FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE501T	Power Electronics	2	1		3	30	70	100

Course Objectives	Course Outcomes
• To introduce students, the basic theory of power semiconductor devices and their practical application in power electronics • To familiarize the operation principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications • To provide the basis for further study of power electronics circuits and systems.	A student who successfully fulfil the course requirements will be able to • understand basic operation of various power semiconductor devices and basic principle of switching circuits • analyze and design an AC/DC rectifier circuit • analyze DC/AC inverter circuit • analyze and design DC/DC converter circuits

Unit I	**[08Hrs]**
SCR and Its characteristics: V-I, turn on & turn off characteristics, rating, gate characteristics, over voltage and over current protection, snubber circuit design. **Commutation techniques of SCR**: Natural commutation and forced commutation method (numerical on class B commutation)	
Unit II	**[08Hrs]**
Static controllable switches: Characteristics & working of MOSFET, Gate turn off thyristor and Insulated gate bipolar transistor, TRIAC, DIAC, UJT , AC regulator and working principle of UJT as relaxation oscillator.	
Unit III	**[08Hrs]**
Line commutated converters: **Single Phase line commutated converters:** Working of single pulse converter, two pulse (mid-point & bridge) converter, effect of source inductance on 1-phase bridge converter, effect of freewheeling diode, single phase semi converter. **Three phase line commutated converters:** Working of three pulse converter and six pulse bridge converter, effect of freewheeling diode.	
Unit IV	**[06Hrs]**
Inverter: Working of basic series inverter, modified series inverter, bridge inverter, three phase inverter in 120° & 180° Modes, output voltage control, harmonic reduction by pulse width modulation techniques.	
Unit V	**[06Hrs]**
Chopper: Principles of step down chopper, step up chopper, impulse commutated chopper, multi-phase chopper, jones chopper. **Cycloconverters :** Working of single phase midpoint cycloconverter , single phase bridge type **c**ycloconverter	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Power Electronics Circuits Devices and Applications	M. H. Rashid	Third	Pearson
2	Power Electronics	M. D. Singh & Khanchandani	Second	Tata McGraw Hill
3	Power Electronics	P. C. Sen.		Tata McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Power Electronics	Ned Mohan, Tora M. Udeland, William P. Riobbins		John Wiley & sons

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ELECTRICAL ENGINEERING

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE501P	POWER ELECTRONICS LAB			2	1	25	25	50

Course Objectives	Course Outcomes
• To introduce students to understand construction, operation and various characteristics of SCR. • To familiarize students to the different types of power semiconductor devices and their switching Operation, characteristics and performance parameters. • To understand basic operation of AC to DC conversion system. • To understand operation and application of DC to AC power conversion system with harmonic reduction methods. • Operation, switching, techniques and basics topologies of DC-DC switching	• Knowledge of different types of semiconductor switches and their characteristics • Knowledge of different types of power conversion system with their operation. • Knowledge of various rectifier circuits at loading conditions. • Knowledge of various operating modes of inverter and control circuits. • Knowledge of different DC —DC conversion circuit & four quadrant operation.

Expt. No.	Title of the experiment
1	To study V-I characteristics of SCR and measure latching and holding currents
2	Study characteristics of MOSFET and IGBT
3	Single phase Half-controlled converter with R & RL load
4	Single phase Fully controlled bridge converter with R & RL loads.
5	Single-phase AC voltage controller
6	Single-phase Cyclo converter with R& RL loads
7	Single Phase Dual converter with R load.
8	Forced commutation circuits(Class A, Class B, Class C, Class D and Class E
9	Single Phase Series Inverter with R& RL loads
10	Single Phase Parallel Inverter with R& RL loads

Text Books

S.N	Title	Authors	Edition	Publisher
1	Power Electronics circuits Devices and Applications	M. H. Rashid	Third	Pearson
2	Power Electronics	M.D.Singh & Khanchandani	Second	Tata McGraw Hill
3	Power Electronics	P.C.Sen.		Tata McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Power Electronics	Ned Mohan, Tora M. Udeland, William P. Riobbins		John Wiley & sons

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ELECTRICAL ENGINEERING

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE502T	Electrical Machines - II	2	1		3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To develop familiarity with Induction Machine. • To develop familiarity with Synchronous Machine • To lay firm foundation of electrical machines for understanding the behaviour of Power system.	**Students will be able to** • To describe basic concept, construction, working of the Three-phase Induction Motor and different tests to be carried out for performance evaluation. • To explain basic concept, construction, working of the Three-phase Alternator • To analyze transient behaviour of alternator and methods of synchronization of alternator with infinite bus. • To discuss basic concept, construction, working of the Synchronous motor and its performance evaluation • Illustrate the awareness of various special motors along with single phase induction motors and their applications.

Unit I	**[8Hrs]**
THREE PHASE INDCTION MOTOR: Construction, Types (Squirrel Cage and Slip-ring), Starting & Maximum Torque, Torque-slip characteristics, Equivalent circuit, No load blocked rotor test, Losses & Efficiency. Method of starting, Speed control & Braking, Crawling & cogging.	
Unit II	**[8Hrs]**
THREE PHASE SYNCHRONOUS GENERATORS: Introduction, constructional features of cylindrical and salient pole rotor machines, introduction to armature winding and field windings, MMF of armature and field windings, induced EMF. Phasor diagram, Voltage Regulation	
Unit III	**[6Hrs]**
Synchronization : Synchronizing of generator with another generator, synchronizing machines on infinite bus, Parallel operation, short circuit ratio, effects of variable excitation and power input on generator operation. damper windings, power angle curve, Transient behaviour, Sudden 3-phase short circuit, time constants and equivalent circuit diagram.	
Unit IV	**[8Hrs]**
THREE PHASE SYNCHRONOUS MOTORS: Principle of operation, Phasor diagram, Torque equation, load / torque angle, effect on variable excitation and load on motor operation, V and inverted V curves, Power input and power developed equations.	
Unit V	**[6Hrs]**
Single-phase induction motors : Constructional features, double revolving field theory, Split-phase IM, Capacitor start IM, Shaded pole IM. **Special Motors :** Repulsion motor, Reluctance motor, Hysteresis motor and Universal Motor	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Machinery	Dr. P.K. Mukherjee & S. Chakraborty		Danpat Rai publication
2	Electrical Machinery	Dr. P.S. Bimbhra		Khanna publisher
3	Electrical Machines	I.S. Nagrath & Dr. D.P. Kothari		McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Elect. Machinery	Fitzogerald and Kingsley and Kusco		McGraw Hill
2	Performance & Design of A.C. M/C.	M.G. Say		CBS publishers

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE502P	Electrical Machines – II Lab			2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended • To study performance of 3-phase Induction motor. • To study performance of Alternator. • To study performance of Synchronous motor.	**Students will be able to** • To identify the tests performed 3-phase industion motor • To illustrate the tests performed 3-phase alternator • To analyze the process of synchronization in alternator • To discuss characteristics of Synchronous motor • To identify and differentiate various special machines

Expt. No. (Any 08)	Title of the experiment (Any 08)
1	Speed Control Of Induction Motor (Slip Ring) By Rotor Resistance Control
2	No Load And Blocked Rotor Test On An Induction Motor
3	To Perform Load Test On An Induction Motor.
4	**D**etermination Of Regulation Of Three Phase Alternator By Direct Loading .
5	Determination Of Regulation Of Three Phase Alternator By Open Circuit And Short Circuit Test.
6	To Study Synchronization Of Alternator With Infinite Bus.
7	To Determine Xd And Xq Of A Salient Pole Synchronous Machine By Slip Test.
8	Determination Of Negative And Zero Sequence Reactance Of Synchronous Generator
9	To Determine Xd" And Xq" Of A Salient Pole Synchronous Machine.
10	To plot V and inverted V characteristics of Synchronous motor.
11	To study performance of BLDC motor.
12	To study speed control of Scherage motor.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Laboratory Courses in Electrical Engineering	R.L. Kharbanda and S. G. Tarnekar		
2	Laboratory manual of Electrical Machines	D.P.Kothari and B.S. Umre		
3	Electrical Technology Volume II	B. L. Thareja		

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Machinery	Dr. P.K. Mukherjee & S. Chakraborty		Danpat Rai publication
2	Electrical Machinery	Dr. P.S. Bimbhra		Khanna publisher
3	Electrical Machines	I.S. Nagrath & Dr. D.P. Kothari		McGraw Hill

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE503P	Seminar on Emerging Trends in Electrical Engineering			2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended • **To impart skills in preparing detailed report describing the project and results.**	**Students will be able to** • explain detailed report describing the project and results

S.N.	Seminar
1	**Seminars are based on :** Recent Trends in Electrical Power System, Power Electronics and Renewable Energy.

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE504T(i)	MATLAB Programming	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To learn MATLAB computing environment • To learn MATLAB Toolboxes	**Students will be able to** • Analyze features of MATLAB development environment • Develop and Draw various plots in MATLAB • Apply knowledge of MATLAB to solve Matrices • Describe Simulink environment • Analyze various toolboxes in MATLAB

Unit I **[10Hrs]**

MATLAB Fundamentals :-Brief Introduction, Use of MATLAB, Key features, Command window, Workspace, Command history, Setting directory Working with the MATLAB user interface, Basic commands, Assigning variables, Operations with variables, Character and string, Arrays and vectors, Column vectors, Row vectors, Arithmetic operations, Operators and special characters. Mathematical and logical operators, Solving arithmetic equations, Creating rows and columns Matrix, Matrix operations, Finding transpose, determinant and inverse.

