

1. Units and Measurements

SI units; dimensions and dimensional analysis; significant figures; least count and zero error; systematic and random errors; absolute, relative and percentage uncertainty; simple uncertainty calculation. Graphical interpretation.

2. Kinematics and Newtonian Dynamics

Motion in one and two dimensions; displacement, velocity and acceleration; motion graphs; relative motion; projectile and circular motion. Newton's laws; free-body diagrams; equilibrium; friction; inclined planes; connected bodies and ideal pulleys. Inertial and uniformly accelerating frames.

3. Work, Energy, and Momentum

Work by constant and simple variable forces; kinetic and potential energy; power; conservative and dissipative forces; energy conservation. Impulse; momentum conservation; centre of mass; elastic and inelastic collisions in one and two dimensions; coefficient of restitution; simple potential-energy diagrams.

4. Rotational Dynamics and Gravitation

Angular motion; torque; angular momentum; rotational energy; moments of inertia of standard uniform bodies; parallel-axis and perpendicular-axis theorems. Static equilibrium, fixed-axis rotation and rolling without slipping. Gravitation; field and potential; variation of gravitational acceleration with altitude; Kepler's laws; circular satellite orbits, orbital energy, geostationary satellites and escape velocity.

5. Mechanical Properties of Matter

Stress and strain; Hooke's law; elastic moduli and elastic energy. Fluid pressure; Pascal's principle; buoyancy and flotation. Continuity and Bernoulli relations; viscosity; Stokes drag and terminal speed; qualitative laminar and turbulent flow. Surface tension, surface energy, and capillary effects.

6. Oscillations and Mechanical Waves

Simple harmonic motion: phase, displacement, velocity, acceleration and energy. Spring-mass systems, spring combinations and the simple pendulum (small angle approximation). Qualitative damping, forced oscillations and resonance. Travelling waves; superposition; reflection; standing waves in strings and air columns; harmonics; beats; speed of sound; elementary Doppler effect in sound.

7. Thermal Physics

Temperature, equilibrium and expansion; calorimetry, heat capacities, latent heat and phase changes. Conduction, qualitative convection, thermal radiation, Stefan-Boltzmann and Wien relations and Newtonian cooling. Ideal gases; kinetic theory; RMS speed; equipartition and heat capacities. First law; standard thermodynamic processes; pressure-volume diagrams; second law; reversibility; heat engines, refrigerators and Carnot limits. Entropy.

8. Electrostatics

Charge; Coulomb interaction; superposition; electric field, potential and energy; dipoles. Simple uniform charge distributions; electric flux; Gauss's law in symmetric cases. Conductors in electrostatic equilibrium and shielding. Parallel-plate capacitance; dielectrics; capacitor combinations; stored energy; fixed-charge and fixed-voltage situations.

9. Current Electricity

Current and drift speed; resistance, resistivity and temperature dependence; Ohmic and non-Ohmic behaviour. Electrical energy and power; emf and internal resistance; resistor and cell combinations. Kirchhoff's laws; simple networks; Wheatstone bridge, metre bridge and potentiometer; Galvanometer and its conversion to ammeter and voltmeter.

10. Magnetism

Magnetic forces on charges and currents; circular and helical charged-particle motion; simple crossed-field applications. Fields of straight wires, circular loops and long solenoids; elementary Biot–Savart and Ampere applications. Forces between currents; magnetic dipoles; torque and energy. Qualitative properties of dia-, para-, and ferro - magnetic materials.

11. Electromagnetic Induction and Electromagnetic Waves

Magnetic flux; Faraday's and Lenz's laws; motional induction; eddy currents; inductance and magnetic energy. Elementary RC charging and discharging. Sinusoidal AC; peak and rms values; reactance, impedance, phase, series RLC resonance and average power. Ideal generators and transformers. Electromagnetic-wave characteristics, spectrum and applications.

12. Optics

Reflection and refraction at plane and spherical surfaces; mirrors; thin lenses; lens-maker formula; magnification; lens combinations. Total internal reflection; prisms and dispersion; elementary microscopes and telescopes. Wavefronts and Huygens principle; coherence; Young's double-slit interference; single-slit diffraction; linear polarization; Malus's and Brewster's laws.

13. Modern Physics

Dual nature of radiation and matter; photoelectric effect; Matter waves; de Broglie relation. Rutherford scattering; Bohr's model, hydrogen-like atom; energy levels and spectra. Nuclear composition; isotopes; mass defect; binding energy; mass–energy equivalence; radioactive decay, half-life, mean life and activity; fission, fusion and reaction energy.

14. Electronics

Energy bands in solids; conductors, insulators and semiconductors; semiconductor diode and its I-V characteristics; Diode as a rectifier; I-V characteristics of LED, photodiode, solar cell and Zener diode; elementary logic gates (NOT, AND, OR, NAND, XOR, NOR, and XNOR).

