

SEMESTER-II

Electricity and Magnetism

Unit -1

Electric charge and field Coulomb's law, electric field strength, electric field lines, point charge in an electric field and electric dipole, work done by a charge (derivation of the expression for potential energy) Gauss's law and its applications (electric fields of a (i) spherical charge distribution, (ii) line charge and (iii) an infinite flat sheet of charge).

Electric potential, line integral, gradient of a scalar function, relation between field and potential. Potential due to point charge and distribution of charges (Examples: potential associated with a spherical charge distribution, infinite line charge distribution, infinite plane sheet of charges). Constant potential surfaces, Potential due to a dipole and electric quadrupole.

Unit -2

Conductors in electrostatic field Conductors and insulators, conductors in electric field. Capacitance and capacitors, calculating capacitance in a parallel plate capacitor, parallel plate capacitor with dielectric, dielectrics: an atomic view. Energy stored in a capacitor, Dielectric and Gauss's law.

Electric currents and current density. Electrical conductivity and Ohm's law. Physics of electrical conduction, conduction in metals and semiconductors, circuits and circuit elements: Variable currents in capacitor circuits, Resistor, inductor and capacitor and their combination. Force on a moving charge.

Unit -3

Magnetism Definition of magnetic field, Ampere's law and Biot-Savart law (magnetic force and magnetic flux), Magnetic force on a current carrying conductor, Hall effect. Electromagnetic induction, conducting rod moving in a magnetic field, law of induction and mutual inductance, self inductance and energy stored in a magnetic field.

Electromagnetic waves: Equation of continuity, Maxwell's equations, displacement current, electromagnetic wave, energy transported by electromagnetic waves. Electromagnetic waves in different frames of reference, Field of a current loop, magnetic moment, Electric current in atoms, electron spin and magnetic moment, magnetization and magnetic susceptibility.

Unit -4

DC circuit analysis :Concept of current and voltage sources ,Kirchoff's current and voltage law principle of Duality (voltage and current equivalents).Thevenin's theorem ,Superposition theorem Reciprocity theorem and maximum power transform theorem. **Transient current:** Growth and decay of charge RC Circuit, Growth and decay of current in series LR circuit, decay of charge in series LCR circuit

Alternating current circuits: Resonant circuit, alternating current, quality factor, RL, RC, LC, LCR circuits, admittance and impedance, power and energy in AC circuits.

Practical Content

List of Experiments to be performed in the Laboratory (Minimum of 8 Experiments)

1. Experiments on tracing of electric and magnetic flux lines for standard configuration.
2. Determination of components of earth's magnetic field using a Ballistic galvanometer.
3. Determination of capacitance of a condenser using B.G.
4. Determination of high resistance by leakage using B.G.
5. Determination of mutual inductance using BG.
6. Charging and discharging of a capacitor (energy dissipated during charging and time constant measurements).
7. Series and parallel resonance circuits (LCR circuits).
8. Impedance of series RC circuits- determination of frequency of AC.
9. Study the characteristics of a series RC and RL Circuit.
10. Verification of laws of combination of capacitances and determination of unknown capacitance using de - Sauty bridge.
11. Determination of BH using Helmholtz double coil galvanometer and potentiometer.
12. Determination of self inductance of a coil.