Unit II **[10Hrs]**

M files, Plots and Graphical User Interface (GUI) :-Working with script tools, Writing Script file, Executing script files, The MATLAB Editor Saving m files, Plotting vector and matrix data Plot labeling, curve labeling and editing, 2D plots, Basic Plotting Functions, Creating a Plot Plotting, Multiple Data Sets in One Graph ,Specifying Line Styles and Colors, Multiple Plots in One Figure, Controlling the Axes, 3D plots Creating, GUI Design, Introduction Of Graphical User Interface, GUI Function.

Unit III **[10Hrs]**

Introduction to Simulink :- Simulink Environment and Interface, Study of Library, Circuit Oriented Design, Equation Oriented Design, Model Subsystem Design, Connect Call back to subsystem.

Unit IV **[9Hrs]**

Loops, Conditional Statement and functions:- Automating commands with scripts ,Writing programs with logic and flow control, Writing functions Control statement, Programming Conditional Statement, Programming Examples, Loops and Conditional Statements, Control Flow Conditional Control — if, else, switch, Loop Control — for, while, continue, break, Program Termination — return, Functions Writing user defined functions, Built in Function, Function calling, Return Value Types of Functions

Unit V **[9Hrs]**

Study of different tool boxes of MATLAB:-

Optimization Toolbox, Fuzzy logic ,Image processing, Signal processing, Machine learning, Artificial intelligence

Text Books

S.N	Title	Authors	Edition	Publisher
1	Getting started with MATLAB	Rudra Pratap	2	Oxford
2	MATLAB and Simulink	Agam Tyagi	1	Oxford

Reference Books

S.N	Title	Authors	Edition	Publisher
1	MATLAB for Engineers	William J Palm	1	Tata Mcgraw Hill

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE504T(ii)	PLC & SCADA Systems	3			3	30	70	100

Course Objectives	Course Outcomes
The objective of this course is to impart knowledge on the following topics- • To have the basic concept, components and programming of PLC for Automation. • To implement ladder logics for various applications. • To understand SCADA displays and its applications.	After successful completion of this course students will be able to • Identify and understand components of PLCs for Automation • Select appropriate module as per application. • Develop PLC Programming for given application. • Understand SCADA System. • Develop SCADA system for various applications.

Unit I	[10Hrs]
Introduction to PLC: Need and tools of Automation, Evolution of PLC, Architecture-PLC Block diagram and working, Selection of PLC, Types of PLCs, Advantage, limitations and applications of PLCs, Networking of PLCs.	
Unit II	**[10Hrs]**
PLC Hardware: Input and Output Modules for PLC- working, description, wiring details, specifications, interfacing; Types of Sensors, Instruction sets for given operation, Ladder Programming: Terminologies & Rules, Ladder logics for some applications, Boolean Expression to Ladder Diagram.	
Unit III	**[10Hrs]**
PLC Programming and Applications: Programming Languages for PLCs, PLC programming standard IEC61131, Relay type Instructions- Timer, Counter, Arithmetic operation, Data handling instructions. PLC based applications as motor control, traffic light, etc.	
Unit IV	**[10Hrs]**
Introduction to SCADA: Application area of SCADA; Architecture-Elements, block diagram of SCADA; Types of SCADA; Features of SCADA, MTU, RTU Functions, Communications in SCADA, Applications of SCADA.	
Unit V	**[8Hrs]**
SCADA Interfacing and Applications: Interfacing of SCADA with PLC, Creating SCADA display, Application of SCADA for ON-OFF Lamp, Traffic light control, water level control, motor control, etc.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers and Industrial Automation,	Madhuchhanda Mitra, SamarjitSen Gupta		Penram International Publishing India Pvt. Ltd
2	Supervisory Control and Data Acquisition	S.A. Boyar		, ISA Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers	V.R. Jadhav,		Khanna Publications

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE505T (i)	Advanced Power System	2	1		3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To learn the various aspects of symmetrical components and various types of faults • To study concepts of power systems stability, economic scheduling and management	**Students will be able to** • Apply symmetrical components concepts in fault analysis. • Evaluate short circuit currents and system voltages for symmetrical fault • Evaluate fault current for unsymmetrical condition • Appreciate concepts of power system stability • Describe and define optimal load scheduling considering transmission losses and to solve economic dispatch problems for power system

Unit I	**[8Hrs]**
Symmetrical Component transformation: Three phase power in unbalanced circuit in terms of symmetrical component. Sequence impedances of Generator. Transformer Transmission line & Passive loads. Phase shift in Y/ delta three phase transformer (Yd1, Yd11 connection.).	
Unit II	**[6Hrs]**
Symmetrical fault analysis: Without & with pre fault load current. Selection of Circuit Breakers ratings, current limiting reactors	
Unit III	**[7Hrs]**
Unsymmetrical fault Analysis: L-G, L-L-G, L-L, open conductors faults analysis using symmetrical components	
Unit IV	**[8Hrs]**
Stability of Power System: Steady state, Dynamic and Transient stability definition. Dynamics of synchronous machine, swing equation, swing equation for machines swinging coherently and Non Coherently. Power angle equation. Steady state stability studies. **Transient stability studies:** Swing curve. Equal Area criterion for transient stability. Application of equal area criterion for different disturbances. Methods of improving transient stability.	
Unit V	**[7Hrs]**
Economic operation of Power system: Introduction, Distribution of load between units within the plant Optimum generation scheduling considering transmission losses. Representation of transmission loss using loss formula coefficient. Derivation of loss formula co-efficient. Electricity market models (Vertically integrated, Purchasing Agency, Whole-sale competition, Retails Competition)	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Elements of P.S. Analysis	William D. Stevenson	Fourth	The McGraw-Hill Company
2	Modem power System analysis	Nagrath & Kothari	Third	The McGraw-Hill Company
3	Power System Analysis	Wadhwa C.L	Fourth	New Age International Publisher

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Extra High Voltage AC. - Transmission Engineering	R D. Begamudre	Fourth	New Age International

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
ET505T(ii)	Linear Electronics Circuits	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended ● To learn Operational Amplifiers ● To learn Linear Circuits and IC's	**Students will be able to** ● Understand basics of Operational Amplifier ● Design Linear Integrated Circuits ● Design applications of opamp ● Understand elementary idea of filter design ● Apply different IC's for signal conditioning

Unit I	**[7Hrs]**
Basics: Differential amplifier using transistors,block diagram of opamp,opamp parameters,virtual ground concept,ideal and practical opamp, equivalent circuit and voltage transfer curve.	
Unit II	**[8Hrs]**
Simple Linear Circuits: inverting,non inverting and differential configurations, integrator,differentiator	
Unit III	**[7Hrs]**
Linear Applications :-Precision Rectifier, Schmitt trigger,Wein bridge and RC phase shift oscillator,current to voltage converter,voltage to current converter	
Unit IV	**[7Hrs]**
Applications : basic bridge amplifiers,peak detector, instrumentation amplifier,active filter design with butterworth filter	
Unit V	**[7Hrs]**
Linear IC's:- D/A and A/D Conversion Circuits,IC 555 as astable multivibrator,IC 555 as monostable multivibrator,LM 723 voltage regulator	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Op-Amps and Linear Integrated Circuits	R. Gayakwad	4th	Pearson
2	Operational Amplifiers and Linear Integrated Circuits	R. Coughlin, F. Driscoll	5th	Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Operational Amplifiers: Design and Applications	Tobey, Grames and Huelsman,	1st	McGraw-Hill Book Company

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE-ET505T(iii)	**Signals and Systems**	2	1		3	30	70	100

Course Objectives	Course Outcomes
This course is intended • The primary objective of this course is to provide a thorough understanding and analysis of signals and systems • To learn different mathematical tools for analysis of signals & Systems	**Students will be able to** • Define & classify signals along with their mathematical representation, basic operations on signals, and their properties • Define & classify systems along with properties • Analyze periodic and aperiodic signals using Fourier Series and Fourier Transform • Analyze continuous time LTI systems using Laplace transform • Analyze and explain Sampling theory involved in analysis of signals.

