Third Year First Semester

Course code	**EE/PC/B/T/311**
Category	Program Core
Course title	Electrical Machines-III
Scheme and Credits	L-T-P: 3-0-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/311: Electrical Machines-III	L	T
Single-phase induction motors: Construction and operating principle of split-phase and capacitor-start-capacitor-run 1-phase induction motors. Operating characteristics.	2	0
Construction and operating principle of capacitor-start-induction-run induction motors. Winding of 1-phase induction motor. Operating characteristics. Double revolving field theory, Cross field theory. Equivalent circuit, phasor diagram.	5	0
Shaded-pole type motor: Construction and operating principle. Operating characteristics.	1	0
Repulsion start 1-phase induction motor: Operating principle. Operating characteristics.	3	0
AC Commutator Motors: Transformer and rotational emf's in phase and commutator windings. Expression for torque and power. Action of commutator as frequency converter.	5	0
Study of the AC Plain Series motor, its phasor diagram, commutation, brush emf's, design features. Use of compensating and compole winding to improve power factor and commutation.	4	0
Synchronous Generator: Stator construction, Cylindrical rotor and salient rotor construction. Principle of operation. Armature reaction, its effect on load power factor. Alternator regulation. Synchronous reactance. Prediction of regulation by various methods.	5	0
Salient Pole Machine: Two-reaction Theory. Damper windings.	3	0
Short circuit, Transient and sub-transient reactances. Determination of X_s, X_d, X_q, X_1, X_2, X_0, $X_{d'}$, $X_{q'}$, $X_{d''}$, $X_{q''}$. Methods of voltage control and schemes for excitation systems.	2	0
Synchronisation of alternators, power flow, power angle characteristics, operating chart, synchronizing power, stability. Excitation characteristics, V-curves, parallel operation.	4	0
Synchronous motors: Power developed, circle diagrams for constant power developed and constant excitation. V-curves and O-curves. Starting methods. Synchronous induction motor. Operation as synchronous condenser.	3	0
Tests as per standards.	2	0
Introduction to Permanent Magnet synchronous machines.	1	0

Reference Books:

1	The Performance and Design of A.C. Commutator Motors: E. Openshaw Taylor
2	Electrical Machinery: S. K. Sen
3	AC Machines: Puchstein, Lloyd &Hunte
4	Performance and Design of Alternating Current Machines: M.G. Say
5	Principles of Alternating Current machinery: Lawrence
6	Electrical Machines: P.K. Mukherjee & S. Chakravorti

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Discussion (D7)

Course Outcomes:

The students of the course should be able to

CO1	**Describe** the basic principles of operation of single phase induction motor, A.C. commutator motor and Cylindrical Rotor and Salient Pole Synchronous machine.(K1)
CO2	**Discuss** the constructions of single phase induction motor, A.C. Commutator motor and Cylindrical Rotor and Salient Pole Synchronous machine.(K2)
CO3	**Develop** and **Analyze** equivalent circuits for single phase induction motor and methods of determining voltage regulation of Cylindrical Rotor and Salient Pole Synchronous machine.(K3)
CO4	**Analyze** various performance characteristics of single phase induction motor, A.C. Commutator motor and **Discuss** and **Analyze** excitation circle and power circle; operating chart, V-curve and O-curve of Synchronous machine. (K4)
CO5	**Solve** numerical problems related to various aspects of single phase induction motor, A.C. commutator motor and Cylindrical Rotor and Salient Pole Synchronous machine. (K3)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Electrical Machines III	CO1	3	2	1				1					1			
	CO2	3	1	2				1					1			
	CO3	1	2	3				1					1			
	CO4	1	1	2	3			1					1			
	CO5	1	3	2				1					1			

