

## Electromagnetism

Course Objectives:

To provide basic understanding of the fundamentals of Electromagnetics.

1. Introduction (3 hours)

- a. Co-ordinate system
- b. Scalar and vector fields
- c. Operations on scalar and vector fields

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2. Electric field (11 hours)

- a. Coulomb's law
- b. Electric field intensity
- c. Electric flux density
- d. Gauss's law and applications
- e. Physical significance of divergence; Divergence theorem.
- f. Electric potential, Potential gradient
- g. Energy density in electrostatic field
- h. Electric properties of material medium
  - i. Free and bound Charges, Polarization, Relative permittivity, Electric dipole
  - j. Electric Boundary conditions
- k. Current, Current density, Conservation of charge, Continuity equation, Relaxation time
- l. Boundary value problems, Laplace and Poisson equations and their solutions, Uniqueness theorem.
- m. Graphical field plotting, Numerical integration.

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3. Magnetic field (9 hours)

- a. Biot-Savart's law
- b. Magnetic field intensity
- c. Ampere's circuital law and its application
- d. Magnetic flux density
- e. Physical significance of curl, Stoke's theorem
- f. Scalar and Magnetic vector potential
- g. Magnetic properties of material medium
- h. Magnetic force, Magnetic torque, Magnetic moment, Magnetic dipole, Magnetization
- i. Magnetic boundary condition

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4. Wave equation and Wave propagation (12 hours)

- a. Faraday's law, Transformer emf, Motional emf
- b. Displacement current
- c. Maxwell's equations in integral and point forms
- d. Wave propagation in lossless and lossy dielectric
- e. Plane waves in free space, lossless dielectric, good conductor
- f. Power and pointing vector
- g. Reflection of plane wave at normal and oblique incidence

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5. Transmission lines (5 hours)

- a. Transmission line equations
- b. Input impedance, Reflection coefficient, Standing wave ratio
- c. Impedance matching, Quarter wave transformer, Single stub matching, Double stub matching

6. Wave guides(4 hours)
  - a.Rectangular wave guide
  - b.Transverse electric mode, transverse magnetic mode
7. Antennas(1 hour)
  - a.Introduction to antenna, antenna types and properties

Practical:

- 1.Teledeltos (electro-conductive) paper mapping of electrostatic fields.
- 2.Determination of dielectric constant, display of a magnetic Hysteresis loop
- 3.Studies of wave propagation on a lumped parameter transmission line
- 4.Microwave sources, detectors, transmission lines
- 5.Standing wave patterns on transmission lines, reflections, power patterns on transmission lines, reflections, power measurement.
- 6.Magnetic field measurements in a static magnetic circuit, inductance, leakage flux.

References:

- 1.W. H. Hayt, "Engineering Electromagnetics", McGraw-Hill Book Company.
- 2.J. D. Kraus, "Electromagnetics", McGraw-Hill Book Company.
- 3.N. N. Rao, "Elements of Engineering Electromagnetics", Prentice Hall.
- 4.Devid K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley.
- 5.M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press.