Unit I	**[7Hrs]**
SIGNALS : Basics of Signals & Systems: Introduction, Continuous-Time and Discrete-Time Signals, Examples and Mathematical Representation, Classification of signals, Basic Operations on Signals, Elementary Signals, singularity functions.	
Unit II	**[8Hrs]**
SYSTEMS : Continuous-Time LTI Systems: Classification of Systems, The Convolution Integral, Properties of LTI Systems, Relations between LTI system properties and impulse response, Step response, Causal LTI Systems Described by Differential and Difference Equations, Block Diagram Representations of First-Order Systems.	
Unit III	**[8Hrs]**
FOURIER SERIES & FOURIER TRANSFORM: Fourier Series representation of periodic signals: Fourier Series Representation of Continuous-Time Periodic Signals, Representation of Aperiodic Signals: The Continuous-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous-Time Fourier Transform, The Magnitude-Phase Representation of the Fourier Transform of LTI Systems.	
Unit IV	**[9Hrs]**
LAPLACE TRANSFORM : Representing signals by using CT complex exponentials: Laplace transforms, poles and zeros, the region of Convergence, properties of Laplace Transform, the unilateral Laplace transform, properties of the unilateral Laplace transform, Analysis and Characterization of LTI Systems Using the Laplace Transform.	
Unit V	**[4Hrs]**
SAMPLING THEORY Introduction, Representation of a Continuous-Time Signal by Its Samples, The Sampling Theorem, Impulse-Train Sampling, Sampling with a Zero-Order Hold, Reconstruction of a Signal from Its Samples	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Signals and Systems	Alan V. Oppenheim, Alan S. Willsky,	revise	Pearson Education

Reference Books

S.N	Title	Authors	Edition	Publisher
1	• B.P. Lathi, "Linear Systems & Signals", , 2004		2nd Edition	, Oxford University Press.

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE505T(iv)	Electrical Machine Design	2	1		3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To study the basic concepts and applications of Electrical Machine Design. • To design the main dimensions of Electrical Machines and study the effect of design on Electrical machines' performance characteristics.	**Students will be able to** • Design the overall dimensions of 1- phase and 3-phase core type transformer. • Estimate the performance characteristics of the transformer as per specified design requirements and constraints. • Design the overall dimensions of stator of 3 phase Induction Motor • Design the overall dimensions of rotor of 3 phase squirrel cage Induction Motor • Design the overall dimensions of alternator.

Unit I	**[8Hrs]**
Design of 1-phase and 3-phase core type transformer: - Classification of transformers based on construction and service conditions, Output equation, overall dimensions of 1-phase and 3-phase core type transformer, need of stepped core cross-section, selection of flux density and current density, design of the transformer for minimum cost, minimum weight, and minimum losses.	
Unit II	**[8Hrs]**
Performance characteristics of Transformer: - Type of windings used in transformer, Calculations of per unit leakage reactance and regulation for core type transformer (Derivation of leakage reactance is not expected) , No load current calculations.	
Unit III	**[7Hrs]**
Design of the stator core of 3-phase Induction Motor: - Output equation of 3-phase Induction motor, selection of specific magnetic loading & specific electric loading, Selection of number and type of stator slots, overall dimensions of the stator core.	
Unit IV	**[7Hrs]**
Rotor Design of 3-phase Induction Motor: - Classification of 3-phase Induction motor based on rotor construction, selection of length of air gap and rotor slots, calculations of overall dimension and rotor speed of 3-phase squirrel cage rotor of 3-phase Induction motor.	
Unit V	**[6Hrs]**
Design of 3-phase alternator: - Classification of the alternators, peripheral speed and runaway speed, pitch factor and distribution factor . Effect of SCR on the performance of the alternator, overall dimensions of 3 phase alternator, Calculations of the volume of coolant required for the cooling of the alternator.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Machine Design	A. K. Sawhney	New	Dhanpat Rai & Sons
2	Electrical Machine Design	Balbir Singh	New	Brite
3	Principles of Electrical Machine Design	R. K. Agarwal	New	Katariya & Sons

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Performance and Design of A.C. Machines	M G Say	New	CBS
2	Design and Testing of Electrical Machines	M V Deshpande	New	PHI
3	Electrical Machine Design	V Rajini	2nd	New Age International

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE-505T(v)	Electric Vehicle Architecture	2	1		3	30	70	100

Course Objectives	Course Outcomes
• The course will enable students to compare and analyse different types of EVs. • The course will enable students to evaluate the impact of various parameters on the performance of EVs.	**Students will be able to** • Quantify economic and environmental impact of EVs compared to IC engines. • Analyze the mathematical models of EVs and justify impact of various parameters • Compare various types of EV propulsion drive motors and be able to choose best for given application • Enlist various types of EV storage systems and analyze characteristics • Analyze various Power electronic circuit topologies for EVs

Unit I	**[8Hrs]**
Introduction: History of EVs – Economic and Environmental impact; Architecture of EV. Basics of vehicle performance, vehicle power source characterization, transmission characteristics. Electric Drivetrains- Basic concept of electric traction, introduction to various electric drive-train topologies.	
Unit II	**[7Hrs]**
Electric Vehicle Modelling: Consideration of Rolling Resistance – Transmission Efficiency – Consideration of Vehicle Mass – Tractive Effort – Modelling Vehicle Acceleration – Modelling Electric Vehicle Range -Aerodynamic Considerations –EV Motor Sizing	
Unit III	**[7Hrs]**
Electric Propulsion: Introduction to electric components used in electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives	
Unit IV	**[7Hrs]**
Energy Storage: Introduction to Energy Storage Requirements in Electric Vehicles, Battery based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.	
Unit V	**[7Hrs]**
Power Converters: DC-DC converters for EVs, Buck and Buck-Boost Converters, Multi-quadrant DC-DC converters, DC-DC converter applications, DC-AC converters for EVs, Three-phase DC-AC converters, Voltage control of DC-AC inverters using PWM	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein		CRC Press, 2003
2	Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi		CRC Press, 2004
3	Electric Vehicle Technology Explained	James Larminie, John Lowry		Wiley, 2003

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE505T(vi)	PLC & Industrial Automation	2	1		3	30	70	100

Course Objectives	Course Outcomes
The objective of this course is to impart knowledge on the following topics- • To have the basic concept, components and programming of PLC for Automation. • To implement ladder logics for various applications. • To understand SCADA displays and its applications.	After successful completion of this course students will be able to • Identify and understand components of PLCs for Automation • Select appropriate module as per application. • Develop PLC Programming for given application. • Understand SCADA System. • Develop SCADA system for various applications.

Unit I	[10Hrs]
Introduction to PLC: Need and tools of Automation, Evolution of PLC, Architecture-PLC Block diagram and working, Selection of PLC, Types of PLCs, Advantage, limitations and applications of PLCs, Networking of PLCs.	
Unit II	**[10Hrs]**
PLC Hardware: Input and Output Modules for PLC- working, description, wiring details, specifications, interfacing; Instruction sets for given operation, Ladder Programming, Ladder logics for some applications.	
Unit III	**[10Hrs]**
PLC Programming and Applications: Programming Languages for PLCs, PLC programming standard IEC61131, Relay type Instructions- Timer, Counter, Arithmetic operation, Data handling instructions. PLC based applications as motor control, traffic light, etc.	
Unit IV	**[10Hrs]**
Introduction to SCADA: Application area of SCADA; Architecture-Elements, block diagram of SCADA; Types of SCADA; Features of SCADA, MTU, RTU Functions, Communications in SCADA, Applications of SCADA.	
Unit V	**[8Hrs]**
SCADA Interfacing and Applications: Interfacing of SCADA with PLC, Creating SCADA display, Application of SCADA for ON-OFF Lamp, Traffic light control, water level control, motor control, etc.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers and Industrial Automation,	Madhuchhanda Mitra, SamarjitSen Gupta		Penram International Publishing India Pvt. Ltd
2	Supervisory Control and Data Acquisition	S.A. Boyar		, ISA Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers	V.R. Jadhav,		Khanna Publications

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ELECTRICAL ENGINEERING

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE506T(i)	Power Station Practice	4		-	4	30	70	100

Course Objectives	Course Outcomes
This course is intended 1) To Understand overview of different Power Plants and the associated energy conversion issues 2) To Understand fixation of tariff and voltage control of AC generator.	**Students will be able to** • Define Various sources of energy generation, conventional & Non – Conventional, Their scope and related factors with generation. They will also recognize the importance of interconnected grid systems • Recognize arrangement and operation of Thermal Power Station along with operation & importance of Various equipment's in Thermal Power plant. They will analyze and perform work in Thermal Power Plant • Recognize the arrangement and operation of Hydro Power Station along with operation & importance of Various equipment's & types of Hydro Power plant. They will analyze and perform work in Hydro Power Plant • Recognize Arrangement and operation of Nuclear Power Station along with operation & importance of Various equipment's like Nuclear Reactor in Nuclear Power plant. They will analyze and perform work in Nuclear Power Plant • Define about Co-generation & Captive Power Plant, their types. They will analyze and perform work with Co - Generation & Captive Power Generation units and also can lead the project for their sustainable development.