Course code	**EE/PC/B/T/312**
Category	Program Core
Course title	Power System Planning and Design
Scheme and Credits	L-T-P: 2-1-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/312: Power System Planning and Design	L	T
Transmission line parameters – Resistance, Inductance, Capacitance and Conductance. Inductance of single phase line, inductance of three phase line with symmetrical and unsymmetrical spacing, concept of GMD and GMR. Inductance of composite conductor systems – stranded conductors, bundle conductor and Double circuit lines.	5	2
Capacitance of single phase line, capacitance of three phase lines with symmetrical and unsymmetrical spacings, capacitance calculation for double circuit line and bundle conductor. Effect of earth on capacitance calculation. Skin effect and proximity effect. Interference between power and communication lines.	4	2
Line representation – Representation of short, medium and long lines, Pi and T models. A, B, C, D constants of transmission lines and their measurement.	4	2
Travelling wave interpretation of long line equations, tuned lines.	2	0
Transmission line structure- Types of conductors, line supports – poles, towers, stay& Guy wires	1	0
Sag And Tension calculations, stringing chart, sag template	2	1
Insulators – Materials of insulators, types of insulators – Pin and Disc type – their applications	1	0
Underground Cables – Construction of cables, single and multicore cables, different types, capacitance of belted cables, dielectric loss in cables, heating of cables.	3	1
Legal aspects of electricity supply- Electricity acts, rules and codes. Standards followed in power supply, environmental and safety measures	1	0
Commercial aspects of electricity supply – Expenditure in power Utility. Factors influencing tariffs, types of consumers, different types of tariffs.	3	1
Administrative aspects of electricity supply- Development of power sector in India. Administrative set up and organisations in power sector. Stages involved in power planning- load analysis, load management & load forecasting.	4	0

Reference Books

1	Power System Analysis: J. J. Grainger & W. D. Stevenson, McGraw Hill
2	Power System Engineering: I. J. Nagrath & D. P. Kothari, Tata McGraw Hill
3	Electrical Power Systems: Ashfaq Husain, Vani Educational Books.
4	Elements of Power System Analysis: W. D. Stevenson, McGraw Hill.
5	A text book on Power System Engineering: A. Chakrabarti, M. L. Soni, T.V. Gupta, U.S.

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)
- Discussion (D7)

Course Outcomes:

The students of the course should be able to

CO1	**Explain** the basic concepts and standards of transmission and distribution system planning. (K2)
CO2	**Explain** the administrative and financial aspects of power transmission system. (K2)
CO3	**Calculate** the overhead and underground transmission line parameters and structures from electrical and mechanical aspects. (K3)
CO4	**Classify** transmission lines and **analyze** the performance of transmission lines. (K4)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

Power System Planning and Design		**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
	CO1	**3**	**1**	**1**			**1**		**1**							
	CO2	**2**	**3**													
	CO3	**3**	**2**	**1**			**1**									
	CO4	**3**	**2**	**1**			**1**									

Course code	**EE/PC/B/T/313**
Category	Program Core
Course title	Linear Control System
Scheme and Credits	L-T-P: 2-1-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/313: Linear Control Systems	L	T
Introduction to Control Systems: Classification of control systems with examples. Properties of Control Systems: Stability, steady-state & transient errors, disturbance rejection, insensitivity and robustness. Errors and Error constants, System types.	2	0
Time response of system: Time domain specifications, Ramp response of second order system, concept of dominant poles, Time response with NMP zeros.	3	2
Review of frequency domain methods: Bode and Nichols plots. Frequency Domain Specifications in open loop and closed loop and their significance, Concept of Bandwidth (3 dB BW & 90 degree BW) and Cut-off frequency, Effect of addition of poles and zeros on Bandwidth.	3	1
Control system components: Position and velocity sensors and encoders, servomotors and voice coil actuators. Case Studies: Performance analysis of remote position control system and generator voltage regulation.	3	0
Basic Control actions: Proportional, integral, derivative, and their combinations. Design and compensation of control systems in frequency domain: Lag compensator, lead compensator, lead-lag compensator and lag-lead compensator.	4	2
Review of Matrix Algebra: Rank of matrix, eigenvalues, eigenvector, computation of function of matrix.	1	1
Stability of linear systems: Routh-Hurwitz criterion, Nyquist criterion. Stability margins.	4	2
Root locus analysis. Effects of system gain and additional pole-zeros on stability. Block diagram representation of control systems: block diagram reduction and signal flow graph analysis.	4	2
State variable analysis: Concept of state, state variable, state model. State variable formulation of control system, diagonalization, Relating transfer function with state model. Time response of state model of linear time-invariant system. Alternative representations in state space (cascade form, parallel form, controllable canonical form, observable canonical form). Elementary concept of controllability & observability.	4	2

Reference Books:

1	Control Systems Engineering: Norman S. Nise, 6th Edition, Wiley, 2011.
2	Control Systems Engineering: I. J. Nagrath and M. Gopal, 5th Edition, New Age International, 2009.

