

PH 407: ELECTROMAGNETIC THEORY (3-1-0:4)

Electrostatics

Coulomb's law, electric field, divergence and curl, applications Gauss's law, electric potential, work and energy, conductor, Laplace equation (1D, 2D and 3D), uniqueness theorem, separation of variables: Cartesian and spherical coordinates, multipole expansion.

Dielectric

Field of an electric dipole, polarization, field of a polarized object, Gauss's law in dielectrics, electric displacement, linear dielectrics, boundary value problems, energy in dielectrics.

Magnetostatics

Introduction, Lorentz force, electric current, equation of continuity, Biot-Savart law and applications, curl and divergence, Ampere's law and applications, magnetic potential, magnetization, field of a magnetized object, Ampere's law in magnetized material, linear and nonlinear media.

Maxwell's Equations

The equation of continuity for time-varying fields, inconsistency of Ampere's law, Maxwell's equation, conditions at a boundary surface. Uniform plane wave propagation, solution of a wave equation in the free-space with frequency domain and time domain, wave propagation in conducting medium and dielectric medium, and polarisation, reflection by a perfect conductor, perfect dielectric, perfect insulator, surface impedance, transmission line analogy.

Power Flow and Poynting Vector

Poynting's theorem, note on the interpretation of $\vec{E} \times \vec{H}$, instantaneous, average and complex Poynting vector, power loss in a plane conductor.

Textbooks and References:

1. E. C. Jordan and K. G. Balmain, "Electromagnetic waves and radiating systems", Prentice Hall India.
2. J. D. Jackson, "Classical Electrodynamics", Wiley Eastern.
3. P. Lorrain, D. R. Corson, and F. Lorrain, "Electromagnetic fields and waves", W.H. Freeman & Company.
4. D. J. Griffith, "Introduction to Electrodynamics", Prentice Hall India.
5. M. A. W. Miah, "Fundamentals of Electromagnetics", Tata McGraw Hill.