Unit I	[08Hrs]
Sources of Electrical Energy Generation: - Coal, oil, & natural gas, their scope and potentialities for energy conversion, Factors connected with generating stations, connected load, Maximum demand, demand factor, Load factor, diversity factor, Plant capacity and utilization factor, Load curve, load duration curve, Load survey, base load and peak load stations, Interconnection of Generating Stations - Advantages	
Unit II	[10Hrs]
Thermal Power Stations: - Choice of site. Size and no. of units, Rankine Cycle and its modification, General layout, Major equipment's, Essential and non-essential auxiliaries, Electric supply to auxiliaries, Cost of generation, Effect of different factors on costs	
Unit III	[10Hrs]
Hydro Power Stations: - Hydrology, Stream flow, Flow duration curve, power duration curve, Power duration curve, mass curve, Reservoir capacity, Types of hydro plants, Their field of use, problems, Pumped storage plants & their utilities, Surge tank, Governing characteristics of turbine & hydro generators	
Unit IV	[10Hrs]
Nuclear Power Stations: - Basics of Nuclear Energy Conversion, Layout and subsystems of Nuclear Power Plant, Boiler Water Reactor (BWR), Pressurized Water Reactor (PWR), Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactor (FBR), Gas Cooled and Liquid Meta Cooled reactors, Safety measures for nuclear power Plants	
Unit V	[08Hrs]
Cogeneration, Captive Power Generation & Sustainable Development: - Introduction, Definition & Scope, cogeneration technologies, industries suitable for cogeneration, Captive generation advantages and constraints, captive generation options, Type of captive power plants, financing of captive power plants, Energy problems, prospects of changes in energy supply, Agenda for sustainable development, General Discussions	

Text Books

S. N	Title	Authors	Edition	Publisher
1	Elements of Power Station design	M.V. Deshpande		PHI
2	Generation, Distribution and Utilization of Electrical Energy	C. L. Wadhwa		New Age International

Reference Books

S. N	Title	Authors	Edition	Publisher
1	Electrical Power Stations	T. H. Carr	2nd	Chapman and Hall Ltd.
2	Electrical Power Station Control	H. P. Young		Chapman and Hall Ltd.
3	Non – Conventional Energy Sources	G. D. Rai	6th	Khanna Publishers

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE506T(ii)	Project Management for Engineers by L&T EduTech	4	-	-	4	30	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Understand the concepts of project management from planning to execution and how to apply them in projects. 2. Prepare the resource, schedule, cost planning for an industrial project. 3. Identify the risk and its management. 4. Usage of MS Project as a tool for project management and monitoring.	**Students will be able to** • Develop WBS and estimate the resource requirements • Prepare bar charts for work schedule • Analyse the cost control monitoring and accounting methods • Understand the quality control and safety during construction

Unit I Contract Management and Scope Management	**[10Hrs]**
Introduction to Project Management, Project and Project Lifecycle – Process, Phases, Organization, Project Financial Feasibility Methods, Non-numerical Feasibility Methods. Basic Concepts of Contract Management, Essential elements, Contract Types, Tendering and Proposal Preparation, Key Commercial Terms and Conditions, Bid Evaluation and Contract Award, Contract Administration, Claim Management. Work Breakdown Structures- Creation & Case Study	
Unit II Schedule and Resource Management	**[10Hrs]**
Approach to schedule management, Charts, Sequencing and Dependency, Network Diagram, Activity Duration, Critical Path Method, Float, Case study, Relationships, Case Study, Precedence Diagramming Method. Resource Allocation and Resource Levelling, Case Study on Schedule Compression, PERT to Predict the Probability of Project Completion.	
Unit III Project Cost and Quality Management	**[10Hrs]**
Cost Estimation, Budget and Variance Analysis, Monitoring and Control, Cash Flows, Case Study. Occupational Health, Safety and Environment, Barriers, Quality Management System – Chart and tools.	
Unit IV Procurement, Subcontracts and Stakeholder Management	**[10Hrs]**
Supply Chain Management, Logistics and Transportation, Vendor and Inventory Management. Stakeholder Analysis and Engagement, Project Communication, Dealing with Difficult Stakeholders.	
Unit V Project Risk Management and Project Monitoring	**[8Hrs]**
Process, Terminology, Identification, Analysis and Response Strategy Analysis Techniques, Monitor and Control Schedule, Cost, Resources, Quality and risks Creating schedules, Assigning Resources, Cost, Evaluation, Optimization and Tracking	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Project management institute, Guide to the Project Management	Body of Knowledge	Seventh edition/2022.	(PMBOK® Guide),
2	E-resources	Course content on LMS		L&T EduTech

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE506T(iii)	Power Quality	4			4	30	70	100

Course Objectives	Course Outcomes
This course is intended • To introduce to the students the types of voltage fluctuations in power systems • To make aware about the impact of fluctuations on the power systems • To help students identify various methods of minimizing the voltage sags and swells • To make student understand the power quality issued and monitoring techniques.	**Students will be able to** • Classify and compare different types of disturbances. • Identify causes of voltage flickers and suggest methods of minimizing the voltage flicker • Identify causes of voltage sags and analyze the methods used to mitigating voltage sags and swells • Analyze various sources of harmonics in power systems and their effects on power system components • Identify need for power quality monitoring, list various instrumentation used for power quality monitoring

Unit I **[6 Hrs]**

Introduction to Power quality: - Introduction: Importance of power quality, terms and definitions of power quality as per IEEE std. 1159 such as transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers and transients. Symptoms of poor power quality. Definitions and terminology of grounding. Purpose of groundings. Good grounding practices and problems due to poor grounding.

Unit II **[6 Hrs]**

Flickers & transient voltages:- RMS voltage variations in power system and voltage regulation per unit system, complex power. Principles of voltage regulation. Basic power flow and voltage drop. Various devices used for voltage regulation and impact of reactive power management. Various causes of voltage flicker and their effects. Short term and long term flickers. Various means to reduce flickers. Transient over voltages, sources, impulsive transients, switching transients, Effect of surge impedance and line termination, control of transient voltages.

Unit III **[6 Hrs]**

Voltage sag, swells and interruptions: - Definitions of voltage sag and interruptions. Voltage sags versus interruptions. Economic impact of voltage sag. Major causes and consequences of voltage sags. Voltage sag characteristics. Voltage sag assessment. Influence of fault location and fault level on voltage sag. Areas of vulnerability. Assessment of equipment sensitivity to voltage sags. Voltage sag *limits for computer equipment, CBEMA, ITIC, SEMI F 42 curves. Representation of the results of voltage sags analysis. Voltage sag indices. Mitigation measures for voltage sags, such as UPS, DVR, SMEs, CVT etc., utility solutions and end user solutions

Unit IV **[6 Hrs]**

Waveform Distortion: - Definition of harmonics, inter-harmonics, sub-harmonics. Causes and effect of harmonics. Voltage versus current distortion. Overview of Fourier analysis. Harmonic indices. A.C. quantities under non-sinusoidal conditions. Triplen harmonics, characteristics and non-characteristics harmonics. Harmonics series and parallel resonances. Consequences of harmonic resonance. Principles for controlling harmonics. Reducing harmonic currents in loads. K-rated transformer. Harmonic study procedure. Computer tools for harmonic analysis. Locating sources of harmonics. Harmonic filtering, passive and active filters. Modifying the system frequency response. IEEE Harmonic standard519-1992.

Unit V **[6 Hrs]**

Power quality monitoring: - Need of power quality monitoring and approaches followed in power quality monitoring. Power quality monitoring objectives and requirements. Initial site survey. Power quality Instrumentation. Selection of power quality monitors, selection of monitoring location and period. System wide and discrete power quality monitoring. Setting thresholds on monitors, data collection and analysis. Selection of transducers. Harmonic monitoring, Transient monitoring, event recording and flicker monitoring.

Power Quality Assessment & Mitigation: Power Quality assessment, Power quality indices and standards for assessment disturbances, waveform distortion, voltage and current unbalances. Power assessment under waveform distortion conditions. Power quality state estimation, State variable model, observability analysis, capabilities of harmonic state estimation. Test systems. Mitigation techniques at different environments.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Understanding power quality problems, voltage sag and interruptions	M. H. J. Bolle	2000	IEEE press, Series on Power Engineering
2	Electrical power system quality	R.C. Dugan, M.F. McGranghan, S. Santoso, H. Wayne Beaty	2nd edition	McGraw Hill Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Power system quality assessment	J. Arrillaga, M.R. Watson, S. Chan		John Wiley and sons
2	Electric power quality	G. J. Heydt		Stars in Circle
3	Power system harmonics: Computer modeling and analysis	Enriques Acha, Manuel Madrigal		John Wiley and Sons
4	Power System Harmonics	J. Arrillaga & N. Watson		John Wiley and sons

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE506T(iv)	Battery Management Systems	4	0		4	30	70	100

Course Objectives	Course Outcomes
The course aims to identify suitable energy storage system for Electric Vehicles, compare different energy storage system and explain use of Energy management systems for Energy Storage system.	**Students will be able to** • Identify suitable energy storage system for Electric Vehicles. • Compare different energy storage system. • Explain use of Energy management systems for Energy Storage system.

Unit I : Introduction **[10Hrs]**

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium-ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

Unit II: Battery Management System Requirement **[10Hrs]**

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of charge estimation, Cell total energy and cell total power

Unit III: Battery State of Charge and State of Health Estimation, Cell Balancing **[10Hrs]**

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Model-based state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing

Unit IV: Modeling and Simulation **[9Hrs]**

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modeling approach, Physics-based modeling approach, Simulating an electric vehicle, Vehicle range calculations, Simulating constant power and voltage, Simulating battery packs

Unit V: Design of battery BMS **[9Hrs]**

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system

Text Books

S.N	Title	Authors	Edition	Publisher
1	Battery management systems, Volume I	Plett, Gregory L	2015	Artech House
2	Battery management systems, Volume II	Plett, Gregory L	2015	Artech House

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Battery Management Systems for Large Lithium-ion Battery Packs	Davide Andrea	2010	Artech House
2	Super capacitors- materials, Systems and Applications.	F. Beguin and E. Frackowiak,	2013.	Wiley-VCH Verlag GmbH & Company

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
ET506T(v)	Electrical Instrumentation	4			4	30	70	100

Course Objectives	Course Outcomes
This course is intended to • To learn various Primary sensing elements and Transducers. • To learn different instruments used for measurement of various non-electrical quantities. • To learn introduction to Advanced Instrumentation and Digital Techniques.	**Students will be able to** • explain various primary sensing elements and • transducers. • explain methods used for measurement of • strain, pressure and flow. • explain methods used for measurement of • torque, velocity, acceleration. • explain types of Data Acquisition Systems. explain Advanced Instrumentation and Digital Techniques.

