BACHELORS WITH PHYSICS AS MAJOR
7th SEMESTER

PHY722J2 PHYSICS _ ELECTRODYNAMICS

CREDITS: THEORY: 4, TUTORIALS: 2

THEORY (4 CREDITS: 60 HOURS)

LEARNING OUTCOMES

The learning outcomes cover a comprehensive range of topics related to electromagnetism, including electrostatics, magnetostatics, electromagnetic waves, and potentials, providing students with a solid understanding of the subject matter.

1. *Understand Gauss's Law and its applications for calculating electric fields.*
2. *Solve Poisson's and Laplace's equations for electric potential.*
3. *Comprehend Green's Theorem and its implications in electrostatics.*
4. *Master the method of images for solving problems involving point charges near grounded infinite planes and conducting spheres.*
5. *Develop the ability to solve Laplace's equation in spherical coordinates.*
6. *Introduce the concept of the vector potential in magnetostatics.*
7. *Understand localized current distributions and calculate the magnetic moment of current loops.*
8. *Apply boundary conditions in magnetostatics.*
9. *Maxwell's Equations and understand their physical significance.*
10. *Investigate the conservation laws for charge and energy in electromagnetic fields.*
11. *Explain the continuity equation and Poynting's Theorem, which describe the flow of energy and momentum in electromagnetic fields.*
12. *Analyze energy and momentum in electromagnetic waves.*
13. *Explore the concept of polarization of electromagnetic waves.*
14. *Understand the concepts of vector and scalar potentials in electromagnetic theory.*
15. *Learn about gauge transformations, including the Lorentz and Coulomb gauges.*
16. *Derive and apply the concept of retarded potentials and Lienard-Wiechert potentials.*
17. *Calculate electric and magnetic fields due to an arbitrarily moving point charge.*
18. *Examine the special case of a charge moving with constant velocity.*
19. *Study radiations from an oscillating dipole and their properties.*

UNIT-I (15 HOURS)

Gauss Law and Boundary conditions for electric field. Potential Formulation and electrostatic energy. Poisson and Laplace Equations, Green's Theorem, Uniqueness of the Solution.

Method of Images: Point Charge in presence of grounded infinite plane. Point Charge in the presence of a Grounded Conducting Sphere, Solution of Laplace equation in Spherical coordinates.

UNIT-II (15 HOURS)

Ampere's Law, Vector potential, magnetic induction of a circular loop of current, Localized current distribution, magnetic moment, force and torque on localised currents in the external field, macroscopic equation, boundary conditions with problems, uniformly magnetized sphere, magnetized sphere in an external field.

UNIT-III (15 HOURS)

Maxwell Equations. Displacement Current. Conservation Laws: Charge and Energy. The Continuity Equation, Poynting's Theorem. Conservation of Momentum Angular Momentum. Wave Equations for E and B. Energy and Momentum in Electromagnetic Waves. Polarization of EM waves.

UNIT IV (15 HOURS)

Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge, Retarded potentials, Lienard-Wiechert potentials, Fields due to an arbitrarily moving point charge, special case of a charge moving with constant velocity, Radiations from an oscillating dipole,

TUTORIALS (2 CREDITS: 30 HOURS)

1. Gauss Law in dielectrics. Induced and bound charges.
2. Boundary Value problems in presence of linear dielectrics.
3. Power radiating by a point charges-Larmor Formula.
4. Lienard's generalization of Larmor formula.
5. Energy loss in Bremsstrahlung.
6. Plane Waves in Dielectric Media: Absorption and Dispersion of EM waves

TEXT BOOKS:

1. Introduction to Electrodynamics, David J Griffiths.
2. Principles of Electrodynamics" Bishwanath Chakraborty, Books & Allied Analytical.
3. Principles of Electrodynamics, Melvin Schwartz , Dover Books