

# PHYSICS

## Unit 1: Units and dimensions

Units for measurement, system of units, SI, fundamental and derived units, dimensional analysis.

## Unit 2: Mechanics

Motion in one-dimension, uniform and non-uniform motion, uniformly accelerated motion; Scalars and Vectors, resolution of Vectors, vector properties. Motion in a plane, Projectile motion, Uniform circular motion.

Newton's laws of motion, conservation of linear momentum, Friction; Work-Energy theorem, kinetic energy, potential energy, conservation of energy; elastic collision in one and two dimensions.

Center of mass of a system of particles, centre of mass of a rigid body, rotational motion and torque, angular momentum and its conservation, moments of inertia for various geometries, parallel and perpendicular axes theorem.

Universal law of gravitation, acceleration due to gravity, planetary motion, Kepler's laws, Satellites, gravitational potential and potential energy and escape velocity.

## Unit 3: Solids and Fluids

**Solids:** Elastic properties, Hooke's law, Young's modulus, bulk modulus, rigidity modulus.

**Liquids:** Cohesion and adhesion; surface energy and surface tension; flow of fluids; Bernoulli's theorem and applications; viscosity, Stokes's law, terminal velocity

## Unit 4: Oscillations and Waves

**Oscillations:** Oscillatory motion - periodic and non-periodic motion; simple harmonic motion (SHM), angular SHM, linear harmonic oscillator – both horizontal and vertical; combination of springs – series and parallel, simple pendulum; Expression of energy – potential energy, kinetic energy and total energy; Graphical representation of SHM; Types of oscillations – free, damped, maintained and forced oscillations and resonance.

**Wave Motion:** Properties of waves; Transverse and Longitudinal waves; Superposition of waves, Progressive and Standing waves; Vibration of strings and air columns, beats, Doppler Effect.

## Unit 5: Heat and Thermodynamics

Heat, work and temperature; Ideal gas laws; Specific heat capacity, Thermal expansion of solids, liquids and gases, Relationship between  $C_p$  and  $C_v$  for gases; Newton's law of cooling, black body, Kirchhoff's law, Stefan's law and Wein's law, thermodynamic equilibrium, internal energy; Zeroth, first and second law of thermodynamics, thermodynamic processes, Carnot cycle, efficiency of heat engines, refrigerator

## Unit 6: Electrostatics, Current Electricity and Magnetostatics

**Electric charges and Fields:** Electric Charge; Conductors and Insulators, Charging by Induction, Basic Properties of Electric Charge, Coulomb's Law, Forces between Multiple Charges, Electric Field, Electric Field Lines, Electric Flux, Electric Dipole, Dipole in a Uniform External Field, Continuous Charge Distribution, Gauss's Law, Applications of Gauss's Law.

**Electrostatic potential and Capacitance:** Electrostatic potential, Potential due to a point charge, electric dipole, system of charges. Equipotential surfaces; Potential energy of a system of charges, potential energy in an external field, Electrostatics of conductors, Dielectric and Polarization, Capacitors and Capacitance, parallel plate capacitor, effect of dielectric on capacitance combination of capacitors, energy stored in a capacitor, Van de Graaff Generator.

**Current Electricity:** Electric current, electric currents in conductors, Ohm's law, drift of electrons and the origin of Resistivity, temperature dependence of resistivity, electrical energy, power, combination of resistors, series and parallel, cells, emf, internal resistance, cells in series and in parallel, Kirchhoff's Rules, Wheatstone bridge, Meter bridge, potentiometer.

**Heating effects of current:** Electric power; concept of thermoelectricity – See beck effect and thermocouple, chemical effect of current – Faraday's laws of electrolysis.

**Magnetic effects:** Oersted's experiment, Biot Savart's law, magnetic field due to a straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field (Lorentz force), forces and torques on a current carrying conductor in a magnetic field, force between current carrying wires, moving coil galvanometer and conversion to ammeter and voltmeter.

**Magneto statistics:** Bar magnet, magnetic field, lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field; para, dia, and ferro magnetism, magnetic induction and magnetic susceptibility.

### **Unit 7: Electromagnetic Induction and Electromagnetic Waves**

**Electromagnetic Induction:** Induced e. m. f: Magnetic flux, Faraday's law, Lenz's Law and Conservation of Energy, self and mutual inductance.

**Alternating Current:** Impedance and reactance; power in AC circuits; AC voltage applied to resistor, inductor, capacitor, LCR circuits and resonance, transformer and AC generator.

**Electromagnetic Waves:** Electromagnetic waves characteristics, electromagnetic spectrum from gamma to radio waves.

### **Unit 8: Ray and Wave Optics**

**Ray Optics and optical instruments:** Reflection and refraction of light by plain spherical mirrors - Total Internal Reflection; optical fiber; deviation and dispersion of light by a prism; lens formula; magnification and resolving power; microscope and telescope.

**Wave Optics:** Huygens principle: Wave nature of light, interference of light waves and Young's experiment, thin films, Newton's rings, Diffraction – single slit, grating, Polarization and applications.

### **Unit 9: Modern Physics**

**Dual nature of radiation and matter:** De Broglie relation, Electron emission, photoelectric effect, experimental study, Einstein's photoelectric equation: Energy quantum of radiation; particle nature of light, the photon, wave nature of matter.

**Atoms:** Alpha-particle scattering and Rutherford's nuclear model of atom, atomic spectra, Bohr model of the hydrogen atom; the line spectra of the hydrogen atom.

**Nuclei:** Atomic masses and composition of nucleus; size of the nucleus; mass-energy and nuclear binding energy; nuclear force; radioactivity; nuclear energy

**Semiconductor materials, devices and simple circuits:** Energy bands in solids; classification of metals, conductors and semiconductors; intrinsic semiconductor, extrinsic semiconductor, p-n junction, semiconductor diode, junction diode as a rectifier, junction transistor, transistor as an amplifier.