PHYSICS

Units and Measurements: The international system of units; Significant figures; Dimensions of physical quantities; Dimensional formulae and dimensional equations; Dimensional analysis and its applications.

Motion in a Straight Line: Instantaneous velocity and speed; Acceleration; Kinematic equations for uniformly accelerated motion.

Motion in a Plane: Scalars and vectors; Multiplication of vectors by real numbers; Addition and subtraction of vectors – graphical method; Resolution of vectors; Vector addition – analytical method; Motion in a plane; Motion in a plane with constant acceleration; Projectile motion; Uniform circular motion.

Laws of Motion: The law of inertia; Newtons first law of motion; Newtons second law of motion; Newtons third law of motion; Conservation of momentum; Equilibrium of a particle; Common forces in mechanics; Circular motion.

Work, Energy and Power: Notions of work and kinetic energy: The work-energy theorem; Work; Kinetic energy; Work done by a variable force; The work-energy theorem for a variable force; The concept of potential energy; The conservation of mechanical energy; The potential energy of a spring; Power; Collisions.

System of Particles and Rotational Motion: Centre of mass; Motion of centre of mass; Linear momentum of a system of particles; Vector product of two vectors; Angular velocity and its relation with linear velocity; Torque and angular momentum; Equilibrium of a rigid body; Moment of inertia; Kinematics of rotational motion about a fixed axis; Dynamics of rotational motion about a fixed axis; Angular momentum in case of rotations about a fixed axis.

Gravitation: Kepler's laws; Universal law of gravitation; The gravitational constant; Acceleration due to gravity of the earth; Acceleration due to gravity below and above the surface of earth; Gravitational potential energy; Escape speed; Earth satellites; Energy of an orbiting satellite.

Mechanical Properties of Solids: Stress and strain; Hooke's law; Stress-strain curve; Elastic moduli; Applications of elastic behaviour of materials.

Mechanical Properties of Fluids: Pressure; Streamline flow; Bernoulli's principle; Viscosity; Surface tension.

Thermal Properties of Matter: Temperature and heat; Measurement of temperature; Ideal-gas equation and absolute temperature; Thermal expansion; Specific heat capacity; Calorimetry; Change of state; Heat transfer; Newton's law of cooling.

Thermodynamics: Thermal equilibrium; Zeroth law of thermodynamics; Heat, internal energy and work; First law of thermodynamics; Specific heat capacity; Thermodynamic state variables and equation of state; Thermodynamic processes; Second law of thermodynamics; Reversible and irreversible processes; Carnot engine.

Kinetic Theory: Molecular nature of matter; Behaviour of gases; Kinetic theory of an ideal gas; Law of equipartition of energy; Specific heat capacity; Mean free path.

Oscillations: Periodic and oscillatory motions; Simple harmonic motion; Simple harmonic motion and uniform circular motion; Velocity and acceleration in simple harmonic motion; Force law for simple harmonic motion; Energy in simple harmonic motion; The Simple Pendulum.

Waves: Transverse and longitudinal waves; Displacement relation in a progressive wave; The speed of a travelling wave; The principle of superposition of waves; Reflection of waves; Beats.

Electric Charges and Fields: Electric Charge; Conductors and insulators; 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; Potential due to an electric dipole; Potential due to a system of charges; Equipotential surfaces; Potential energy of a system of charges; Potential energy in an external field; Electrostatics of conductors; Dielectrics and polarisation; Capacitors and capacitance; The parallel plate capacitor; Effect of dielectric on capacitance; Combination of capacitors; Energy stored in a capacitor.

Current Electricity: Electric current; Electric currents in conductors; Ohm's law; Drift of electrons and the origin of resistivity; Limitations of Ohms law; Resistivity of various materials; Temperature dependence of resistivity; Electrical energy, power; Cells, emf, internal resistance; Cells and resistors in series and in parallel; Kirchhoff's rules; Wheatstone bridge.

Moving Charges and Magnetism: Magnetic force; Motion in a magnetic field; Magnetic field due to a current element, Biot-Savart law; Magnetic field on the axis of a circular current loop; Ampere's circuital law; The solenoid; Force between two parallel currents, the Ampere; torque on current loop, magnetic dipole; The moving coil galvanometer.

Magnetism and Matter: The bar magnet; Magnetism and Gauss's law; Magnetisation and magnetic intensity; Magnetic properties of materials.

Electromagnetic Induction: The experiments of Faraday and Henry; Magnetic flux; Faraday's law of induction; Lenz's law and conservation of energy; Motional electromotive force; Inductance; AC generator.

Alternating Current: AC voltage applied to a resistor; Representation of AC current and voltage by rotating vectors – phasors; AC voltage applied to an inductor; AC voltage applied to a capacitor; AC voltage applied to a series LCR circuit; Power in AC circuit: the power factor; Transformers.

Electromagnetic Waves: Displacement current; Electromagnetic waves; Electromagnetic spectrum.

Ray Optics and Optical Instruments: Reflection of light by spherical mirrors; Refraction; Total internal reflection; Refraction at spherical surfaces and by lenses; Refraction through a prism; Optical instruments.

Wave Optics: Huygens principle; Refraction and reflection of plane waves using Huygens principle; Coherent and incoherent addition of waves; Interference of light waves and Young's experiment; Diffraction; Polarisation.

Dual Nature of Radiation and Matter: Electron emission; Photoelectric effect; Experimental study of photoelectric effect; Photoelectric effect and wave theory of light; 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; De Broglie's explanation of Bohrs second postulate of quantisation.

Nuclei: Atomic masses and composition of nucleus; Size of the nucleus; Mass-energy and nuclear binding energy; Nuclear force; Radioactivity; Nuclear energy.

Semiconductor Electronics: Materials, Devices and Simple Circuits: Classification of metals, conductors, and semiconductors; Intrinsic semiconductor; Extrinsic semiconductor; p-n junction; Semiconductor diode; Application of junction diode as a rectifier.