EOPC2005 ELECTROMAGNETIC THEORY (3-0-0)

Course Objectives : This course aims to provide students with a comprehensive understanding of electromagnetic theory, including coordinate systems, vector calculus, electrostatics, magnetostatics, and electromagnetic wave propagation. Students will explore foundational principles, numerical techniques for solving boundary value problems, and applications such as transmission line modeling and wave reflection. Emphasis is placed on applying theoretical concepts to analyze and investigate practical scenarios, enabling learners to connect cause-and-effect relationships within electromagnetic systems effectively. The course prepares students to grasp advanced electromagnetic principles and apply them to engineering and scientific challenges.

Module 1 (6 Hours)
Coordinate systems & Transformation: Cartesian, Cylindrical and Spherical Coordinate Systems.
Vector Calculus: Differential length, Area & volume, Line, Surface and Volume Integrals, Del operator, Gradient of a scalar, Divergence of a vector & divergence theorem, curl of a vector & Stoke's theorem, laplacian of a scalar, Maxwell's equations.

Module 2 (8 Hours)
Electrostatic Fields: Coulomb's Law, Electric Field Intensity, Electric Fields duetopoint, line, surface and volume charge, Electric Flux Density, Gauss's Law–Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between E and V–Maxwell's Equation. An Electric Dipole & Flux Lines, Energy Density in Electrostatic Fields., Electrostatic Boundary – Value Problems: Possion's & Laplace's Equations, Uniqueness theorem, General procedures for solving position's or Laplace's Equation, Greens functions,

Module 3 (6 Hours)
Magnetostatic Fields: Magnetic Field Intensity, Biot-Savart's Law, Ampere's circuit law-Maxwell Equation, applications of Ampere's law, Magnetic Flux Density-Maxwell's equations. Maxwell's equation for static fields, Magnetic Scalar and Vector potentials. Polarizations of waves

Module 4 (6 Hours)
Electromagnetic Fields and Wave Propagation: Faraday's Law, Transformer & Motional Electromagnetic Forces, Displacement Current, Maxwell's Equation in Final forms, Time Varying Potentials, Time-Harmonic Field. Electromagnetic Wave Propagation: Wave Propagation in lossy Dielectrics, Plane Waves in loss less Dielectrics, Power & pointing vector

Module 5 (4 Hours)
Types of Two-Conductor Transmission Lines; Circuit Model of a Uniform Two-Conductor Transmission Line; The Uniform Ideal Transmission Line; Wave Reflection at a Discontinuity in an Ideal Transmission Line; Matching of Transmission Lines with Load.

Course Outcomes
After the completion of this course, students will be able to:

1. Understand basic theories of electromagnetics.
2. Understand numerical techniques to solve a boundary value problem.
3. Describe the various aspect of electromagnetic theory
4. Analyze the two-conductor transmission line model.
5. Apply the knowledge to investigate the cause and effect qualitatively

Text Book:

1. Principles of Electromagnetics, Mathew N.O. Sadiku & S.V. Kulkarni., Oxford University Press, 6th edition
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi, 2nd Edition

Reference Book:

1. C.R.Paul, K.W.Whites, S.A.Nasor, Introductionto Electromagnetic Fields, 3rd, TMH.
2. W.H.Hyat, Electromagnetic Field Theory, 7thEd,TMH.
3. RogerF. Harrington,Time-harmonic electromagnetic fields, McGraw-Hill
4. Principles of Electromagnetic, S.C. Mahapatra, &S. Mahapatra, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2nd Edition.