3	Automatic Control Systems: Benjamin C. Kuo and Farid Golnaraghi, 9th edition, Wiley; 2009.
4	Control Systems Principles and Design: M. Gopal, 3rd edition, Tata Mgraw Hill, 2008
5	Control Systems: Naresh K. Sinha, 3rd edition, New Age International, 2004.
6	Modern Control Systems: Richard C. Dorf and Robert H. Bishop, 12th Edition, Prentice Hall, 2011.
7	Control System Theory: Sushil Das Gupta, Khanna Publishers, 1987

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)
- Discussion (D7)

Course Outcomes:

The students of the course should be able to

CO1	**Explain** the configurations of control systems, the notion of stability and related concepts on steady-state and transient errors, disturbance rejection, insensitivity and robustness. (K1, K2).
CO2	**Describe** different control system components; **Interpret** time responses of the systems; **Discuss** about the absolute stability of a system using Routh-Hurwitz Criteria (K1, K2).
CO3	**Develop** knowledge on Block Diagram reduction technique and Signal Flow Graph (K3); **Develop** knowledge on closed loop frequency response of an LTI system; (K2, K3).
CO4	**Design** suitable P, PI, PD, PID controllers; **Examine** the dynamic behavior and stability of an LTI system by constructing Root Locus and **Ascertain** the stability of a system using Nyquist Criterion (K3, K4).
CO5	**Analyze** and LTI system and synthesize controllers for the same using State Space Techniques; **Design** suitable compensators using both frequency and time domain based techniques (K4).

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Linear Control Systems	**CO1**	3	1	1												
	CO2	3	2	1		2										
	CO3	3	3	2	1	2										
	CO4	3	2	2	2	2		1		1		1	1			
	CO5	3	2	2	2	2		1		2		1	1			

Course code	**EE/PC/B/T/314**
Category	Program Core
Course title	Power Electronics
Scheme and Credits	L-T-P: 2-1-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/314: Power Electronics	L	T
Major Power semiconductor devices used in Power Electronics: Diode, SCR, GTO, Triac, Bipolar Power Transistor, Power MOSFET, IGBT -their type variations, important parameters, internal and equivalent circuits, Safe Operating Area, their operation and switching characteristics. Drive techniques and isolation of drive pulses. Protection including fuses, snubbers and clamps. Steady and switching power loss in devices: its effect & minimization. Cooling and Heat-sinks.	5	2
Choppers: Principles of buck, boost and buck-boost Choppers with R and RL load. Methods of voltage control : PWM & PFM techniques.	2	1
Inverters: Push-pull inverter, principles and different topologies of single-phase and three-phase bridge and PWM inverters. Methods of voltage control: DC bus variation and PWM. Methods of frequency control, reduction of harmonics. SCR forced commutation techniques and their application to choppers and inverters. Current Source Inverters.	3	1
Power Supplies: Principles of isolated dc/dc converters, Linear Power Supply and SMPS.	2	1
AC Voltage Controller: Integral Cycle control, phase control and their applications	2	1
Uncontrolled Rectifiers: Input and output characteristics of common rectifier topologies: Single-phase half-wave and full-wave Diode rectifiers with R, RL, RC and RLE load. Study of same with highly inductive load. Effect of Free-wheel diode. Output average voltage for 'm' pulse diode rectifier. Three-phase half-wave and full-wave Diode rectifiers with highly inductive load. Introduction to higher pulse rectifier systems and use of Inter-Phase Reactor.	5	2
Phase Controlled Rectifiers: Single-phase half-wave and full-wave SCR rectifiers with R, RL and RLE load. Study of same with highly inductive load. Effect of Free-wheel diode. Output average voltage for 'm' pulse SCR rectifier. Three-phase half-wave and full-wave SCR rectifiers with highly inductive load. Effect of free-wheel diode. Half-controlled rectifiers with highly inductive load. Commutation effects, overlap angle and voltage loss. Input current harmonics and power factor, output voltage ripple & harmonics.	5	2

