IC221 Foundations of Electrodynamics

Credit: 2.5-0.5-0-3

Prerequisite: Consent of the faculty member

Students intended for: B.Tech

Elective or Core: Core Semester: Even/Odd

Course content:

Part I - Derivation of Maxwell's equations

- (Review) Vector calculus, Helmholtz equation, Coulomb's law, Gauss law, Poisson and Laplace equations. [3 Lectures]
- Electrostatic boundary conditions, Conductors and capacitors, mean value and uniqueness theorem, separation of variables, Dipoles and electric polarization in matter Dielectrics. [6 Lectures]
- Lorentz force law – Biot and Savart law and Magnetic vector potential – boundary conditions on B. Magnetic materials – paramagnetic, diamagnetic. Bound currents – boundary conditions on H, Inductance – magnetic energy density [6 Lectures]
- Ohm law – EMF's – Faraday's law - Maxwell's equations [5 Lectures]

Part II – Maxwell's equations and electromagnetic waves

- Electromagnetic waves in vacuum - Maxwell's stress tensor – momentum conservation Poynting theorem and conservation of energy and momentum [5 Lectures]
- Gauge transformations, Coulomb gauge and Lorentz gauge. [3 Lectures]
- Electromagnetic waves in matter – reflection, transmission, polarization - Electromagnetic waves in dispersive medium – KramersKronig relation - Lorentz oscillator model for atomic dispersion and absorption, negative-index materials [6 Lectures]
- Waveguides, transverse electric and transverse magnetic modes, Radiated power, Electric dipole radiation, antenna theory [6 Lectures]

Text Book

Introduction to electrodynamics by D J Griffiths

Reference

Lectures on Physics II by R P Feynman

Fields and wave electromagnetics by D K Cheng

Elements of Electromagnetics M. O Sadiku

Electricity and Magnetism by Purcell E M

Electromagetics by B. B. Laud

Classical electrodynamics by J. D Jackson