

Physics

Electrostatics

Frictional electricity, charges and their conservation; Coulomb's law - forces between two point electric charges - Forces between multiple electric charges - superposition principle.

Electric field - electric field due to a point charge, electric field lines; electric dipole, electric field intensity due to a dipole - behavior of a dipole in a uniform electric field - application of electric dipole in microwave oven.

Electric potential - potential difference - electric potential due to a point charge and dipole - equipotential surfaces - electrical potential energy of a system of two point charges.

Electric flux - Gauss's theorem and its applications to find field due to (i) infinitely long straight wire (ii) uniformly charged infinite plane sheet (iii) two parallel sheets and (iv) uniformly charged thin spherical shell (inside and outside)

Electrostatic induction - capacitor and capacitance - dielectric and electric polarisation - parallel plate capacitor with and without dielectric medium - applications of capacitor - energy stored in a capacitor - Capacitors in series and in parallel - action of points - Lightning arrester - Van de Graaff generator.

Current Electricity

Electric Current - flow of charges in a metallic conductor - drift velocity and mobility and their relation with electric current.

Ohm's law, electrical resistance - V-I characteristics - electrical resistivity and conductivity - classification of materials in terms of conductivity - Superconductivity (elementary ideas) - Carbon resistors - colour code for carbon resistors - combination of resistors - series and parallel - temperature dependence of resistance - internal resistance of a cell - potential difference and emf of a cell - combinations of cells in series and in parallel.

Kirchoff's law - illustration by simple circuits - Wheatstone's Bridge and its application for temperature coefficient of resistance measurement - Metrebridge - special case of Wheatstone bridge - Potentiometer - principle - comparing the emf of two cells.

Effects of Electric Current

Magnetic effect of electric current – Concept of magnetic field - Oersted's experiment – Biot-Savart law-Magnetic field due to an infinitely long current carrying straight wire and circular coil – Tangent galvanometer – construction and working – Bar magnet as an equivalent solenoid –magnetic field lines.

Ampere's circuital law and its application.

Force on a moving charge in uniform magnetic field and electric field – cyclotron – Force on current carrying conductor in a uniform magnetic field – Forces between two parallel current carrying conductors - definition of ampere.

Torque experienced by a current loop in a uniform magnetic field - moving coil galvanometer – conversion to ammeter and voltmeter – current loop as a magnetic dipole and its magnetic dipole moment-Magnetic dipole moment of a revolving electron.

Electromagnetic Induction and Alternating Current

Electromagnetic induction - Faraday's law - induced emf and current - Lenz's law.

Self induction - Mutual induction - self inductance of a long solenoid - mutual inductance of two long solenoids.

Methods of inducing emf - (i) by changing magnetic induction (ii) by changing area enclosed by the coil and (iii) by changing the orientation of the coil (quantitative treatment).

AC generator - commercial generator. (Single phase, three phase).

Eddy current - applications - transformer - long distance transmission.

Alternating current - measurement of AC-AC circuit with resistance - AC circuit with inductor - AC circuit with capacitor - LCR series circuit - Resonance and Q - factor - power in AC circuits.

Electromagnetic Waves and Wave Optics

Electromagnetic waves and their characteristics - Electromagnetic spectrum-radio, microwaves, infra-red, visible, ultra-violet, X rays, gamma rays.

Wavefront and Huygens's principle - Reflection, total internal reflection and refraction of plane wave at a plane surface using wavefronts.

Interference - Young's double slit experiment and expression for fringe width - coherent source - interference of light-Formation of colours in thin films - analytical treatment - Newton's rings.

Diffraction - differences between interference and diffraction of light-diffraction grating.

Polarisation of light waves - polarisation by reflection - Brewster's law - double refraction - nicol prism - uses of plane polarised light and Polaroids - rotatory polarisation - polarimeter.

Atomic Physics

Atomic structure - discovery of the electron - specific charge (Thomson's method) and charge of the electron (Millikan's oil drop method) - alpha scattering - Rutherford's atom model.

Bohr's model - energy quantization - energy and wave number expressions - Hydrogen spectrum - energy level diagrams - sodium and mercury spectra - excitation and ionization potentials - Sommerfeld's atom model.

Masers and Lasers - spontaneous and stimulated emissions - normal population and population inversion - Ruby laser - He-Ne laser - properties and applications of laser light - holography.

Dual Nature of Radiation and Matter

Photoelectric effect - Light waves and photons - Einstein's photoelectric equation - laws of photoelectric emission - particle nature of energy - experimental verification of Einstein's photoelectric equation - work function - photo cells and their application.

Matter waves - wave mechanical concept of the atom - wave nature of particles - De Broglie relation - De Broglie wavelength of an electron - electron microscope.

Nuclear Physics

Nuclear properties - nuclear radii, masses, binding energy, density, charge- isotopes, isobars and isotones - nuclear mass defect - binding energy - stability of nuclei - Bainbridge mass spectrometer.

Nature of nuclear forces- Neutron - discovery - properties - artificial

transmutation - particle accelerator.

Radioactivity - alpha, beta and gamma radiations and their properties - decay, β -decay and -decay - Radioactive decay law - half life - mean life - artificial radioactivity - radio isotopes - effects and uses - Geiger - Muller counter.

Radio carbon dating - biological radiation hazards.

Nuclear fission - chain reaction - atom bomb - nuclear reactor - nuclear fusion - Hydrogen bomb- cosmic rays - elementary particles.

Semiconductor Devices and their Applications

Semiconductor theory - energy band in solids - difference between metals, insulators and semiconductors based on band theory - semiconductor doping - Intrinsic and Extrinsic semi conductors.

Formation of P-N Junction - Barrier potential and depletion layer - P-N Junction diode - Forward and reverse bias characteristics - diode as a rectifier - Zener diode - Zener diode as a voltage regulator - LED - seven segment display - LCD.

Junction transistors - characteristics - transistor as a switch - transistor as an amplifier - transistor biasing - RC, LC coupled and transformer coupling in amplifiers - feed back in amplifiers - positive and negative feedback - advantages of negative feedback in amplifiers - oscillator - condition for oscillations - LC circuit - Colpitt oscillator.

Logic gates - NOT, OR, AND, EXOR using discrete components - NAND and NOR gates as universal gates - Laws and theorems of Boolean algebra