relays, Distance relays, Differential relays. **Static relays:** Comparison with electromagnetic relays, Classification and their description, Overcurrent relays, Directional relays, Distance relays, Differential relays	8	CO2
3	**Protection of Transmission line** Time graded protection; Differential and distance protection of feeders; Choice between impedance, reactance and MHO relays; Elementary idea about carrier current protection of lines; Protection of bus; Auto reclosing, Pilot wire protection	8	CO3
4	**Circuit Breaking:** Arc phenomenon, Properties of arc, Arc extinction theories, Recovery voltage and re-striking voltage, Current chopping, Resistance switching, Capacitance current interruption, Circuit breaker ratings. **Circuit breakers**: Need of circuit breakers; Types of circuit breakers; Operating modes; Principles of construction; Details of Air Blast, Bulk Oil, Minimum Oil, SF6, Vacuum Circuit Breakers, DC circuit breakers.	8	CO4
5	**Apparatus protection** Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection, Types of faults on transformers, Percentage differential protection, Isolated neutral system, Grounded neutral system and selection of neutral grounding	8	CO5

References Books:

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers, 13th Edition, 2008.

2. B. Ravindranath and M. Chander, "Power system Protection and Switchgear", Wiley Eastern Ltd., 5th Edison, 2015.

3. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw

Hill, 2nd Edition, 2011.

4. Y. G. Paithankar and S R Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India, 2004.

5. T.S.M. Rao, “Power System Protection: Static Relays with Microprocessor Applications”, Tata McGraw Hill, 2nd edition, 1993.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1									1	2		2	3
CO2	3	2		1									2	2	2	3
CO3	3	2										1	2	2	2	3
CO4	3	2		2								1	2	2	2	3
CO5	3	1	2									1	2	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

4th Year/7th Semester				Effective from Session		2018-19		
Course Code	**EE403/EEE403**	Title of The Course	**ELECTRIC DRIVES**	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology. Analyze the operation of motor drives system to satisfy four-quadrant operation to meet mechanical load requirements. Understand the basic principles of power electronics in drives using switch-mode converters and pulse width modulation to synthesize the voltages in dc and ac motor drives. Describe the operation of induction machines in steady state that allows them to be controlled in induction-motor drives. Learn speed control of induction motor drives in an energy efficient manner using power electronics. Learn the basic operation of stepper motors and switched-reluctance motor drives. Realize an appreciation of power quality issues in powering electric drives.

	Course Outcomes
CO1	**Conceptualize** fundamental elements of drive systems, **design** important elements of a drive system, **understand** the multi-quadrant operation and **analyze** it for different types of operation.
CO2	**Understand** and **evaluate** dynamics of motor-load combination, **Develop** the thermal model of a motor, **Analyze** steady state and transient state stability, **select** and **determine** the motor power rating for various duty cycles.
CO3	**Analyze** and **perform** the dynamics during starting and braking of DC and AC motor, **evaluate** energy loss and **implement** various methods to reduce it, **examine**, **develop** and **solve** various energy relations during starting and braking.
CO4	**Acquire** detailed knowledge of DC Shunt and Series motor operation using generalized machine theory, **Apply** the concepts of AC-DC and DC-DC Converters to evaluate and **enhance** the performance of steady and transient state operation, **Implement** speed control and current control loops of a DC Motor drive. **Understand** how DC Drives may pollute the power supply and **analyze** how to mitigate such pollution.
CO5	**Understand** the working of various phase controlled converters used in AC Drives**. Learn** the working principle and **design** details of frequency controlled converters used in induction motor drives. **Analyze** and **perform** the modeling and controlling CSI based drives.

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Unit-1 Fundamentals of Electric Drives** Electric drives and its parts, Advantages of electric drives, Classification of electric drives Speed torque conventions and multi-quadrant operations constant torque and constant power operation, Types of load torque: Components, Nature and Classification. .	8	CO1
2	**Dynamics of Electric Drives** Dynamics of motor-load combination; Steady state stability of Electric Drive; Transient stability of electric drive; Selection of motor power rating; Thermal model of motor for heating and cooling; Classes of motor duty; Determination of motor power rating for continuous duty, short time duty and intermittent duty; Load equalization.	8	CO2
3	**Electric Braking** Purpose and types of electric braking; Braking of dc, three phase induction and synchronous motors; Dynamics during starting and braking of dc motors; Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors; Methods of reducing energy loss during starting; Energy relations during braking, Dynamics during braking of ac motors.	8	CO3
4	**Power Electronic Control of DC Drives** Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only); Dual converter fed separately excited dc motor drive; Rectifier control of dc series motor; Supply harmonics, power factor and ripples in motor current; Chopper control of separately excited dc motor and dc series motor.	8	CO4
5	**Power Electronic Control of AC Drives** Three phase induction motor drive: Static voltage control scheme, Static frequency control scheme: VSI, CSI, and cyclo-converter based drives; Special drives: Switched reluctance motor, Brushless dc motor: Selection of motor for particular applications.	8	CO5
References Books:			