Unit I	**[10Hrs]**
Primary sensing elements and Transducers: - Transducers, Electric Transducers, Advantages, Types, Piezoelectric transducer, Strain gauges, load cell, Bellows, Diaphragms, orifice plate, Venturi tube, pitot tube, Hall effect transducers, Digital encoding transducers.	
Unit II	**[10Hrs]**
Measurement of strain, pressure, flow: - Measurement of strain, pressure and flow using electric transducers.	
Unit III	**[10Hrs]**
Measurement of Torque, velocity, acceleration: - Measurement of Torque, velocity, acceleration using electric transducers.	
Unit IV	**[8Hrs]**
Data Acquisition Systems and Modern sensors: - Introduction, Types of DAS, Modern digital DAS. Introduction to Modern sensors.	
Unit V	**[10Hrs]**
Advanced Instrumentation and Digital Techniques: - Introduction to Virtual instruments, Intelligent Instrumentation. Introduction to digital techniques. Block diagram of SCADA, EMS.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electrical & Electronics Measurements & Instrumentation	A. K. Sawhney	5th revise	DHANPAT RAI & sons
2	Electronic Instrumentation & Measurement Technique	W. D. Cooper	New	Prentice Hall
3	Mechanical and Industrial Measurements	R. K. Jain	New	Khanna Publishers

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Measurement System Application and Design	E.O. Doeblin	New	Mcgraw-Hill
2	Instrumentation for Engineering	Dalley Railey, Mc	New	John Wiley & Sons

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	Measurements	Conne		
3	Electrical Instrumentation	H. S. Kalsi	2nd revised	Tata Mcgraw-Hill education

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
H104	Foundational Humanities Elective- Development of Societies	2	-	-	-	--	--	--

Course Objectives	Course Outcomes
This course will provide a natural link between engineering and humanities. **Reference**	At the end of the course, students will be able to: 1. develop a larger view of social structures and systems. 2. understand the political systems and their comparative study. 3. Aware themselves of various economic systems and sustainable development. 4. understand the interaction of political and economic strategies. 5. apply learnt concepts and generate and evaluate models of development in current context.

Unit I Social Development	**[5Hrs]**
1. Concepts behind the origin of Family, Clan and Society 2. Different Social Systems 3. Relation between Human being and Society 4. Comparative studies on different models of Social Structures and their evolution	
Unit II Political Development	**[4Hrs]**
1. Ideas of Political Systems as learnt from History 2. Different models of Governing system and their comparative study	
Unit III Economic Development I	**[4Hrs]**
1. Birth of Capitalism, Socialism, Marxism	
Unit IV Economic Development II	**[7Hrs]**
1. Concept of development in pre-British, British and post British period- Barter, Jajmani 2. E. F. Schumacher's idea of development, Buddhist economics. Gandhian idea of development. Swaraj and Decentralization	
Unit V Economic Development III	**[4Hrs]**
1. Economic Development 2. Idea of development in current context.	

Reference Books

S.N	Title	Authors	Edition	Publisher
1.	Sociology: Basic concepts	H.K.Rawat	2007	Rawat Publication
2.	Sociology: Themes and Perspectives	Michael Haralambos, Martin Holborn and Robin Heald	2000	Collins Educational, London, United Kingdom

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FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
AS502T	English for Engineers	2	-	-	2	15	35	50

Course Objectives	Course Outcomes
To provide students with the skills and knowledge of communication in a business environment.	**At the end of the course, students will be able to:** 1. develop an understanding of basic grammar concepts and their applications. 2. prepare and equip themselves for competitive exams 3. deliver effective presentations in a professional environment, tackle group discussions and face interviews. 4. acquire hands-on experience in writing business letters 5. display written communication in line with different workplace requirements.

Unit I : Functional Grammar	**[6Hrs]**
1. Subject-Verb Agreement 2. Preposition, Pronoun and Articles 3. Tenses 4. Direct – Indirect Speech 5. Transformation of sentences – Simple, Complex, Compound and Degrees of comparison 6. Active and Passive Voice	
Unit II : English for Competitive Exams	**[5Hrs]**
1. Sentence improvement and construction 2. Paragraph ordering 3. One word substitution 4. Verbal Analogies 5. Idioms	
Unit III : Verbal Ability	**[4Hrs]**
1. Reading Comprehension 2. Listening to Conversation (formal and Informal) and Announcements. 3. Integrated Writing – Read, and listen to a short excerpt and write a response. 4. Speaking – Podcast, Group Discussion, Presentations and Mock Interviews	
Unit IV : Formal Correspondence	**[4Hrs]**
1. Describing, summarizing, comparing graphs or illustrations 2. Basic patterns of Business Letter Writing 3. Approaches to writing – Direct, Indirect and persuasive styles. 4. Cover letter, Resume, Applications.	
Unit V : Communication at Workplace	**[5Hrs]**
1. Drafting emails and reports 2. Circular and notices. 3. Meeting etiquette and recording Minutes of the Meeting 4. Writing a Press Release	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Functional English for Technical Student	Dr. Pratibha Mahato and Dora Thompson	2020	Himalaya Publishing House
2.	Communication Skills for Engineer	C. Muralikrishna and Sunita Mishra	2022	Pearson
3.	Effective Technical Communication	Barun K Mitra	1	Oxford University Press
4.	Basic Business Communication	Lesikar, R. & Flately	9	Tata McGraw Hill

FIFTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE507P	Technical Skill Development - II			2	1	50	-	50

Course Objectives	Course Outcomes
The objective of this course is to impart knowledge on the following topics- • To have the basic concept, components and programming of PLC for Automation. • To implement ladder logics for various applications. • To understand SCADA displays and its applications.	After successful completion of this course students will be able to • Identify and understand components of PLCs for Automation • Select appropriate module as per application. • Develop PLC Programming for given application. • Understand SCADA System. • Develop SCADA system for various applications.

Expt. No.	Title of the experiment
1	Basic Instructions
2	Write a simple ladder logic program to study and verify logic gates using digital inputs and outputs for PLC. (OR,AND,NOT,NOR,NAND,EXOR,EXNOR)
3	Write a simple ladder logic program to Execute Boolean expressions that uses digital inputs and outputs for a PLC.
4	Write and implementation of simple ladder logic program using timer (ON Delay Timer, OFF Delay Timer, Retentive Timer)
5	Write and implementation of simple ladder logic program using counter (Up Counter, Down Counter).
6	Write a simple ladder logic program using Math instruction.
7	Write a simple ladder logic program for Traffic Light Control System.
8	Write a simple ladder logic program for Pump ON/OFF System.

Text Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers and Industrial Automation,	Madhuchhanda Mitra, SamarjitSen Gupta		Penram International Publishing India Pvt. Ltd
2	Supervisory Control and Data Acquisition	S.A. Boyar		, ISA Publication

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Programmable Logic controllers	V.R. Jadhav,		Khanna Publications

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE601T	High Voltage Engineering	3	1		4	30	70	100

Course Objectives	Course Outcomes
• To enable student in analyzing the breakdown mechanism dielectrics • To enable students analyze methods of high voltage generation and measurement • To enable students in evaluating the impact of non-destructive testing of power system equipments.	**Students will be able to** • Describe the breakdown processes of gas, liquid, solid and vacuum dielectrics • Enumerate the causes of over voltages due to lightning and switching, and analyze the effects through behavior of travelling waves. • Design the high AC, DC & impulse voltage generators for testing of insulators • Compare and analyze the measurement methods for high AC, DC & impulse voltages used for testing of insulators. • Demonstrate the testing methods of different power system components.

Unit I **[8Hrs]**

Breakdown mechanism in Di-electric: Townsend's criterion for break down (B.D.) in gases, Streamer theory for B.D. in gases, Paschen's law; B.D. in non-uniform field. Corona discharges and introduction of corona post B.D. phenomenon and applications, Vacuum insulation, Liquid insulators B.D. mechanisms, Solid insulator B.D., Intrinsic, electromechanical &.thermal B.D., B.D. of solid di-electrics in practice.

Unit II **[7Hrs]**

Lightning and switching over voltages (O.V.); Mechanism of lightning, types of strokes, parameter and characteristics of lightning strokes, Protection of lines by ground wires, protection by lightning arrester, gapless L.A., selection of L.A. ratings, surge-absorbers. Characteristics of switching surges; control of O.V. due to switching.

Traveling waves and Insulation coordination; Traveling waves' on transmission lines, Classification of lines attenuation and distortion of traveling waves, reflection and transmission of waves, behavior of rectangular waves at transition points, Introduction to BIL Reduced BIL and SIL.

