

RAJASTHAN ILD SKILLS UNIVERSITY

(RISU)

Paper 154: Electricity, Magnetism and electromagnetism

Unit I

Classical Fields: Concept of Field, Scalar and Vector Fields, Gradient of a scalar field, Divergence and Curl of a vector field in Cartesian co-ordinates system, Physical significance of Gradient, Divergence and Curl, problems based on Gradient. Divergence and curl operators. Concept of Solid angle. Gauss divergence and Stroke's theorem. Gauss law from inverse square law. Differential form of Gauss law.

Unit II

Field of stationary and moving charges: Potential energy of system of (i) Discrete N-charges (ii) Continuous charge distribution. Energy required to build a uniformly charged sphere, classical radius of electron, Electric field due to a short electric dipole, Interaction of electric dipole with external uniform and non-uniform electric field potential due to a uniformly charged spherical shell.

Poisson's and Laplace equations in Cartesian co-ordinates and their applications to solve the problems of electrostatics.

Invariance of charge, Gaussian and SI units and their inter conversions, Electric field measured in moving frames, Electric field of a point charge moving with constant velocity.

Unit III

Electric field in matter: Electric potential and electric field due to a uniformly polarized sphere (i) outside the sphere (ii) at the surface of the sphere (iii) inside the sphere, Electric field due to a dielectric sphere placed in a uniform electric field (a) outside the sphere (b) inside the sphere, Electric field due to a charge placed in dielectric medium and Gauss law.

Magnetostatics and magnetic field in matter: Lorentz force, properties of magnetic field, Ampere's law, field due to a current carrying solid conducting cylinder (a) outside (b) at the surface and (c) inside the cylinder. Ampere's law in differential form, Introduction of Magnetic Vector potential, Poisson's equation for vector potential. Deduction of Bio-Savart law using Magnetic Vector potentials, Differential form of Ampere's law.

Unit IV

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity & Magnetism, A.S. Mahajan & Abbas A. Rangwala, Tata McGraw-Hill
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
- Fundamental University Physics Vol II: Fields and Waves . M. Alonso and EJ Finn, Addison- Wesley Publishing Company.
- Berkley Physics Course. Vol. II