1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House, Reprint 2017.
2. S.K. Pillai, “A First Course on Electric Drives”, Wiley Eastern Limited, 2nd Edition, 1989.
3. M. Chilkin, “Electric Drives”, Mir Publishers, Moscow,1st Edition, 2002.
4. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore, 1st Edition, 2000.
5. N.K. De and Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd., 1st Edition,2006.
6. V. Subrahmanyam

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	2		1						2	2	1	2
CO2	3	3	2	1	2								2	2	2	3
CO3	3	3	2	2	2	2								2	2	2
CO4	3	3	3	1	2	1		1			1		2		2	3
CO5	3	3	3	2	2		1		1		1			1	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING. 4th Year

				Effective from Session		2018-19		
Course Code	EE421/ EEE421	Title of The Course	ELECTRICAL INSULATION IN POWER APPARATUS AND SYSTEM		L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE		3	1	0	4

Objective	• Knowledge and application of Theory of Break Down In Gaseous, Liquid and Solid dielectrics • Knowledge and application of Generation of High Voltage and Currents • Knowledge and application of Measurement of High Voltage and Currents • Knowledge and application of Over Voltage Phenomenon & Insulation Coordination • Knowledge and application of Non -Destructive Insulation Test Techniques

	Course Outcomes
CO1	Understand and analyze the concept, design, technique, advancement and application of Break Down In Gases**,** electronegative gases, non- uniform field, vacuum, Liquid Dielectrics, pure liquid and commercial liquid, Solid Dielectric**,** solid dielectric in practice, composite dielectrics.
CO2	Understand and analyze the concept, design, technique, advancement and application of Generation of High direct Current Voltage, alternating voltages, impulse voltages, impulse currents and Tripping and control of impulse generators
CO3	Understand and analyze the concept, design, technique, advancement and application of Measurement of High direct Current Voltages; alternating & Impulse voltages, High direct, alternating & Impulse Currents and Cathode ray oscillographs for impulse voltage and current measurements
CO4	Understand and analyze the concept, design, technique, advancement and application of Lighting Phenomenon as natural cause for over voltage, Overvoltage due to switching surges and abnormal conditions and Principal of insulation coordination
CO5	Understand and analyze the concept, design, technique, advancement and application of Dynamic properties of dielectrics, Measurement of direct current resistivity, Measurement of dielectric constant and loss factor and Partial discharge measurements.

No.	Content	Contact Hrs.	Mapped CO
1	**Break Down In Gases:** Ionization processes, Townsend's criterion, Breakdown in electronegative gases, Time lags for breakdown, Streamer theory, Paschen's law, Breakdown in non- uniform field, Breakdown in vacuum. **Break Down In Liquid Dielectrics:** Classification of liquid dielectric, Characteristics of liquid dielectric, Breakdown in pure liquid and commercial liquid. **Break Down In Solid Dielectric:** Intrinsic breakdown, Electro-mechanical breakdown, Breakdown of solid dielectric in practice, Breakdown in composite dielectrics. .	8	CO1
2	**Generation of High Voltage and Currents** Generation of High direct Current Voltage, Generation of high alternating voltages, Generation of impulse voltages, Generation of impulse currents, Tripping and control of impulse generators	8	CO2
3	**Measurement of High Voltage and Currents** Measurement of High direct Current Voltages; Measurement of High alternating & Impulse voltages; Measurement of High direct, alternating & Impulse Currents; Cathode ray oscillographs for impulse voltage and current measurements.	8	CO3
4	**Over Voltage Phenomenon & Insulation Coordination** Lighting Phenomenon as natural cause for over voltage, Overvoltage due to switching surges and abnormal conditions, Principal of insulation coordination	8	CO4
5	**Non -Destructive Insulation Test Techniques** Dynamic properties of dielectrics, Measurement of direct current resistively, Measurement of dielectric constant and loss factor, Partial discharge measurements.	8	CO5

References Books:

1. E. Kuffel, W.S. Zaengl and J. Kuffel, "High Voltage Engineering", CBS Publishers New Delhi, 2nd Edition, 2005.

2. M.S. Naidu & V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill, 5th edition, 2013.

3. C.L. Wadhwa, “High Voltage Engineering”, New Age Internationals (P) Limited, 3rd Edition, 2010.

4. M. Khalifa, “High Voltage Engineering: Theory and Practice”, Marcel Dekker, 1st edition, 1990.

5. Subir Ray, “An Introduction to High Voltage Engineering”, Prentice Hall of India, 2nd edition, 2013.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	3							2	3	2	3	3
CO2	3	3	1	2	3							2	3	2	3	3
CO3	3	1	1	2	3							2	3	2	3	3
CO4	3	1	1	2	3							2	3	2	3	3
CO5	3	1	1	2	3							2	3	2	3	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING ,4th Yr

			Effective from Session	2018-19			
Course Code	EE425/EEE425	Title of The Course	**EHVAC & EHVDC TRANSMISSION**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	• Knowledge of ENVAC and EHVDC Transmission • Design of EHV using software • Knowledge od control circuits used in power transmission network