Generation of control pulses for SCR Converters: Principle of generation of control pulses for SCR converters: cosine, ramp and equidistant pulse methods. Principle of UJT control. Line Commutated SCR inverters, reverse power flow.	2	1
Cyclo-converters: Principle operation of the Cyclo-converter. Their operation and switching characteristics	2	1

Reference Books:

1	Power Electronics: N. Mohan, T. M. Undeland & W.P. Robbins, John Wiley & Sons.
2	Power Electronics: V. Subrahmanyam, New Age International (P) Ltd.
3	Power Electronics: M. H. Rashid, 3rd Edition, Prentice-Hall of India Pvt. Ltd.
4	Power Electronics: B. W. Williams, Macmillan.
5	Modern Power Electronics: P. C. Sen, Wheeler Publishing.
6	Power Electronics: P. S. Bimbhra, 4th Edition, Khanna Publishers
7	Power Electronics: P. C. Sen, Tata McGraw-Hill Publishing Co. Ltd.
8	Thyristorised Power Controllers: G. K. Dubey, S. R. Doradla, A. Joshi & R. M. K. Sinha, Wiley Eastern Ltd

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)
- Tutorial (D3)
- Discussion (D7)

Course Outcomes:

The students of the course should be able to

CO1	**Describe** the construction, characteristics and basic principle of operation of power electronic devices and common rectifier topologies (K2)
CO2	**Describe** working principle , circuit diagrams , and input output characteristics of DC-DC converter, Inverters, SMPS and common rectifier topologies (K2)
CO3	**Discuss** SCR forced commutation techniques and their applications to Chopper, Volt Source Inverters and Current Source Inverters (K2)
CO4	**Develop** the mathematical expression of output voltages of DC-DC Converters, and common rectifier topologies (K3)
CO5	**Analyze** the output waveforms of common DC-DC Converters, Rectifiers and Inverter configurations (K4)
CO6	**Explain** use of inter-phase reactors in higher pulses rectifier systems, drive techniques and protection of power electronics devices and its cooling (K5)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)																
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
Power Electronics	**CO1**	**3**	**1**	**1**				**1**								
	CO2	**1**	**2**	**3**												
	CO3	**1**	**2**	**3**	**1**			**1**								
	CO4	**2**	**1**	**3**												
	CO5	**2**	**3**	**1**												
	CO6	**1**	**3**	**2**	**1**			**1**								

Course code	**EE/PC/B/T/315**
Category	Program Core
Course title	Introduction to Statistical & Probabilistic Methods
Scheme and Credits	L-T-P: 2-1-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/315: Introduction to Statistical & Probabilistic Methods	L	T
Review of probability concepts, rules of probability, conditional probability, Bayes' formula.	2	1
Concept of random variables, probability mass function, cumulative distribution function and probability density function. Moments of random variables, moment generating functions, characteristic functions, probability generating functions. Markov's inequality and Chebyshev's inequality.	5	2
Discrete distributions: Binomial and Poisson, Continuous distributions: Uniform, Exponential, Gaussian, lognormal, Chi-Square, Gamma, Rayleigh.	4	2
Bivariate data: Joint probability distribution; Concept of correlation and covariance. Correlation coefficient: properties calculations, interpretations and usage, applications in electrical engineering.	4	2
Introduction to Random Process: First-order and Second-order statistics, ensemble averages. Auto correlation and Cross correlation, concepts of stationarity and ergodicity, Spectral density: energy spectral density and power spectral density, concept of white noise. LTI systems with random inputs: innovations representation of a stationary random process and applications in electrical engineering.	5	2
Sampling Statistics: sample mean and sample variance, distribution of sample mean, central limit theorem, joint distribution of sample mean and sample variance.	4	1
Parameter Estimation: maximum likelihood estimators, point estimates, interval estimates, confidence interval, the Bayes estimator.	4	1
Hypothesis Testing: significance level, critical region, Type I and Type II errors, tests concerning unknown mean of a normal population- two-sided test and one-sided test, p-value of a test, the t-test, tests concerning unknown variance, goodness of fit- chi-square test.	4	1
Regression: linear regression model, least squares estimators of the regression parameters, distribution of the estimators, statistical inferences about the regression parameters, weighted least squares, polynomial regression.	3	2
Statistical analysis of measurement errors: types of measurement errors, statistical treatment of measurement data.	2	1

