

PHYSICS

Unit : 1 Introduction and Measurement

What is Physics? Scope and excitement; Physics in relation to science, society and technology; Need for measurement of physical quantities, units for measurement, systems of units-SI : fundamental and derived units. Dimensions of physical quantities. Dimensional analysis and its applications. Orders of magnitude, Accuracy and errors in measurement – random and instrumental errors, Significant figures and rounding off the numbers.

Graphs, Trigonometric functions, Concepts of differentiation and integration.

Unit : 2 Description of Motion in One Dimension

Objects in motion in one dimension, Motion in straight line, Uniform and non-uniform motion, its graphical representation and formulae, speed and velocity, relative velocity, average speed and instantaneous velocity. Uniformly accelerated motion, velocity-time graph, position-time graph and their formulae. Relations for uniformly accelerated motion with examples. Acceleration in one-dimensional motion.

Unit : 3 Description of Motion in Two and Three Dimensions

Vectors and scalars quantities, vectors in two and three dimensions, vector addition and multiplication by a real number, null-vector and its properties. Resolution of a vector in a plane, rectangular components. Scalar and vector products. Motion in two dimensions, cases of uniform velocity and uniform acceleration-projectile motion, general relation among position-velocity-acceleration for motion in a plane and uniform circular motion. Motion of objects in three dimensional space (elementary ideas).

Unit : 4 Laws of Motion

Force and inertia, first law of motion. Momentum, second law of motion, impulse, examples of different kinds of forces in nature. Third law of motion, conservation of momentum, rocket propulsion. Equilibrium of concurrent forces. Static and kinetic frictions, laws of friction, rolling friction, lubrication, Inertial and non-inertial frames (elementary ideas).

Unit : 5 Work, Energy and Power

Work done by a constant force and by a variable force, unit of work, energy and power. Work Energy Theorem. Elastic and in-elastic collisions in one and two dimensions. Notions of potential energy, conservation of mechanical energy : gravitational potential energy, and its conversion to kinetic energy, potential energy of a spring. Conservative forces. Different forms of energy, mass-energy equivalence, conservation of energy.

Unit : 6 Rotational Motion

Centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of rigid body, general motion of a rigid body, nature of rotational motion, rotational motion of a single particle in two dimensions only, torque, angular momentum and its geometrical and physical meaning, conservation of angular momentum, examples of circular motion (car on a level circular road, car on banked road, pendulum swinging in a vertical plane). Moment of inertia, its physical significance, moment inertia of uniform bodies with simple geometrical shapes, parallel axis

and perpendicular axis theorem (statements only), Comparison between translatory (linear) and rotational motion.

Unit : 7 Gravitation

Acceleration due to gravity, one and two dimensional motion under gravity. Universal law of gravitation, inertial and gravitational mass, variations in the acceleration due to gravity of the earth, statement of Kepler's laws of planetary motion, orbital velocity, geostationary satellites, gravitational potential, gravitational potential energy near the surface of earth, escape velocity, weightlessness.

Unit : 8 Heat and Thermodynamics

Thermal equilibrium and temperature (zeroth law of thermodynamics). Heat, work and internal energy. Specific heat, specific heat at constant volume and constant pressure of ideal gas and relation between them. First law of thermodynamics. Thermodynamic state, equation of state and isothermals, pressure-temperature phase diagram. Thermodynamic processes (reversible, irreversible, isothermal, adiabatic). Carnot cycle, second law of

thermodynamics, efficiency of heat engines. Entropy. Transfer of heat : conduction, convection and radiation. Newton's law of cooling.

Thermal conductivity. Black body radiation, Wien's law, Solar constant and surface temperature of the sun, Stefan's law,

Unit : 9 Oscillations

Periodic and oscillatory motions. Simple harmonic motion (S.H.M.) and its equation of motion. Oscillations due to a spring, kinetic energy and potential energy in S.H.M., Simple pendulum, physical concepts of forced oscillations, resonance and damped oscillations; Simple examples.

Unit : 10 Waves

Longitudinal and transverse waves and wave motion, speed of progressive wave. Principle of superposition of waves; reflection of waves, harmonic waves (qualitative treatment only), standing waves. Normal modes and its graphical representation. Beats, Doppler effect.