	Course Outcomes
CO1	Knowledge of EHVDC and EHVAC transmission and conductors used in transmission
CO2	Knowledge of switching and their effects on transmission circuits
CO3	Knowledge of single and three phase converters and design of EHV lines
CO4	Knowledge of different converters used in EHV DC transmission
CO5	Knowledge of protection circuits

No.	Content	Contact Hrs.	Mapped CO
1	**Introduction** Need of EHV transmission, Standard transmission voltage, Comparison of EHV ac & dc transmission systems and their applications & limitations, Surface voltage gradients in conductor,Distribution of voltage gradients on sub-conductors, Mechanical considerations of transmission lines, Modern trends in EHV AC and DC transmission .	8	CO1
2	**EHV AC Transmission** Corona loss formula, Corona current, Audible noise – generation and characteristics, Corona pulses their generation and properties, Radio interference (RI) effects, Over voltage due to switching, Ferro resonance, Reduction of switching surges on EHV system, Principle of half wave transmission.	8	CO2
3	**Consideration for Design of EHV Lines:** Design factors under steady state limits, EHV line insulation design based upon transient over voltages, Effects of pollution on performance of EHV lines. **Converter Circuits:** 1-phase and 3-phase converters (properties and configurations), Cascade of converters	8	CO3
4	**EHV DC Transmission–I** Types of dc links, converter station, Choice of converter configuration and pulse number, Effect of source inductance on operation of converters, Principle of dc link control, Converter controls characteristics, Firing angle control, Current and excitation angle control, Power control, Starting and stopping of dc link	8	CO4
5	**EHV DC Transmission–II** Converter faults; Protection against over currents and over voltages; Smoothing reactors; Generation of harmonics; AC and DC filters; Multi Terminal DC systems (MTDC): Types, Control,protection and applications.	8	CO5

References Books:

1. R. D. Begamudre, “Extra High Voltage AC Transmission Engineering”, Wiley Eastern, 3rdedition, 2006.
2. K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions”,New Age International, 2nd edition, 1983.
3. M. S. Naidu & V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill, 3rd edition,2004.
4. M. H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Prentice Hall ofIndia, 4th edition, 2014.
5. S. Rao, “EHV AC and HVDC Transmission Engineering and Practice”, Khanna Publisher,4th edition, 2011.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										2	3			2
CO2	3	2										2	3	2	2	
CO3	2	3	2									2	2	3	2	3
CO4	3	2	3									2	2	2		2
CO5	2	3	2										2	2	2	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

				Effective from Session		2018-19	
Course Code	**EE427/EEE427**	Title of The Course	**POWER SYSTEM DYNAMICS**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objectives	• To understand the students about dynamics of Power systems. To develop ability for analysis of system stability and obtain the solution of transient problems. • To analyze the modeling of synchronous machine by applying fundamental law's. • To realize and examine the excitation systems and response the behavior of prime mover controllers in different system. • To recognize the concepts of dynamics of synchronous generator Connected to Infinite Bus by investigation in real time domain. • To execute the analysis of transient and voltage stability by various parameters and comparison with angle stability.

	Course Outcomes
CO1	Given a Power System Dynamics Problems, students shall be able to represent this in various conventional models, identify type of system, apply vector algebra, and formulate the expression in different System Model and solve using mathematical terms.
CO2	Given a Modeling of Synchronous Machine with sources, student shall be able to analyze System Simulation and evaluate the Steady State Performance using Equivalent Circuit of Synchronous Machine.
CO3	For a Excitation systems & Prime Mover Controllers, student shall be able to generate its analytical response by Standard Block Diagram and examine, analyze and evaluate the characteristics by State Equations and Load Modeling.
CO4	For a given System Model, students shall be able to identify its characteristics and for Stator Equation, select suitable design of application of Network Equation, develop various combination for System Simulation Small Signal Analysis with Block Diagram Representation for Single Machine System.
CO5	Given a Modeling and Analysis of Transient and Voltage Stability, student shall be able to define its Stability Evaluation, solve/ analyze, and modify energy functions for direct stability evaluation;

No.	Content	Contact Hrs.	Mapped CO
1	**Power System Dynamics Problems** Introduction, General basic concept of Power System Stability, States of operation & System Security, System Dynamics Problems, Review of Classical Model, System Model, Analysis of Steady State Stability & Transient Stability .	8	CO1
2	**Modelling of Synchronous Machine** Introduction, System Simulation, Park's Transformation, Analysis of Steady State Performance, P. U. Quantities and Equivalent Circuit of Synchronous Machine.	8	CO2
3	**Excitation systems & Prime Mover Controllers** Simplified Representation of Excitation Control, Excitation systems, Modelling, Standard Block Diagram, State Equations, Prime Mover Control System, Transmission Line & Load Modelling	8	CO3
4	**Dynamics of Synchronous Generator Connected to Infinite Bus** System Model, Stator Equation, Rotor equations, Application of Model 1.1, Network Equation, Calculation of Initial Conditions, System Simulation Small Signal Analysis with Block Diagram Representation for Single Machine System, Synchronizing & Damping Torque Analysis, State Equation.	8	CO4
5	**Modelling and Analysis of Transient and Voltage Stability** Simulation for Transient Stability Evaluation; Application of energy functions for direct stability evaluation; Voltage Stability: Introduction, Factors affecting voltage collapse, Analysis and comparison with angle stability.	8	CO5
References Books:			
1. K. R. Padiyar, "Power System Dynamics: Stability & Control", BS Publications, 2nd edition,			