Reference Books:

1	Probability, random variables, and random signal principles: Peyton Z. Peebles, Jr.
2	Probabilistic Methods of Signal and System Analysis: George R. Cooper and Clare D. McGillem.

3	Probability, Random Variables and Stochastic Processes: Athanasios Papoulis and S. U. Pillai.
4	Introduction to Probability and Statistics for Engineers and Scientists: Sheldon M. Ross.
5	SCHAUM'S Outline Series: Theory and Problems of Probability and Statistics: Murray R. Spiegel.
6	Statistical Methods (Part I and Part II): N. G. Das.
7	Modern Electronic Instrumentation and Measurement Techniques: Albert D. Helfrick and William D. Cooper.

Content Delivery Method

- Class Room lecture (Chalk and Board) (D1)
- Visual presentation (D2)
- Tutorial (D3)
- Discussion (D7)

Course Outcomes:

The students of the course should be able to

CO1	**State** the notion of probability, rules of probability, conditional probability, Bayes' formula.
CO2	**Describe** the notion of random variables, operations performed on a single random variable, and moment generating functions, and the essence of sampling theory(K2)
CO3	**Interpret** discrete distributions: Binomial and Poisson, Continuous distributions: Uniform, Exponential, Gaussian, lognormal, Chi-Square, Gamma, Rayleigh distributions (K3).
CO4	**Develop** the knowledge on bivariate random variables, independence and correlation; The estimation theory along with different estimators and percentage confidence level, regression analysis (K3).
CO5	**Analyze** the properties of Random processes of different orders in the presence of noise and test statistical hypotheses (K4); **Analyze** statistical measurement of errors and uncertainties and relate the outputs of LTI systems with random inputs (K4).

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Introduction to Statistical & Probabilistic Methods[H]	**CO1**	3	2	1												3
	CO2	2	3	1				1			1	1	1			3
	CO3	2	3	2			1	1			2	2	1			3
	CO4	2	2	2	3		1	1		1	2	2	1			3
	CO5	2	2	2	3	1	1	1		2	2	2	1			3

Course code	**EE/PC/B/T/316**
Category	Program Core
Course title	Programmable Logic & Microcontroller
Scheme and Credits	L-T-P: 3-0-0; Credits: 3.0;
Pre-requisites (if any)	

EE/PC/B/T/316 : Programmable Logic and Microcontroller	L	T
Programmable Logic Controllers (PLC): Architecture and functional components, I/O Processing Methodologies, Programming Languages. Sequence Function Chart, Ladder Diagram, and PLC input/output Diagram. Case Studies.	5	0
Programmable Logic Devices: Concepts of PLA, PAL and FPGAs, Architecture, Basic Design Process.	4	0
Introduction to VHDL language basics. Modeling combinational and sequential logic systems. Simulation and testing.	8	0
Types of FPGAs	1	0
Xilinx solutions: Xilinx CPLDs and applications areas.	1	0
JTAG Development and Debugging Support.	1	0
Microprocessor vs. Microcontroller, Microcontroller Architecture, Memory Organization, On-chip Hardware modules, Pin Configurations and Functions.	4	0
Programming of Microcontroller in Assembly language and C, Concept of Assembler and Cross-compiler, Structures for Writing, Debugging and Uploading Program to Microcontroller.	4	0
Addressing modes, Instructions corresponding to Data Transfer, Arithmetic, Logical, Bit-based and Branching operations, I/O Port programming, Time delay loop.	6	0
Interrupt programming, Interfacing with input and output peripherals, Interfacing with Sensors and Actuators using various communication protocols.	6	0