Unit III **[7Hrs]**

Generation of high voltage and Currents: Generation of High D. C. voltages by rectifiers, voltage doubler and multiplier circuits, electrostatic machines, Generation of high AC voltages by Cascade transformers, Resonant transformers, generation high frequency AC high voltage. Generation of impulse voltages: Standard impulse wave shapes, wave shape contro1 Marx circuit, generation of switching surges, generation of impulse current.

Unit IV **[7Hrs]**

Measurement of high voltage and current: Measurement of high AC & DC voltage by generating voltmeter, capacitance potential divider, CVT, Electrostatic voltmeter. Peak reading AC voltmeter. Sphere gap arrangement. Measurement of impulse voltage Peak reading voltmeters. Measurement of High AC & DC currents.

Unit V **[7Hrs]**

Non-destructive and high voltage testing of electrical apparatus; Measurement of DC Resistivity, measurement of Dielectric constant and loss-factor (low and power frequency only), Schering bridge for high charging circuits, for three terminal measurement, partial discharge measurements by straight detectors, discharge detection in power cables. Testing of circuit breakers.

Text Books

S.N	Title	Authors	Edition	Publisher
1	High voltage Engineering	M. S. Kamaraju & V. Naidu		Tata MacGraw-hill
2	High voltage Engineering	C. L. Wadhwa		New Age International
3	EHVAC transmission	R. D. Begamudre		New Age International
4	Reliabilty and life estimation of power equipments	T S. Ramu, Chakradhar Reddy		New Age International

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Advances in High voltage Engineering,	A. Haddat & D. Warne		IET

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SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE601P	High Voltage Engineering			2	1	25	25	50

Course Objectives	Course Outcomes
• To enable student in analyzing the breakdown mechanism dielectrics • To enable students analyze methods of high voltage generation and measurement • To enable students in evaluating the impact of non-destructive testing of power system equipments.	**Students will be able to** • Enlist high voltage equipments used in testing • Determine the breakdown strength of solid and liquid insulators • Demonstrate the testing of sphere gap • Visualize the electric field distributions

Expt. No. (Any 08)	Title of the experiment (Any 08)
1	Study of High Voltage Laboratory Equipments.
2	Study arcing phenomenon using Horn Gap Apparatus.
3	Demonstration of treeing phenomenon on solid insulation i.e. Paper, Card board on '25 KV High Voltage Tester'.
4	To study Voltage Distribution in Uniform & Non Uniform Fields using 'Electrolytic Tank assembly'.
5	Demonstration of Corona formation on High Voltage Overhead Lines.
6	Calibration of voltmeter using Sphere gap assembly
7	To determine the breakdown strength of Transformer oil
8	To study surface breakdown for thin paper sample.
9	**Virtual Lab:** Simulation of Impulse Voltage Generator
10	**Virtual Lab:** Simulation of Cockroft-Walton Voltage multiplier

Text Books

S.N	Title	Authors	Edition	Publisher
1	High voltage Engineering	M. S. Kamaraju & V. Naidu		Tata MacGraw-hill
2	High voltage Engineering	C. L. Wadhwa		New Age International
3	EHVAC transmission	R. D. Begamudre		New Age International
4	Reliabilty and life estimation of power equipments	T S. Ramu, Chakradhar Reddy		New Age International

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Advances in High voltage Engineering,	A. Haddat & D. Warne		IET

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE602T	Control System Engineering	3	1		4	30	70	100

Course Objectives	Course Outcomes
This course is intended • To determine transfer function of linear time-invariant system • To understand the stability, time domain specifications and tools. • To study state variable analysis	**Students will be able to** • Determine transfer function by classical approach. • Understand time response specifications of second order system. • Analyse stability of the control system • Analyze the relative stability through root locus method. • Determine state model.

Unit I	**[08Hrs]**
Introduction to Control System:- Need of control system, Open loop and closed loop control system, Transfer function, Block diagram reduction. Signal flow graph.	
Unit II	**[07Hrs]**
Time Response Analysis:- Basic concept of steady state and transient response, Time response of first and second order system, Time response specifications of second order system.	
Unit III	**[08Hrs]**
Stability Analysis :- Stability of control systems, Stability by Routh Hurwitz criterion, special cases for determining relative stability.	
Unit IV	**[08 Hrs]**
Root Locus Techniques: Root location and its effect on time response, Construction of root locus.	
Unit V	**[05Hrs]**
State Variable Analysis: Formation of state model in phase variable and diagonal (CCF) form, determination of transfer function using state model	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Feedback Control System	R A Barapatre	11	Tech-Max
2	Modern Control Engineering	D Roy Choudhary		PHI
3	Control System Analysis	Nagrath/Gopal		New age International

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Control System Engineering	S. K. Bhattacharya		Pearson
2	Control Systems, Principles & Design	M. Gopal		TMH (Tata McGraw Hill)
3	Control Systems Engineering	Samarajit Ghosh		Pearson

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE602P	Control System Engineering Lab			2	1	25	25	50

Course Objectives	Course Outcomes
This course is intended • To determine transfer function of linear time-invariant system. • To understand the stability, time domain specifications and tools. • To study state variable analysis	**Students will be able to** • Determine transfer function by classical approach. • Understand time response specifications of second order system. • Analyse stability of the control system • Analyze the relative stability through root locus method. • To determine state model.

Expt. No.	Title of the experiment
1	To plot the characteristics of Potentiometer as an Error detector.
2	To Plot the characteristic of synchro as a: a) Transducer b) Transmitter-Receiver c) Error detector
3	To plot Speed-Torque characteristics of AC servo motor.
4	To plot effect of gain on speed of DC servo motor in closed loop.
5	To study the time response of a second order control system using PSIM.
6	To study the frequency response of a second order control system using PSIM.
7	To plot the effect of addition of zero and pole on time response of a unity feedback control system using MATLAB.
8	To plot the effect of addition of zero and pole to open loop transfer function on root locus for a unity feedback control system using MATLAB

Text Books

S.N	Title	Authors	Edition	Publisher
1	Modern Control System Engineering	K. Ogatta		Prentice Hall, India
2	Control System Analysis	Nagrath/Gopal		New age International
3	Automatic Control Systems	B. C. Kuo		Prentice Hall, India

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Control System Engineering	S. K. Bhattacharya		Pearson
2	Control Systems, Principles & Design	M. Gopal		TMH (Tata McGraw Hill)
3	Control Systems Engineering	Samarajit Ghosh		Pearson

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE603T(i)	Microcontroller Application in Electrical Engineering	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To learn the concept of Microcontroller and Arduino programming • To learn applications of microcontrollers in the field of electrical engineering.	**Students will be able to** • Analyze architecture of microcontroller 8051 • Interpret programs of 8051 in assembly language • Apply knowledge of Microcontroller to various electrical applications • Analyze Arduino Platform • Explain Arduino Programming

Unit I	**[10Hrs]**
8051 Microcontroller :- Microprocessor Vs Microcontroller, Introduction to Embedded Systems,8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	
Unit II	**[10Hrs]**
8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions. Simple Assembly language program examples to use these instructions.	
Unit III	**[10Hrs]**
Microcontroller based applications in Electrical Engineering: Measurement of various electrical and non-electrical parameters, Speed monitoring and control of various motors, Control of firing circuits of power electronics systems, Numerical Protective relays.	
Unit IV	**[9Hrs]**
Introduction to Arduino:- Arduino platform, Prototyping environment, Electronic component overview, Arduino Development Environment.	
Unit V	**[9Hrs]**
Arduino Programming:- Arduino C, Data types, Decision making, Loops, Functions, Pointers, Structures.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	PIC Microcontroller	Gaonkar R. S	3	Penram International
2	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Muhammad Ali Mazidi, Rolin Mckinlay, Janice Gillispie Mazidi	4	Pearson
3	Arduino for beginners : Essential Skills Every Maker Needs	John Baichtal	2	Pearson

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Microcontroller & Embedded Systems Using Assembly and C	Kenneth Ayala	3	Delmar Cengage Learning
2	Microcontroller: Internals, Instructions, Programming and Interfacing	Subrata Ghoshal	2	Pearson
3	Arduino Programming	Ryan Turner	2	Nelly B.L. International Consulting Ltd

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SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE603T(ii)	Computer Applications in Power System	3			3	30	70	100

Course Objectives	Course Outcomes
This course is intended • To give the basic knowledge for the4 design & analysis of electrical power system, formation of Zbus & its importance. • Calculation of power flow in a power system network using various techniques. • It is also deals with short circuit analysis & transient stability analysis.	**Students will be able to** • Define and explain basic concepts of network topologies and simple mathematical calculations for the formation of network matrices by singular transformation for a single Phase power system network. • Explain and write mathematical calculations for the formation of network matrices by algorithm method for single phase power system network. • Define and explain basic concepts of network topologies to three-phase networks and will write mathematical analyses for short circuit studies for electrical power systems. • Solve load flow and transient stability analysis problems and will write mathematical analysis for load flow and transient stability analysis for electrical power systems.....