2002

2. I. J. Nagrath and M. Gopal, **“**Control system engineering**”,** Wiley Eastern Ltd, 3rd edition, 2000.

3. Benjamin C. Kuo, “Automatic Control system**”,** Prentice Hall of India Pvt. Ltd, 8th edition, 2003.

4. Prabha Kundur, **“**Power System Stability and Control**”**, Tata McGraw Hill, 5th edition, 2014

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2										2	3	1	3
CO2	3	3	2	2	2								2	3	1	3
CO3	3	3	1									2	2	3	1	3
CO4	3	2	3	2	3					2	2		2	3		3
CO5	3	3	3			2	1						2	3	1	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

			Effective from Session	2018-19			
Course Code	**EE431/EEE431**	Title of The Course	**UTILIZATION OF ELECTRICAL ENERGY AND TRACTION**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	• To impart the detail knowledge of different types of Electrical Heating • To understand about Electrical Welding, Refrigeration and Air conditioning. • To study different definitions of Illuminations and its Laws • To understand types of Electric Traction, system of track electrification, Tractive effort. • Study of salient features of traction Drives. To impart knowledge of Diesel Electric Traction

	Course Outcomes
CO1	**Conceptualize** fundamental elements of electrical heating, **designing** of different elements used in electrical heating, **understand** working and application of different type of furnaces.
CO2	**Understand** different types and working of electrical welding, **understand** different instrument used for electrical welding. **Acquire** detailed knowledge electro-deposition, laws of electrolysis and its application in different field.
CO3	**Acquire** knowledge of different Laws of Illuminations, **Develop** the designing skill for indoor and outdoor lighting system. **Understand** construction and operation of Refrigeration and air conditioner system, **Analyze** the electric circuit and **Learn** the maintenance of domestic refrigerator
CO4	**Understand** operation, mechanism and types of track electrification used of a traction system. **Acquire** detailed knowledge of different terminology used in electric traction.
CO5	**Acquire** knowledge of different motor drives operation, **Analyze** starting, braking and of different type of motor drives used for traction **Apply** the concepts of AC-DC and DC-DC Converters for traction drives, **Implementation** of bridge transition speed control of a DC traction drive. **Understand** the concept of diesel electric traction.

No.	Content	Contact Hrs.	Mapped CO
1	**Electric Heating** Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating.	8	CO1
2	**Electric Welding:** Electric Arc Welding, Electric Resistance welding, Electronic welding control **Electrolyte Process:** Principles of electro-deposition, Laws of electrolysis, Applications of electrolysis	8	CO2
3	**Illumination:** Various definitions, Laws of illumination, Requirements of good lighting, Design of indoor lighting and outdoor lighting systems. **Refrigeration and Air Conditioning:** Refrigeration systems, Domestic refrigerator, Water cooler,Types of air conditioning, Window air conditioner	8	CO3
4	Types of electric traction; Systems of track electrification; Traction mechanics - Types of services, Speed time curve and its simplification, Average and schedule speeds; Tractive effort; Specific energy consumption; Mechanics of train movement; Coefficient of adhesion and its influence.	8	CO4
5	**Electric Traction – II** Salient features of traction drives, Series – parallel control of dc traction drives (Bridge transition) and energy saving Power Electronic control of dc and ac traction drives, Diesel electric traction	8	CO5

References Books:

1. H. Partab, "Art and Science of Electrical Energy", Dhanpat Rai & Sons, 2014
2. G.K. Dubey, "Fundamentals of Electric Drives", Narosa Publishing House, 2nd edition,2015.
3. H. Partab, "Modern Electric Traction", Dhanpat Rai & Sons, 2013
4. C.L. Wadhwa, " Generation, Distribution and Utilization of Electrical Energy", New Age International Publications, 3rd edition, 2010
5. E. Open Shaw Taylor, "Utilization of Electric Energy", Orient Longman, Reprint 2011.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	2	2	2			2		1	2	2	3	1

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

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ELECTRICAL ENGINEERING 4th Year/7th Semester

				Effective from Session	2018-19		
Course Code	**EE435/EEE435**	Title of The Course	**HIGH VOLTAGE DC TRANSMISSION**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	To introduce students with the concept of HVDC Transmission system. To familiarize the students with the HVDC converters and their control system. To expose the students to the harmonics and faults occur in the system and their prevention. To Develop the knowledge of HVDC transmission and HVDC converters and the applicability and advantage of HVDC transmission over conventional AC transmission. To Formulate and solve mathematical problems related to rectifier and inverter control methods and learn about different control schemes as well as starting and stopping of DC links To Analyze the different harmonics generated by the converters and their variation with the change in firing angles. To Develop harmonic models and use the knowledge of circuit theory to develop filters and assess the requirement and type of protection for the filters. To Study and understand the nature of faults happening on both the AC and DC sides of the converters and formulate protection schemes for the same. To Review the existing HVDC systems along with MTDC systems and their controls To Recognize the need to follow the advancements in both the existing systems and HVDC systems and determine the most economic coexistence of both.