Reference Books:

1. Introductory VHDL: From Simulation to Synthesis: Sudhakar Yelamanchilli, Pearson Education.
2. A VHDL Primer: J. Bhasker, Pearson Education.
3. VHDL for Engineers: Kenneth L. Short, Pearson Education
4. The AVR Microcontroller and Embedded Systems Using Assembly and C: Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education
5. Programming and Customizing the AVR Microcontroller: Dhananjay Gadre, McGraw Hill Education
6. AVR ATmega data sheets

Content Delivery Method

- Class room lecture (chalk and board) (D1)
- Visual presentation (D2)

Course Outcomes:	
The students of the course should be able to	
CO1	**Arrange** and **recognize** processors and controllers according to their evolution of development and technology. (K1)
CO2	**Describe** the architectures and functional components of the relevant hardware. (K1)
CO3	**Explain** the programming language of hardware and **distinguish** each from others. (K2)
CO4	**Develop** appropriate program and **apply** the programmed device in association with its supporting peripherals to obtain output of specific requirements. (K3)
CO5	**Analyze** the requirement of various sub-systems and **illustrate** their interfacing techniques to implement a system of desired functionality. (K4)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
Programma-ble Logic and Microcontro-ller	**CO1**	**3**	**1**													
	CO2	**3**	**1**													
	CO3	**3**	**2**	**1**												
	CO4	**2**	**3**	**2**	**1**											
	CO5	**2**	**2**	**3**	**1**											

Course code	**EE/PC/B/S/311**
Category	Program Core
Course title	Electrical Engineering Laboratory - III
Scheme and Credits	L-T-P: 0-0-3; Credits: 1.5;
Pre-requisites (if any)	

EE/PC/B/S/311 : Electrical Engineering Laboratory - III	P
1. Open Circuit & Short Circuit characteristics of a single phase transformer.	3
2. Calibration of Wattmeter using DC Potentiometer.	3
3. Identification of linear system from frequency response test.	3
4. Measurement of phase shift and observation of magnetizing current wave form and hysteresis loop by CRO.	3
5. Determination of breakdown strength of liquid insulating material.	3
6. Studies of Spectral composition and CCT of different lamps.	3
7. Separation of losses of DC machine.	3
8. Measurement of strain.	3
9. Simulation of a second order dynamic system on an analog simulator.	3
10. Study of constant current source	3
11. Determination of breakdown strength of solid insulating material.	3
12. Arrear, Laboratory Examination	6

Content Delivery Method

- Class room lectures (Chalk and Board) (D1)
- Active learning (D4)
- Blended/Hybrid learning (D5)
- Discussions (D7)
- Case Studies (D9)

Course Outcomes:

The students of the course should be able to

CO1	**Identify** the instruments required to perform the experiment (K1, S1)
CO2	**Select** the range/ratings of the instruments identified (K2, S1)
CO3	**Comprehend** the objective of the experiment and **Relate** that with the acquired theoretical knowledge (K3, S2)
CO4	**Develop** the circuit duly connecting selected instruments and other devices (K2, S2)
CO5	**Interpret** the data and prepare a detailed report. (K2, S2)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Electrical Engineering Laboratory - III	**CO1**	**3**	**2**	**1**						**2**				**3**		
	CO2	**1**	**3**	**2**						**2**				**3**		
	CO3	**1**	**3**	**2**						**2**				**3**		
	CO4	**1**	**2**	**3**						**2**				**3**		
	CO5	**1**	**1**	**2**	**3**				**1**	**2**		**1**	**1**	**3**		

Course code	**EE/PS/B/S/312**
Category	Program Sessional
Course title	Electrical Machine Design-I
Scheme and Credits	L-T-P: 0-0-2; Credits: 1.0;
Pre-requisites (if any)	

