ADVANCE PHYSICS 6 (CLASSICAL ELECTRODYNAMICS)

PRE-REQUISITE: Undergraduate level Electricity and Magnetism

INTRODUCTION: CREDITE HOURS: 3+1

Understanding electromagnetic fields is essential to our understanding the world around us. The most fundamental processes in nature, from the forces that determine the structure of atoms and molecules to the phenomena of light to nerve impulses in living systems, depend on electric and magnetic fields.

It is fundamental to current and future technologies. Motors, power generation and transmission, electronics, sensors, and communication – both wired and wireless – involve the manipulation of electric or magnetic fields. There are few advances in technology that can be made without the use of electronic circuits or electric and magnetic fields.

COURSE OBJECTIVE:

The objective of the course is to present a theory of classical electrodynamics. Thus, Maxwell equations and their consequences are considered in great detail and presented pedagogically following Griffiths textbook.

TOPICS COVERED:

Electrostatics:
Electric Current:
Magnetic Properties of Matter:
Maxwell's Equations and their Applications:

COURSE OUTLINE:

Electrostatics:
Electric dipole, potential energy of a dipole in an electric field, mutual energy of two dipoles, force and couple on the dipole placed in an external electric field, multipole expansion of electric fields external field of a dielectric displacement vector, electric susceptibility and dielectric constant, boundary conditions on the field vectors, potential energy of a group of point charges, electrostatic energy of a charge distribution, energy of an electrostatic field, energy of a system of charged conductors, stress in the electrostatic field and dielectric media, coefficients of potential, capacitance and inductance.
Equation of Poisson and Laplace, applications of Laplace's equation to problems (conductors and dielectrics) having spherical cylindrical and cartesian symmentry,

electrical images (conductors and dielectrics).

Electric Current:

Nature of the current, current density and equation of continuity, Ohm's law, steady current in media without sources of e.m.f., approach to electrostatic equilibrium. Magnetic induction, force on current carrying conductors, Biot-Savart law, Ampere's circuital law, the magnetic vector and scalar potentials, the magnetic field of a distant circuit.

Magnetic Properties of Matter:

Magnetisation, vectors M and H produced by magnetized materials field equation, boundary conditions on the field vectors.

Maxwell's Equations and their Applications:

Maxwell's equations and the generalization of the Ampere's law, electromagnetic energy, vector and scalar potentials, gauge transformations (Lorentz gauge, coulombs guage). pressure of radiations, Green's function for time dependent wave equation, retarded scaler and vector potentials, radiation from an oscillating dipole, plane electromagnetic wave, plane waves in a conducting and non-conducting media, linear and cirucular polarization, and superposition of waves in one dimension, boundary conditions, reflection and refraction of electromagnetic waves at a plane interface between dielectrics, waves polarization by reflection and total internal reflection, reflection from a conducting medium, covariant formulation of electrodynamics, transformation laws of electro magnetic fields, the field of a uniformly moving and accelerated electron.

Practical:

1. To study some aspects of Ferromagnetism by drawing B. H. curve.
2. Measurement of speed of light using laser source rotating mirror method.
3. To determine e/m of an electron using a fine beam tube.
4. To determine charge of an electron by Millikan's oil drop method.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

REFERENCE BOOKS:

1. Classical Electrodynamics by Jackson, John Wiley & Sons, (1975).
2. Electricity and Magnetism by W. J. Duffin , McGraw-Hill, (1990).
3. Electromagnetism by I.S. Grant and W. R. Phillips, John Wiley & Sons (1990).
4. Introduction to Electrodynamics by D. Griffiths Prentice Hall, (1989).
5. Foundation of Electromagnetic Theory¸ 4th edition by Reitz, Milford and Christy, Addison Wesley, (1993).