	Course Outcomes
CO1	Choose intelligently AC and DC transmission systems for the dedicated application(s).
CO2	Identify the suitable two-level/multilevel configuration for high power converters.
CO3	Select the suitable protection method for various converter faults.
CO4	Decide the configuration for harmonic mitigation on both AC and DC sides.
CO5	Identify suitable reactive power compensation method and basics of MTDC system.

No.	Content	Contact Hrs.	Mapped CO
1	**General Aspects of HVDC Transmission** Introduction to HVDC Transmission, Comparison of HVAC and HVDC systems (Economics of power transmission, Technical Performance and Reliability), Type of HVDC Transmission systems, Description of HVDC transmission system (Types of DC Links and Converter), Planning for HVDC transmission, Modern trends in HVDC technology .	8	CO1
2	**Converters** Simple rectifier circuits, Rectification circuits for HVDC transmission, HVDC converters (Line commutated and Voltage Source converters), Analysis of Graetz Bridge with and without overlap, Pulse number, 12 pulse firing schemes	8	CO2
3	**HVDC System Control** HVDC system control (Principles of DC link control, Firing Angle Current and extinction angle control), Converter mal-operations, Commutation failure, Converter control characteristics, Power Control, Starting and stopping of converter bridge, Converter protection, DC Breakers.	8	CO3
4	**Reactive Power And Harmonics Control** Reactive power requirements, Sources of Reactive Power, Smoothing reactor and DC Lines, Generation of Harmonics, Characteristic and Non-characteristic Harmonics, Troubles due to Harmonics, Harmonics Filters (AC Filters and DC Filters), Active Filters and Passive Filters	8	CO4
5	**Power Flow Analysis**	8	CO5

	Interaction between AC and DC system, Power Flow in AC/DC Systems, DC system model, Basics of Multi-terminal DC (MTDC) system, Types of Multi-terminal DC (MTDC) system, Multi-In feed DC System		

References Books:

1. Padiyar K.R., “HVDC transmission system”, Wiley Eastern Ltd., New Delhi, Second Edition, 2015.

2. Arrilaga J., “High voltage direct current transmission”, Peter Pereginver Ltd. London, U.K., 1998.

3. Kim Bark E.W., “Direct current transmission – Vol.1”, Wiley Inter Science, New York, 1971.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2								2		1		1	2
CO2	3	3	2	2	2								2	2		3
CO3	3	3	1										2	2		3
CO4	3	2	3	2	3					2	2		1	2	1	3
CO5	3	3	3			2	1				2		1			3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

				Effective from Session	2018-19		
Course Code	**EE437/EEE437**	Title of The Course	**ELECTRICAL DISTRIBUTION SYSTEM & AUTOMATION**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	

	Course Outcomes
CO1	Knowledge of energy losses, OHTL and UG lines
CO2	Analyze and modelling of distribution system
CO3	Design of distribution system
CO4	Protection analysis of distribution system
CO5	Knowledge of automation systems and sensors

No.	Content	Contact Hrs.	Mapped CO
1	**Industrial and commercial distribution system** Energy Loss in distribution system, System ground for safety and- protection, Comparison of overhead lines and underground cable system	8	CO1
2	**Network model** Power flow, short circuit and calculations, Distribution system reliability analysis, Reliability concepts, Markov model, Distribution network reliability, Reliability performance	8	CO2
3	**Distribution system expansion planning** Load characteristics, Load forecasting, Design concepts, Optimal location of sub-station, Design of radial lines, Solution technique	8	CO3
4	**System protection** Requirement; Fuses and section analyzers; Over current, under voltage and under frequency protection; Co-ordination of protective device	8	CO4
5	Introduction to Industrial Automation and Control Architecture of Industrial Automation Systems, Introduction to sensors and measurement systems, Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level.	8	CO5

References Books:

1. Pabla. A.S., “Electrical Power Distribution, System”, Tata McGraw Hill, 1981.
2. Tuvar Goner, "Electrical Power Distribution System”, McGraw Hill, 1986.
3. Johnson C.D., "Process control instrumentation technology", Prentice-Hall, New Delhi,2006
4. Kalsi H.S., “Electronic Instrumentation”, McGraw Hill, 3rd edition, New Delhi, 2010

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2									2	3		2	
CO2	2	3	3										2	3		3
CO3	3	2	3									3	3	3	3	
CO4	3	2	2									3	3			3
CO5	3											3	3			3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

			Effective from Session				
Course Code	**EE439**	Title of The Course	**HIGH POWER SEMICONDUCTOR DEVICES**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	• Knowledge of latest semiconductor switches • Apply knowledge of thyristors in hardware based models

	Course Outcomes
CO1	To understand the construction and working of power switches like diode, transistor, IGBT and their practical applications in industries.
CO2	Analysis of different types thyristors their practical implementation. To understand the different methods to turn it on and their blocking characteristics.
CO3	To understand the structure and operation of MOSFET, Silicon IGBT, Silicon carbide IGBT and its practical application in electrical devices for industries.
CO4	To understand the operation and structure of VMOS and DMOS and its practical application in electrical devices for industries.
CO5	To understand the operation and structure of silicon MCT, BRT, EST, Gallium Nitride devices and its practical application in electrical devices for industries.

