B.Tech II Year II Semester

ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES

Course Code: 21EC402PC **L/T/P/C:3/0/0/3**

Course Objectives:

- To learn the Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields, and apply them to solve physics and engineering problems.
- To distinguish between static and time-varying fields, and understand the significance and utility of Maxwell's Equations and Boundary Conditions, and gain ability to provide solutions to communication engineering problems.
- To analyze the characteristics of Uniform Plane Waves (UPW), determine their propagation parameters and estimate the same for dielectric and dissipative media.
- To study on transmission lines and usage of Smith Chart.

Course Outcomes: Upon completing this course, the student will be able to:

- Get the knowledge of Basic Laws, Concepts and proofs related to Electrostatic Fields and Magneto static Fields.
- Distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell's Equations and Boundary Conditions.
- Analyze the Wave Equations for good conductors, good dielectrics and evaluate the UPW Characteristics for several practical media of interest.
- Apply filed theory, circuit theory and Smith chart knowledge to transmission lines

UNIT – I

Electrostatics: Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density. Convection and Conduction Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Capacitance – Parallel Plate, Coaxial, Spherical Capacitors.

UNIT – II

Magnetostatics: Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law.

UNIT – III

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer EMF, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Forms, Conditions at a Boundary Surface - Dielectric-Dielectric and Dielectric- Conductor Interfaces, Conductors & Dielectrics – Characterization.

UNIT -IV

EM Wave Characteristics: Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definitions, Relation between E & H, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media, Wave Propagation in Good Conductors and Good Dielectrics, Polarization.

Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance, Poynting Vector and Poynting Theorem.

UNIT-V

Transmission Lines-Transmission line equations, parameters- primary and secondary constants, Analogy of transmission lines, Determination of α, β, γ and v_p, characteristics impedance, Input impedance of a lossless line, open and short circuited lines, distortion-less lines, reflection coefficient and standing wave ratio, matched transmission line, Impedance matching, Smith chart and its applications, Introduction to Finite element method (FEM) and Finite difference time domain method (FDTD).

TEXT BOOKS:

- Hayt William., "Engineering Electromagnetics", Tata Mc Graw Hill
- Matthew N.O. *Sadiku* 'Elements of Electromagnetics' Oxford University Press
- Kraus J.D, "Electromagnetics" Tata Mc Graw Hill

REFERENCE BOOKS:

- Complex Electromagnetic Problems and Numerical Simulation Approaches, Levent Sevgi, IEEE Press and John Wiley, New York, 2003.
- Jordan E.C. and Balmain K.G., "Electromagnetic waves and Radiating Systems"PHI
- Plonsey R. and Collin R.E., "Principles and Applications of Electromagnetic fields", Tata Mc Graw Hill.