Unit : 11 Electrostatics

Frictional electricity, charges and their conservation, unit of charge, Coulomb's law, dielectric constant, electric field, electric field due to a point charge, electric potential – its physical meaning, potential due to a di-pole, di-pole field and behaviour of dipole in a uniform (2-dimensional) electric field. Flux, Statement of Gauss's theorem and its applications to find electric field due to uniformly charged simple systems. Conductors and insulators, presence of free charges and bound charges inside a conductor, Capacitance (parallel plate), Dielectric material and its effect on capacitance (concept only), capacitances in series and parallel, energy of a capacitor. Van de Graff generator.

Unit : 12 Current Electricity

Introduction (flow of current), sources of e.m.f., cells : simple, secondary, chargeable, combinations of cells in series and parallel. Electric current, resistance of different materials, temperature dependence, thermistor, specific resistivity, colour code for carbon resistors. Ohm's law and its limitation. Superconductors (elementary ideas). Kirchoff's laws, resistances in series and parallel, Wheatstone's bridge, measurement of resistance.

Potentiometer – measurement of e.m.f. and internal resistance of a cell.

Unit : 13 Thermal and Chemical Effects of Currents

Electric power, heating effects of current and Joule's law. Thermoelectricity: Seebeck effect, measurement of temperature using thermocouple. Chemical effects and Faraday's laws of electrolysis.

Unit : 14 Magnetic Effect of Currents

Oersted's observation, Biot-Savart's law (magnetic field due to an element of current), magnetic field due to a straight wire, circular loop and solenoid. Force on a moving charge in a uniform magnetic field (Lorentz force), cyclotron (simple idea), forces and torques on currents in a magnetic field, forces between two currents, definition of ampere, moving coil galvanometer, ammeter and voltmeter. Conversion of galvanometer into voltmeter/ammeter.

Unit : 15 Magnetism

Bar magnet (comparison with a solenoid), magnetic lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field as a bar magnet, tangent galvanometer, vibration magnetometer.

Para, dia and ferromagnetic substances with examples (simple idea). Electromagnets and permanent magnets.

Unit : 16 Electromagnetic Induction and Alternating Currents

Faraday's Law of electromagnetic induction, Lenz's Law, induced emf, self and mutual inductance. Alternating current, and voltage, impedance and reactance; A.C. circuits containing inductance, capacitance and resistance; phase relationships, and power in a.c. circuits, L.C oscillations. Electrical machines and devices (transformer, induction coil, generator, simple motors, choke and starter), eddy current.

Unit : 17 Electromagnetic Waves (Qualitative Treatment)

Electromagnetic oscillations, brief history of electromagnetic waves (Maxwell, Hertz, Bose, Marconi). Electromagnetic spectrum (radio, micro-waves, infra-red, optical, ultraviolet, X-

rays, gamma rays) including elementary facts about their uses, propagation of electromagnetic waves in atmosphere.

Unit : 18 Ray Optics and Optical Instruments

Ray optics as a limiting case of wave optics. Phenomena of reflection, refraction, and total internal reflection. Optical fibre.

Curved mirrors, lenses; mirror and lens formulae. Dispersion by a prism. Spectrometer. Absorption and emission spectra. Scattering and formation of rainbow. Telescope (astronomical), microscope, their magnifications and resolving powers.

Unit : 19 Electrons and Photons

Discovery of electron, e/m for an electron, electrical conduction in gases, photoelectric effect, particle nature of light, Einstein's photoelectric equation, photocells. Matter waves – wave nature of particles, de-Broglie relation, Davison and Germer experiment.

Unit : 20 Atoms, Molecules and Nuclei

Rutherford model of the atom, Bohr model, energy quantization. Hydrogen spectrum. Composition of nucleus, atomic masses, binding energy per nucleon of a nucleus, its variation with mass number, isotopes, size of nucleus. Radioactivity : properties of α ,

β and γ rays. Mass energy relation, nuclear fission and fusion.

Unit : 21 Solids and Semiconductor Devices

Crystal structure-Unit cell; single, poly and liquid crystals (concepts only). Energy bands in solids, difference between conductors, insulators and semi-conductors using band theory.

Intrinsic and extrinsic semiconductors, p-n junction, semiconductor diodes, junction transistor, diode as rectifier, solar cell, photo diode, LED, Zener diode as a voltage regulator, transistor as an amplifier and oscillator. Combination of gates. Elementary ideas about IC.