No.	Content	Contact Hrs.	Mapped CO
1	**Introduction:** Power Switching Waveforms, High Voltage Power Device Structures, Breakdown Model for Silicon, High Voltage Applications	8	CO1
2	**SCR:** Operation & structure of Silicon Thyristors, Silicon Carbide Thyristors & Silicon GTO, Blocking characteristics	8	CO2
3	**Power Bipolar Transistors** Operation and structure of Silicon IGBT, SiC Planar MOSFET Structures and Silicon Carbide IGBT	8	CO3
4	**Power MOS Devices** Operation and structure of V MOS and DMOS, Heat Transfer in Power MOS devices, Device packaging	8	CO4
5	**High Voltage Devices** Operation and structure of silicon MCT,silicon BRT,silicon EST,Gallium nitride devices	8	CO5

References Books:

1. B. Jayant Baliga, “Fundamentals of Power Semiconductor Devices”, 3rd edition, Springer, 2008
2. B. Jayant Baliga, “Advanced High Voltage Power Device Concepts”, 1st edition, Springer, 2011
3. Robert Perret, “Power Electronics Semiconductor Devices”, 1st edition, Wiley, 2009
4. Tadahiro Ohmi, Andre A. Jaecklin, “Power Semiconductor Devices & Circuits”, 1st edition,Springer, 1992
5. Josef Lutz, Heinrich Schlangenotto, Uwe Scheuermann, Rik De Doncker, “SemiconductorPower Devices”, Springer, 1st edition, 2011

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1	1	2	2	1					3	2	1	2
CO2	3	2	3	2	2	3	1	1	1				3	1	2	2
CO3	3	2	3	2	2	2	2	1	1		1	2	3	2	2	2
CO4	3	2	3	2	3	2	2	1	1		3	2	3	2	2	2
CO5	3	2	3	2	3	2	2		1		3	2	3	2	2	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

				Effective from Session		2018-19		
Course Code	**EE441/EEE441**	Title of The Course	**FLEXIBLE AC TRANSMISSION SYSTEMS**	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objective	• To familiarize power engineers about the Flexible AC Transmission devices and their applications in power systems with respect to active/reactive power control.

	Course Outcomes
CO1	**Understand** the importance of controllable parameters and benefits of FACTS controllers.
CO2	**Know** the significance of shunt, series compensation and role of FACTS devices on system control.
CO3	**Analyze** the functional operation and control of GCSC, TSSC and TCSC.
CO4	**Describe** the principles, operation and control of UPFC and IPFC.
CO5	**Knowledge** of UPFC and IPFC

No.	Content	Contact Hrs.	Mapped CO
1	**Introduction to FACTS** Challenges and needs, Power Flow in AC transmission line, Power flow control, Description and definition of Flexible AC Transmission Systems (FACTS) controllers, Static power converter structures. .	8	CO1
2	**Power Semiconductor devices** Types of power semiconductor devices, Voltage-sourced and Current-sourced converters, Converter output and harmonic control, Power converter control issues, Reactive power compensation.	8	CO2
3	**Shunt Compensation** Static VAR compensator (SVC), Static Synchronous Compensator (STATCOM), Thyristor controlled Reactor (TCR) and Thyristor switched Reactor (TSR) Operation and control, Configurations and applications	8	CO3
4	**Series Compensation:** Thyristor Controlled Series Capacitor (TCSC), Static Synchronous Series Compensator (SSSC), Operation and control, Configurations and applications. **Voltage and Phase angle regulators:** Thyristor controlled voltage regulators (TCVRs) and Thyristor controlled phase angle regulators (TCPARs) operation and control.	8	CO4
5	**Shunt-Series compensation** Unified power flow controller (UPFC), Power flow studies with FACTS controllers, Operational constraints, Interline Power flow Controller (IPFC), Operation and control.	8	CO5

References Books:

1. Narain G. Hingorani, " Understanding FACTS", Wiley IEEE PRESS, Reprint 2015.

2. K.R. Padiyar, "FACTS Controllers in Transmission & Distribution", 3rd edition 2017.

3. V. K. Sood, "HVDC and FACTS Controllers: Applications of Static Converters in Power Systems", 2004.

4. Enrique Acha, C.R. Feurte, Esquivel, "Modelling and Simulation in Power Networks", Wiley-India edition, 2004.

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3		1				2	1			2	2	2	2
CO2	3	3	3	1			3		3	1	3		2	2	2	3
CO3	3	3	3	1					3	1	3	1	2	2	2	3
CO4	3	3	3	1					3	1		1	2	2	2	3
CO5													2	2	2	3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year/7th Semester

				Effective from Session		2018-19	
Course Code	**EE443/EEE443**	Title of The Course	**SPECIAL ELECTRICAL MACHINES**	L	T	P	C
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4

Objective	Knowledge of slip power recovery scheme To get knowledge of constructional features of special machines such as single-phase synchronous motor and ac servomotor. To attain knowledge of working of stepper motor and switched reluctance motor and their drive circuits To study about different types of magnets and their application in different machines To have the knowledge of working and application of linear induction motor and universal motor.