EE/PS/B/S/312 : Electrical Machine Design-I	P
Design of Single-phase transformers	30
Design of Three-phase transformers	9

Reference Books:

1	A Course in Electrical Machine Design: A. K. Shawney
2	Electrical Machinery: S. K. Sen
3	Performance and Design of Alternating Current Machines: M. G. Say

Content Delivery Method

- Class room lectures (Chalk and Board) (D1)
- Active learning (D4)
- Blended/Hybrid learning (D5)
- Discussions (D7)
- Case Studies (D9)

Course Outcomes:

The students of the course should be able to

CO1	**Relate** acquired knowledge of single-phase transformers, lifting magnets and reactors. (K1, S1)
CO2	**Estimate** dimensions of different parts of single-phase transformers, lifting magnets and reactors. (K2, S2)
CO3	**Assess** the performance of the designed solution and suitably **modify** the design to meet the set performance criteria. (K3,S3)
CO4	**Analyze** the overall performance of the designed single-phase transformers, lifting magnets and reactors. (K4,S3)
CO5	**Prepare** a comprehensive detailed design report. (K5,S3)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Electrical Machine Design- I	**CO1**	3	2	1						1						
	CO2	1	3	2						1						
	CO3	1	2	3					1	1						
	CO4	1	2	2	3		2	2	1	1						
	CO5	1	2	2			1		2	1		3	1			

Course code	**EE/PS/B/S/313**
Category	Program Sessional
Course title	Modeling & Digital Simulation Laboratory
Scheme and Credits	L-T-P: 0-0-3; Credits: 1.5;
Pre-requisites (if any)	

EE/PS/B/S/313: Modeling and Digital Simulation Laboratory	P
Introduction to Matlab/Simulink: Basic matrix operation, file operations, plotting, Matlab program development in command window. Simulation of problems on Matlab/Simulink related to:	
– Modeling of 1st and 2nd order systems. Study on time domain and frequency domain behavior.	3
– D.C. circuit transients in time domain.	3
– A.C. circuit response in time and frequency domain.	3
– Simulation of D.C. shunt motor and open loop response.	3
– Closed-loop speed control of D.C. shunt motor: Stability analysis by root-locus method.	3
– Simulation of series and shunt faults in transmission lines.	3
– Simulation of load frequency control for single-area and two-area power system.	3
– Simulation of sampling and aliasing phenomenon. Study on quantization error of ADC.	3
– FFT and Inverse FFT of harmonic rich signals.	3
– Design of IIR and FIR filters and study on effect of finite word length.	3
–Simulation of long transmission line and study of wave propagation.	3
– Modeling of illumination level at working plane.	3
Arrear, Laboratory Examination	3

Content Delivery Method

- Class room lectures (Chalk and Board) (D1)
- Active learning (D4)
- Blended/Hybrid learning (D5)
- Discussions (D7)
- Case Studies (D9)
- Projects (D11)

Course Outcomes:

The students of the course should be able to

CO1	**Describe** the basic concepts of MATLAB and Simulink and **perform** basic simulations and solve general purpose problems. (K1, S1)
CO2	**Simulate** and **Solve** problems related to time and frequency domain analyses of LTI systems. (K2, S2)

CO3	**Simulate** and **Solve** problems related to modeling and control of DC motors and modeling of illumination levels. (K3, S2)
CO4	**Simulate** faults and propagation of waves through different models of transmission lines, and load frequency control in power systems. (K4, S2)
CO5	**Solve** problems related to digital signal processing e.g. aliasing, Fast Fourier Transform and Digital filters. (K4, S2)

CO-PO Mapping (3 – Strong, 2 – Moderate and 1 – Weak)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Modeling and Digital Simulation Laboratory	**CO1**	**2**	**2**	**1**		**3**										
	CO2	**3**	**2**	**2**	**1**	**3**				**1**	**2**	**1**				
	CO3	**3**	**2**	**2**	**1**	**3**				**1**	**2**	**1**				
	CO4	**3**	**2**	**2**	**1**	**3**				**1**	**2**	**1**				
	CO5	**3**	**2**	**2**	**1**	**3**				**1**	**2**	**1**				