Unit I	**[12Hrs]**
Power System Network Matrices-1: - Definition of Graph Theory , Incidences Matrices , Primitive Matrices , Calculation of Network Matrices by singular transformation methods.	
Unit II	**[12Hrs]**
Power System Network Matrices-2: - Derivation of Addition of Branch & addition of link, Formulation of Z_{BUS} & Y_{BUS} by algorithms method, Modification of Z_{BUS} for changes in power system**.**	
Unit III	**[12Hrs]**
Three Phase Network Matrices: - Three phase balance & unbalanced network elements for balance & unbalance excitation, Formation of sequence impedance matrix. **Short Circuit Studies: -** Short Circuit Calculation for Balance three phase network using Z_{BUS} (Three phase to ground faults & Line to ground fault)	
Unit IV	**[12Hrs]**
Load Flow Analysis: - Power System load flow equation , solution techniques : Newton Raphson method in rectangular form without PV bus. **Transient Stability Studies: -** Modelling of synchronous machine, power system network for transient stability studies, and numerical solution of swing equation by modified Euler method.	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Computer Methods in Power system Analysis	Stagg & El-Abaid		McGraw Hill
2	Computer Techniques in Power System Analysis	Dr. M. A. Pai		McGraw Hill

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Modern Power System Analysis	D.P.Kothari & I.J.Nagrath		TMG

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE603T(iii)	Electric Drives	3		-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended to familiarize learners with - 1) Starting, speed control, braking, heating, cooling characteristics of electric motor and necessity of flywheel 2) The basics of PLC and its programming, Digital control of electric motors and its applications 3) The motors used in Electric Traction, Electric Vehicles and its control strategies	Students will be able to • Understand the concept of Electrical characteristics like starting, speed control and braking along with numerical • Relate various factors of industries with reference to PLC, its programming and Digital control • Analyze the causes and effects of motor control used in Electric Vehicle • Acquire knowledge of various electrical drives used in industries, AC and DC contactors and work on drives used in industries • Perceive the concept of Electric traction and their control strategies used in practice.

Unit I	**[08Hrs]**
Characteristics of Electrical Motors: Definition, Classification, Speed - Torque Characteristics of Common Drive motors, Speed - Torque Characteristics of Common Drive motors, characteristics under starting, Running, Braking, and Speed Control Selection Of Motors: Power Capacity for continuous and intermittent periodic duties, Flywheel Effect, Numerical based on above topic.	
Unit II	**[10Hrs]**
PLC and Digital Control: PLC - Its Programming and Application in Electrical Drives, Brief Idea about drives commonly used in industries, Digital Control of electric motor, Block Diagram, Comparison with other methods of control	
Unit III	[10Hrs]
Basics of Electric Vehicle (EV): Definition of EV, Block Diagram, Types of EV, Electric Motors and speed control Motor Controllers and Battery Charging	
Unit IV	[10Hrs]
AC and DC Contactors and Relays: Lock out contactors, Magnetic structure, Operation, Arc Interuption, Contactor Rating, HV contactors, Control circuit for automatic starting and braking of DC motors and 3 phase induction motor drives, HV contactors, Control circuit for automatic starting and braking of DC motors and 3 phase induction motor drives, Control Panel design for MCC	
Unit V	[08Hrs]
Electric Traction Drives: Motors used in AC / DC traction, Their performance and desirable characteristics requirement and suitability of Motor for traction duty, Traction motor control - control of DC traction motor Series - Parallel control with numerical starting and braking of traction motors	

Text Books

S. N	Title	Authors	Edition	Publisher
1	Modern Electric Traction	H. Pratap		Dhanpat Rai Publication
2	A First Course on Electrical Drives	S. K. Pillai		New Age International

Reference Books

S. N	Title	Authors	Edition	Publisher
1	Advanced Electrical Drives: Analysis, Modeling, Control	Rik W. De Doncker · Duco W.J. Pulle ·		Springer

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		André Veltman		
2	Fundamentals Of Electric Drives and Control	by B.R.Gupta & V.Singhal		Katson House
3	Industrial Electronics and control	S K bhattacharya S Chatterjee	1st	Tata McGraw – Hill Publishing company

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE603T(iv)	Vehicle Dynamics	3	0		3	30	70	100

Course Objectives	Course Outcomes
The course intends in understanding the dynamics of the automotive systems and its performance parameters, Identifying the driving/ braking resistances and their influences on vehicle dynamics, analyzing dynamics systems such as suspension systems, body vibrations, steering mechanisms. To Understand the vehicle aerodynamics and its effects on vehicle performance. To identify, formulate, and solve engineering problems related to vehicle dynamics	**Students will be able to** • Analyze the dynamics of vehicle under different riding condition. • Examine acceleration and braking performance in electric vehicle to understand the vehicle dynamics under these conditions. • Articulate road loads and tyre dynamics in electric vehicles. • Interpret riding comfort & vibrations, cornering and roll over in electric vehicles to understand the vehicular dynamics. • Infer on the suspension kinematics and controllable suspension elements used in electric vehicles

Unit I	**[8Hrs]**
Basics of Vehicle Dynamics: History, vehicle classifications, fundamental approaches to vehicle dynamics modelling; SAE Vehicle axis system, Forces & moments affecting vehicle, Earth Fixed coordinate system, Dynamic axle loads, Equations of motion, transmission characteristics, vehicle performance, Brake proportioning, braking efficiency	
Unit II	**[8Hrs]**
Acceleration and Braking Performance: Power train components; power and traction limited acceleration; transverse weight shift; front wheel drive vs rear wheel drive vs. all-wheel drive vehicles. Braking force analysis; brake design and analysis; federal regulation on braking performance; antilock braking system; wheel lock-up; tire/road friction; safety and maintenance issues in braking	
Unit III	**[8Hrs]**
Road Loads and Tyre Dynamics: Wind drag and car body design, rolling resistance; breakdowns of total road loads; gas mileage analysis and driving styles; Aerodynamics. Tire specifications and constructions; tire motion analysis; tire force analysis; tire contact stress analysis; tire vibration analysis; tire models	
Unit IV	**[8Hrs]**
Ride & Cornering/steering: Riding comfort; perception of vibration; vibration sources; vibration transmission to the passengers; lower speed cornering; high speed corner; cornering bicycle model; Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover	
Unit V	**[8Hrs]**
Chassis and Suspension Systems: Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and AntiPitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Center Analysis, Suspension Dynamics, Multi-body vibration, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate. Vehicle suspension in fore and apt directions	

Text Books

S.N	Title	Authors	Edition	Publisher
1	Fundamentals of Vehicle Dynamics	Thomas Gillespie		SAE Publication.
2	Vehicle dynamics and control	Rajesh Rajamani		Springer publication
3	Theory of Ground Vehicles	J. Y. Woung		John Willey & Sons, NY

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Steering, Suspension & Tyres	J. G. Giles		Ilete Books Ltd
2	Vehicle Dynamics: Theory and Application	Reza N Jazar		Springer publication
3	Mechanics of Road Vehicles	W. Steed		Ilete Books Ltd

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SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE603T(v)	Utilization of Electrical Energy	3		-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Understand the concept of various Heating, Welding methodologies, Illumination methods and traction supply system. 2. Appreciative of the concepts of Electrolysis processes, DG system	**Students will be able to** • Understand use of electric energy for industrial heating. • Study the use of electrical energy in electric welding • Learn basics of Illumination and design of lighting schemes for Various applications • Understand pumps and DG systems and evaluate their performance. • Understand Electric Traction system with its power supply structure.

Unit I	[08Hrs]
S**Electric Heating:** Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipment, transfer of heat. Resistance Ovens: General constructions, design of heating elements, efficiency & losses, radiant heating. Induction heating: Core type & core less induction furnace & application Dielectric heating: Principle and application. Arc furnace: Direct & indirect arc furnace, power supply, characteristics & control.	
Unit II	[10Hrs]
Electric Welding: Importance, Advantages & Disadvantages of welding, classification of welding processes. Resistance welding, Butt welding, Spot welding, Seam welding, Electric arc welding, ultrasonic welding, laser beam welding.	
Unit III	[10Hrs]
Illumination: Nature of light, terms used in illumination, solid angle, laws of illumination, Colour Rendering Index(CRI), Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, floodlighting, street lighting, energy saving in lighting systems	
Unit IV	[10Hrs]
Pumps:- Pump types, system characteristics. Pump curves, factors affecting pump performance, efficient pumping system operation, energy conservation opportunities in pumping system. **Diesel Generating Systems:** Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets	
Unit V	[08Hrs]
Electric Traction: Traction system, requirement of an ideal traction system, different systems for traction, system of railway electrification, comparison between AC and DC systems, power supply for electric traction system, overhead equipment (collector gear for overhead equipment, conductor-rail equipment), Speed- Time curve for train movement, crest speed, average speed and schedule speed, simplified speed-time curve	

Text Books

S. N	Title	Authors	Edition	Publisher
1	"Utilization of Electric Power & Electric Traction"	J.B. Gupta	10th Edition 2012, Reprint 2021	S. K. Kataria & Sons, New Delhi.
2	"Art and Science of Utilization of Electrical Energy"	H Partap		Dhanpat Rai & Sons, Delhi

Reference Books

S. N	Title	Authors	link
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors, BEE	Bureau of Energy Efficiency	https://aipnpc.org/Guidebooks.aspx

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
AS501T	Economics and Management	3	-		3	30	70	100

Course Objectives	Course Outcomes
1. The course examines how the economics, business and industrial management practices are related and how business decision is taken.	• Apply managerial economics concept in business analysis and business decision making. • Explain relationships between production and costs and understand different forms of market structures. • Assess impact of macroeconomics and government policies on business and economy. • Recognize the functions of management and marketing management for business decisions. • Explore role of financial management in business and decision making.