	Course Outcomes
CO1	**Evaluate** the performance special induction motors and slip power recovery schemes
CO2	**Analyze** the performance of single-phase synchronous motor and ac servomotor
CO3	**Evaluate** the performance of drive circuit of stepper motors
CO4	**Knowledge** of permanent magnet machines
CO5	**Knowledge** of linear induction motor and universal motor used for special applications

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**Poly-phase AC Machines** Construction and performance of double cage and deep bar three phase induction motors, E.m.f. injection in rotor circuit of slip ring induction motor, Concept of constant torque and constant power controls, Static slip power recovery control schemes (constant torque and constant power). .	8	CO1
2	**Single phase synchronous motor**: Construction, Operating principle and characteristics of reluctance and hysteresis motors. **Two Phase AC Servomotors:** Construction, Torque-speed characteristics, Performance and applications.	8	CO2
3	**Stepper Motors:** Principle of operation; Variable reluctance, Permanent magnet and Hybrid stepper motors; Characteristics, drive circuits and applications. **Switched Reluctance Motors:** Construction, Principle of operation, Torque production, Modes of operation, Drive circuits.	8	CO3
4	**Permanent Magnet Machines** Types of permanent magnets and their magnetization characteristics, Demagnetizing effect, Permanent magnet dc motors, Sinusoidal PM ac motors, Brushless dc motors and their important features and applications, PCB motors, Introduction to permanent magnet generators.	8	CO4
5	**Single Phase Commutator Motors**: Construction, Principle of operation; Characteristics of universal and repulsion motors; Linear Induction Motors: Construction, Principle of operation, Linear force and applications.	8	CO5

References Books:

1. P.S. Bimbhra “Generalized Theory of Electrical Machines”, Khanna Publishers Limited, 5th Edition, 4th Reprint, New Delhi, 2000
2. P.C. Sen, “Principles of Electrical Machines and Power Electronics”, John Wiley & Sons, 2nd edition, 2001.
3. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa Publishing House, 2nd edition, reprint 2017.
4. Cyril G. Veinott, “Fractional and Sub-fractional horse power electric motors”, McGraw Hill International, 1986
5. M.G. Say, “ Alternating current Machines”, Pitman & Sons, 4th edition, 1976

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1								1	2	2	2	2
CO2	3	2										1	3	2	2	2
CO3	3	3	2	2								1	3	2	1	2
CO4	3	2										1	2	1	2	2
CO5	3	1										1	3	1	1	2

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING 4th Year /7th Semester

				Effective from Session		2018-19		
Course Code	**EE445/EEE445**	Title of The Course	**ELECTRICAL SYSTEM & SUBSTATION DESIGN**	L	T	P	C	
Pre-Requisite	NONE	Co-Requisite	NONE	3	1	0	4	

Objectives	• To develop knowledge of general aspects of electrical system design • Having Knowledge of Medium and HV installations • Having knowledge of installation of transformers, Switchgears and protective devices • To get knowledge of Design of illumination systems • To get the knowledge of different types of substation, Substation equipment and its function.

	Course Outcomes
CO1	Understands the general aspects of electrical system design
CO2	Selection of main distribution board; Sub distribution board; MCCB, ELCB, MCB and cables for sub circuits
CO3	Understand installation of transformers, Switchgears and protective devices
CO4	Knowledge of Design of illumination systems
CO5	Knowledge of types of substation, substation equipment and its function.

