B.Sc. - Semester III

ELECTRICITY AND MAGNETISM

(4 CREDITS) **PAPER-I** **(40 LECTURES)**

Unit I

Electrostatics: Electric Field and Lines, Electric Field **E** due to a Ring of Charge. Electric Flux; Gauss's law, Gauss's law in Differential form. Applications of Gauss's Law : **E** due to (1) an Infinite Line of Charge, (2) a Charged Cylindrical Conductor, (3) an Infinite Sheet of Charge and Two Parallel Charged Sheets, (4) a Charged Spherical Shell, (5) a Charged Conducting Sphere, (6) a Uniformly Charged Sphere, (7) Two Charged Concentric Spherical Shells and (8) a Charged Conductor. Force on the Surface of a Charged Conductor and Electrostatic Energy in the Medium surrounding a Charged Conductor. Electric Potential: Line Integral of Electric Field. Electric Potential Difference and Electric Potential V (Line integral). Conservative Nature of Electrostatic Field. Relation between **E** and V. Electrostatic Potential Energy of a System of Charges. Potential and Electric Field of (1) a Dipole, (2) Quadrupole (3) a Charged Wire and (4) a Charged Disc. Force and Torque on a Dipole. Conductors in an Electrostatic Field. Description of a System of Charged Conductors. An Isolated Conductor and Capacitance. Electrostatic Energy of (1) a Point Charge, (2) a System of Point Charges, (3) a Uniform Sphere, (4) a Capacitor.

Unit -II

Magnetism: Magnetostatics: Magnetic Effect of Currents, Magnetic Field **B**. Magnetic Force between Current Elements and Definition of **B.** Magnetic Flux. Biot-Savart's Law : **B** due to (1) a Straight Current Carrying Conductor, (2) Current Loop and (3) Solenoid. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital law (Integral and Differential Forms): B due to (1) a Solenoid and (2) a Toroid. Properties of **B.** Curl and Divergence of **B**. Vector Potential. Forces on an Isolated Moving Charge. Magnetic Force on a Current Carrying Wire. Torque on a Current Loop in a Uniform Magnetic Field. Magnetic Properties of Matter: Gauss's law of magnetism (Integral and Differential Forms). Magnetization current. Relative Permeability of a Material. Magnetic Susceptibility. Magnetization Vector (**M**). Magnetic Intensity (**H**). Relation between **B**, **M** and **H**. Stored Magnetic Energy in Matter. Magnetic Circuit. B-H Curve and Energy Loss in Hysteresis.

Unit –III

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. Skin effect. Motion of Electron in Changing Magnetic field , Betatron , Magnetic Energy in Field , Induced Magnetic Field (Time Varying Electric Field), Displacement current.

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Ballistic Galvanometer: Potential Energy of a Current Loop. Ballistic Galvanometer: Current and Charge sensitivity. Electromagnetic Damping. Logarithmic Damping.

Unit –IV

Dielectrics: Electric Field in Matter. Dielectric Constant. Parallel Plate Capacitor with a Dielectric. Polarization, Polarization Charges and Polarization Vector. Electric Susceptibility. Gauss's law in

Dielectrics. Displacement Vector **D**. Relations between the three Electric Vectors. Capacitors filled with Dielectrics. Electrostatic equation with dielectrics, Field , Force and Energy in Dielectrics.

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.

Suggested Books:

1. Electricity and Magnetism By Edward M. Purcell (McGraw-Hill Education, 1986)
2. Fundamentals of Electricity and Magnetism By Arthur F. Kip (McGraw-Hill, 1968)
3. Electricity and Magnetism by J.H.Fewkes & John Yarwood. Vol. I (Oxford Univ. Press, 1991).
4. Electricity and Magnetism. By D C Tayal (Himalaya Publishing House,1988).
5. David J. Griffiths, Introduction to Electrodynamics, 3rd Edn, (Benjamin Cummings,1998).

B.Sc. - Semester III

PRACTICALS

(4 CREDITS) **PAPER-II** **(40 LECTURES)**

1. To study the time constant in a C.R. Circuit.
2. To study the solid state common power supply.
3. To determine the field along the axis of Helmholtz coil.
4. To measure magnetic field using a ballistic galvanometer.
5. To determine the capacity of condensor by absolute method.
6. To determine the coefficient of mutual induction between two coils.
7. To determine high resistance by leakage method.
8. To study the characteristics of junction and Zener diodes.
9. To Study the Characteristics of p-n-p transistor.
10. To measure ‘L’ & ‘C’ by A.C. bridge