

**CURRICULUM
FOR
ELECTRICAL & ELECTRONICS ENGINEERING**

SEMESTER - VII (ELECTRICAL & ELECTRONICS ENGINEERING)

S.No	Paper Code	Paper Title	L	T	P	Credits
1	1107xx	Open Elective - I	3	0	0	3
2	1107xx	Open Elective - II	3	0	0	3
3	1107xx	Program Elective - III	3	0	0	3
4	1107xx	Program Elective - IV	3	0	0	3
5	100709	Project - I	0	0	12	6
6	100706	Seminar	0	0	2	1
7	100702	Summer Entrepreneurship-III	0	0	16	8

PROGRAM ELECTIVES

PAPER CODE - 110701

110701	Electromagnetic Waves	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module 2

Maxwell's Equations: Basic quantities of Electromagnetics, Basic laws of

Electromagnetics: Gauss' law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module 3

Uniform Plane Wave: Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module 4

Plane Waves at Media Interface: Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module 5

Waveguides: Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cutoff frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Module 6

Antennas: Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

Text/Reference Books:

- R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
- D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
- M. N.O. Sadiku, "Elements of Electromagnetics", Oxford University Press, 2007.
- C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons, 2012.

- C. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley & Sons, 2005.

Course Outcomes:

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

- Analyse transmission lines and estimate voltage and current at any point on the transmission line for different load conditions.
- Provide solutions to real life plane wave problems for various boundary conditions.
- Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
- Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
- Understand and analyse radiation by antennas.

PAPER CODE - 110703

110703	High Voltage Engineering	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Breakdown in Gases: Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Module 2

Breakdown in liquid and solid Insulating materials: Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Module 3

Generation of High Voltages: Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Module 4

Measurements of High Voltages and Currents: Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillo graphs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Module 5

Lightning and Switching Overvoltages: Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching overvoltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Module 6

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories:

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing isolators and circuit breakers, testing cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books:

- M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
- C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
- D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
- E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2000.
- R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.
- Various IS standards for HV Laboratory Techniques and Testing

Course outcomes:

At the end of the course, the student will demonstrate

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

PAPER CODE - 110704

110704	Industrial Electrical Systems	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Electrical System Components: LT systems wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Module 2

Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Module 3

Illumination Systems: Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaires like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for residential and commercial premises, flood lighting.

Module 4

Industrial Electrical Systems I: HT connection, industrial substation,

Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Module 5

Industrial Electrical Systems II: DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Module 6

Industrial Electrical System Automation: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books:

- S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
- K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
- S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
- Web site for IS Standards.
- H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

Course Outcomes:

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

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.

- Analyze and select the proper size of various electrical system components.

PAPER CODE - 110707

110707	Digital Control Systems	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Discrete Representation of Continuous Systems: Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

Module 2

Discrete System Analysis; Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Module 3

Stability of Discrete Time System: Stability analysis by Jury test, Stability analysis using bilinear transformation, Design Digital Control system with dead beat response. Practical issues with deadbeat response design.

Module 4

State Space Approach for discrete time systems: State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Module 5

Design of Digital Control System: Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Module 6

Discrete output feedback control: Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books:

- K. Ogata, "Digital Control Engineering", Prentice Hall, Englewood Cliffs, 1995.
- M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
- G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley, 1998.
- B.C. Kuo, "Digital Control System", Holt, Rinehart and Winston, 1980.

Course Outcomes:

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

- Obtain discrete representation of LTI systems.
- Analyse stability of open loop and closed loop discrete-time systems.
- Design and analyse digital controllers.
- Design state feedback and output feedback controllers.

PAPER CODE - 110709

110709	Electrical and Hybrid Vehicles	L:3	T:0	P:0	CREDIT:3
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Detailed contents:

Module 1

Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Module 2

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive- train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Module 3

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and 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 Switched Reluctance Motor drives, drive system efficiency.

Module 4

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell 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. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5

Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

- C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
- S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
- M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
- T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Course Outcomes:

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

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

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