Unit I	**[8Hrs]**
Economics, Classification of economics, Industrial economics, Applications of Industrial economics. Types of Business structures, Consumer demand, Law of Demand, Determinants of demand, Demand forecasting, Law of supply, Utility, Law of diminishing marginal Utility, Types of Elasticity of demand	
Unit II	**[7Hrs]**
Concept of Production, Factors of Production, Laws of return, Cost concepts and types of cost, cost curves, Market Structures- Perfect competition, Monopoly, Oligopoly, and Monopolistic competition. Business cycles, optimum size of firm.	
Unit III	**[7Hrs]**
The functions of central bank, Inflation, Deflation, Recession. Measures to control Inflation, National income, GDP, GNP, Monetary and fiscal policy of government. Liberalization, Privatization and Globalization	
Unit IV	**[7Hrs]**
Definition of management, functions of management – planning, organizing, directing, Controlling, Introduction to human resources Management, Marketing Management, Concepts of Marketing, Marketing mix, Methods of pricing, channels of distribution, advertising and sales promotion.	
Unit V	**[7Hrs]**
Financial Management, nature and scope of financial management, Sources of finance, Types of capital, Brief outline of profit and loss account, balance sheet, Budgets and types of budgets, Ratio analysis, Principles of costing	

Text Books

S. N	Title	Authors	Edition	Publisher
1.	Managerial Economics	D.N. Dwivedi	8th	Vikas Publishing
2.	Modern Economic Theory	K.K. Dewett	2005	S. Chand Publisher
3.	Industrial Management	Dr.I.K. Chopde, Dr.A.M. Sheikh	Revised edition	S. Chand Publisher

Reference Books

S. N	Title	Authors	Edition	Publisher
1.	Industrial Organization and Industrial economics	T.R. Banga, S.C. Sharma	2006	Khanna Publishers

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ELECTRICAL ENGINEERING

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE604T(i)	Monitoring & Testing of Electrical machines	3		-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended to • To increase awareness about safety practices while handling electrical equipment. • To develop the skills for the testing and maintenance of the electrical equipment as per prevailing standard .	**Students will be able to** • Follow safety practices to prevent accidents while using electrical equipment . • Test and Maintain Transformer • Test and Maintain 3 phase Induction Motor • Test and Maintain DC machines • Maintain insulation systems of electrical equipment.

Unit I	[06Hrs]
Safety Practices : : Safety, Electrical hazards, Electric shock, factors influencing severity of shock, rescuing persons, Precautions against electric fires, use of fire extinguishers, Need of Earthing ,Factors affecting Earthing , types of Earthing.	
Unit II	[8Hrs]
Testing & maintenance of transformer: Different components of transformer viz., conservator, breather, radiator, Buchholz's relay , tap changer etc. Type test, routine test and special test of transformer, Measurement of winding resistance; Measurement of voltage ratio, open circuit and short circuit test, Temperature-rise test, switching impulse test. Maintenance of transformer.	
Unit III	[8Hrs]
Testing & maintenance of 3 phase induction motor: Routine, type and special test of three phase induction motor. No load test, Blocked rotor test, Vibration test, Temperature test, Phase sequence test, Insulation resistance test. Maintenance of 3 phase Induction Motor.	
Unit IV	[8Hrs]
Testing & maintenance of DC machines: Type test, routine test and special test of DC machines. The magnetization or open-circuit test. The load characteristic ,The determination of the efficiency curve. The temperature rise test. Maintenance of DC machines**.**	
Unit V	[6Hrs]
Testing of insulation of electrical system: Classification of insulating material, factors affecting life of the insulation , measurement of insulation resistance, maintenance of insulations, Testing of physical and electrical properties of transformer oil.	

Text Books

S. N	Title	Authors	Edition	Publisher
1	Testing, commissioning, operation and maintenance of electrical equipment	S. Rao		Khanna Publishers
2	Installation, commissioning and maintenance of Electrical equipment	Tarlok Singh		S. K. Kataria & Sons, New Delhi.

Reference Books

S. N	Title	Authors	link
1	"Electrical power equipment maintenance and testing	Paul Grill	CRC Press

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Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE604T(ii)	Utilization of Electrical Energy	3		-	3	30	70	100

Course Objectives	Course Outcomes
This course is intended to 1. Understand the concept of various Heating, Welding methodologies, Illumination methods and traction supply system. 2. Appreciative of the concepts of Electrolysis processes, DG system	**Students will be able to** • Understand use of electric energy for industrial heating. • Study the use of electrical energy in electric welding • Learn basics of Illumination and design of lighting schemes for Various applications • Understand pumps and DG systems and evaluate their performance. • Understand Electric Traction system with its power supply structure.

Unit I	[08Hrs]

Electric Heating:

Types and methods of electrical heating, advantages of electrically produced heat, types & application of electric heating equipment, transfer of heat. Resistance Ovens: General constructions, design of heating elements, efficiency & losses, radiant heating. Induction heating: Core type & core less induction furnace & application Dielectric heating: Principle and application. Arc furnace: Direct & indirect arc furnace, power supply, characteristics & control.

Unit II	[10Hrs]

Electric Welding:

Importance, Advantages & Disadvantages of welding, classification of welding processes. Resistance welding, Butt welding, Spot welding, Seam welding, Electric arc welding, ultrasonic welding, laser beam welding.

Unit III	[10Hrs]

Illumination:

Nature of light, terms used in illumination, solid angle, laws of illumination, Colour Rendering Index(CRI), Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, floodlighting, street lighting, energy saving in lighting systems

Unit IV	[10Hrs]

Pumps:-

Pump types, system characteristics. Pump curves, factors affecting pump performance, efficient pumping system operation, energy conservation opportunities in pumping system.

Diesel Generating Systems:

Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets

Unit V	[08Hrs]

Electric Traction:

Traction system, requirement of an ideal traction system, different systems for traction, system of railway electrification, comparison between AC and DC systems, power supply for electric traction system, overhead equipment (collector gear for overhead equipment, conductor-rail equipment), Speed- Time curve for train movement, crest speed, average speed and schedule speed, simplified speed-time curve

Text Books

S. N	Title	Authors	Edition	Publisher
1	"Utilization of Electric Power & Electric Traction"	J.B. Gupta	10th Edition 2012, Reprint 2021	S. K. Kataria & Sons, New Delhi.
2	"Art and Science of Utilization of Electrical Energy"	H Partap		Dhanpat Rai & Sons, Delhi

Reference Books

S. N	Title	Authors	link
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of	Bureau of Energy Efficiency	https://aipnpc.org/Guidebooks.aspx

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	Energy Efficiency		

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE605P	Project-I			2	1	50	50	100

Course Objectives	Course Outcomes
This course is intended • To enable the Students to undertake short research projects and fabricate it.	**Students will be able to** • explain fabrication work of project set up / devices or developed software.

S.N.	Project
1	**Projects are based on :** Recent Trends in Electrical Power System, Power Electronics and Renewable Energy , emerging technologies , and multidisciplinary areas..

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE606P	Electrical Engineering Workshop			2	1	50	-	50

Course Objectives	Course Outcomes
This course is intended • To develop basic knowledge of preliminary energy audit, design of illumination scheme and wiring system. • To introduce with transformer design for particular rating • To introduce with home appliances and Earthing system. PCB Design	**Students will be able to** • Calculate total energy consumed or Electric bill • Design illumination scheme in case of domestic consumers • Manufacture small VA rating shell type transformer • Understand Earthing system and different types of home appliances • Design PCB

Expt. No.	Title of the experiment
1	Calculation of cost of energy consumption in case of domestic consumers
2	To find number of Lights required for given space
3	Design of wiring system 1) Staircase Wiring and 2) Godown Wiring
4	Design of wiring system for Residential Building
5	Design of Single Phase Shell type Transformer of Small VA Rating
6	To study different types of Earthing System
7	Design of Overall Dimensions of Three Phase Core Type Transformer using MATLAB
8	Design of Overall Dimensions of Three Phase Induction Motor using MATLAB
9	To study home appliances 1) Electric Fan 2) Electric Mixer 3) Water Heater
10	PCB Design

Text Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Design Estimating & Costing	S. K. Bhattacharya	Third	New Age International Publishers
2	Electrical Wiring Estimating & Costing	Dr. S. L. Uppal	Second	Khanna Publishers

Reference Books

S.N	Title	Authors	Edition	Publisher
1	Electrical Machine Design	A.K. Sawhney	Third	Dhanpat Rai & Co.

SIXTH SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
EE608P	Capstone Course-1			2	1	50	-	50

Course Objectives	Course Outcomes
This course is intended • To revise and test comprehensive knowledge gained in Electrical Engineering branch by the students	**Students will be able to** • Prepare for technical entrance exam for pursuing higher studies (Like GATE , MH CET for M.Tech) • Prepare for technical entrance exam required to be employed in Government like (IES , MPSC & UPSC)

S.N.	Capstone Course-1
1	**Preparation of objective questions based on :** Recent Trends in Electrical Power System, Power Electronics and Renewable Energy , emerging technologies , and multidisciplinary areas..