No.	**Content**	**Contact Hrs.**	**Mapped CO**
1	**General Aspects** National Electric Code (NEC) - scope and safety aspects applicable to low and medium (domestic)voltage installations, Electric services in buildings, Classification of voltages, Standards and specifications, IE Rules, IS Codes, General aspects of the design of electrical installations for domestic buildings – connected load calculation.	8	CO1
2	**Distribution board** Selection of main distribution board; Sub distribution board; MCCB, ELCB, MCB and cables forsub circuits; Pre-commissioning tests of domestic installations; Medium and HV installations –Selection of cables, Guidelines for cable installation & installation of induction motors.	8	CO2
3	**Transformers** Selection and installation of transformers, Switchgears and protective devices; Design of indoor and outdoor 11 KV substation up to 630 KVA: Design of Earthing system - Pipe, plate and mat earthing; Lightning arresters; Metering and protection; HT and LT breaker control panels; Selection of standby generator, installation and its protection.	8	CO3
4	**Illumination systems** Design of illumination systems – Yard lighting, Street lighting and Flood lighting; Design and layout of installation for recreational or assembly buildings and high rise building; Design of Electrical system related to fire fighting, lifts and escalators.	8	CO4
5	**Substation** Types of Substation, Substation equipment and its function, Bus bar arrangement, Single busbar systems and duplicate bus-bar systems, Capacitor bank, Earthing practices, Substation automation	8	CO5
References Books:			
1. M.K.Giridharan, “Electrical System Design”. I.K. International Pvt. Ltd., 2011.			
2. Raina & Bhattacharya, “Electrical Design Estimating and Costing”. New Age International,1st Edition, 1991.			
3. Bureau of Indian Standards publications, “National Electric Code”, 1986.			
4. S.N. Singh, “Electric Power Generation, Transmission & Distribution”, PHI, 2015			

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1								1	3		2	3
CO2	3	2					1					1		2		3
CO3	3	1										2		3		3
CO4	3	2										1		3		3
CO5	3	2					1					1	2			3

3: Strong contribution, 2: average contribution, 1: Low contribution

ELECTRICAL ENGINEERING

				Effective from Session			
Course Code	**EE 303**	Title of The Course	**POWER ELECTRONICS**	L	T	P	C
Pre-Requisite	None	Co-Requisite	None	3	1	0	4

Objectives	

	Course Outcomes
CO1	Understand and analyze the concept, design, technique, advancement and application of Bipolar junction transistor, Power Metal oxide semiconductor field effect transistor, Insulated gate bipolar junction transistor, operation of Silicon controlled rectifier (SCR), Firing circuits of Thyristor, Turn on methods of a Thyristor and Thyristor turn-off process.
CO2	Understand and analyze the concept, design, technique, advancement and application of Protection of Thyristor, Series and parallel operation of SCR, Gate turn off (GTO) thyristor. Understand and analyze the concept and knowledge advancement in Gate characteristic of an SCR, Dynamic characteristics of SCR, Two transistor analogy, Rating of an SCR
CO3	Understand and analyze the concept, design, technique, advancement and application of single phase half wave and full wave controlled rectifiers with different types of load, Effect of source impedance on the performance of full wave converter, Dual converter, three phase converters and cyclo-converters
CO4	Understand and analyze the concept, design, technique, advancement and application of Single phase bridge inverters (half and full wave), Pulse width modulation (PWM) inverters, Series inverter, Parallel inverter, Mc-Murray half bridge inverter, Three phase inverter.
CO5	Understand and analyze the concept, design, technique, advancement and application of choppers, chopper circuits, Multi quadrant choppers, Commutation of choppers, Switched mode power supplies.

No.	Content	Contact Hrs.	Mapped CO
1	Power Transistors I Classification of power transistors, Bipolar junction transistor (BJT), Power Metal oxide semiconductor field effect transistor (MOSFET), Insulated gate bipolar junction transistor (IGBT), Basic principle of operation of Silicon controlled rectifier (SCR), Voltage vs Current characteristics of SCR, Firing circuits of Thyristor, Turn on methods of a Thyristor, Thyristor turn-off process.	8	CO1
2	Power Transistors II :Protection of Thyristor, Gate characteristic of an SCR, Dynamic characteristics of SCR, Series and parallel operation of SCR, Two transistor analogy, Rating of an SCR, Gate turn off (GTO) thyristor.	8	CO2
3	Controlled Rectifiers Analysis of single phase half wave and full wave controlled rectifiers with different types of load, Effect of source impedance on the performance of full wave converter, Dual converter, Introduction to three phase converters and cyclo-converters.	8	CO3
4	Classification of inverters, Single phase bridge inverters (half and full wave), Pulse width modulation (PWM) inverters, Series inverter, Parallel inverter, Mc-Murray half bridge inverter, Three phase inverter.	8	CO4
5	Choppers :Principle of choppers, Analysis of chopper circuits, Multi quadrant choppers, Commutation of choppers, Switched mode power supplies.	8	CO5

References Books:

1.M. H. Rashid, "Power Electronics: Devices, Circuits and applications", Pearson, 4th edition, 2014.

2. J. M. Jacob, "Power Electronics: Principles and applications", Thomson Press (India) Ltd; 1st edition, 2006.

3. Vedam Subramanium, "Power Electronics: Devices, Converters, Application", New Age Int. (P) Ltd., 2nd edition, 2012.

4. Ned Mohan, "Power Electronics: Converters, Applications and Design", Wiley, 3rd edition, 2002.

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	3	2	1	3	3	2	2	2	1	1	2	3	2	3	3
CO2	3	3	2	1	3	3	2	2	2	1	1	2	3	2	2	2
CO3	3	3	2	1	3	3	2	2	2	1	1	2	2	2	2	3
CO4	3	3	2	1	3	3	2	2	2	1	1	2	2	3	2	2
CO5	3	3	2	1	3	3	2	2	2	1	1	2	3	3	2	3

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