

**A. MECHANICS, THERMAL PHYSICS AND WAVES AND OSCILLATIONS**

- Mechanics** : Conservation Laws, Collisions, impact parameter, scattering cross-section, centre of mass and lab systems with transformation of physical quantities, Rutherford Scattering. Motion of a rocket under constant force field. Rotating frames of reference, Coriolis force, Motion of rigid bodies, Angular momentum, Torque and procession of a top, Gyroscope, Central forces, Motion under inverse square law, Kepler's Laws, Motion of Satellites (including geostationary). Galilean Relativity, Special Theory of Relativity, Michelson-Morley Experiment, Lorentz Transformations - addition theorem of velocities, Variation of mass with, Velocity, Mass- Energy equivalence. Fluid dynamics, streamlines, Bernoulli's Equation with simple applications.
- Thermal Physics** : Laws of thermodynamics, Entropy, Carnot's cycle. Isothermal and Adiabatic Changes, Thermodynamic Potentials Maxwell's relations. The Clausius-Claapeyron equation reversible cell, Joule-Kelvin effect etc. Boltzmann Law, Kinetic Theory of Gases, Maxwell's Distribution Law of velocities, Equipartition of energy, Specific heats of gases. Mean Free path, Brownian Motion. Black Body radiation, specific heat of solid-Einstein & Debye theories, Wien's Law, Planck's Law. Solar Constant. Thermal ionization and Stellar spectra-production of low temperatures using adiabatic demagnetization and dilution refrigeration, Concept of negative temperature.
- Waves and Oscillations** : Oscillations, Simple harmonic motion, stationary and travelling waves, Damped harmonic motion. Forced oscillation & Resonance. Wave equation, Harmonic Solutions, Plane and Spherical waves. Superposition of waves, Phase and Group velocities, Beats Huygen's principle. Interference. Diffraction-Fresnel and Fraunhofer. Diffraction by straight edge, Single and multiple slits, Resolving power of grating and Optical Instruments. Rayleigh Criterion. Polarization; Production and Detection of polarized light (linear, circular and elliptical). Laser sources (Helium-Neon, Ruby, and semiconductor diode). Concept of spatial and temporal coherence. Diffraction as a Fourier transformation. Fresnel and Fraunhofer diffraction by rectangular and circular apertures, Holography, theory and applications.

**B. ELECTRICITY & MAGNETISM, MODERN PHYSICS AND ELECTRONICS**

- Electricity & Magnetism** : Coulomb's Law, Electric field. Gauss's Law. Electric-potential, Poisson and Laplace equations for a homogeneous dielectric, uncharged conducting Plane. Magnetic Field Magnetic induction and field strength. Biot-Savart law and applications. Electro-magnetic induction, Faraday's Lenz's laws, Self and mutual inductances. Alternating currents. L.C.R circuits series and parallel resonance circuits, quality factor. Kirchhoff's laws with application. Maxwell's equations and electromagnetic waves, Transverse nature of electromagnetic waves. Poynting vector, magnetic fields in matter—dia, para, ferro antiferro and ferri magnetism (qualitative approach only).
- Modern Physics** : Bohr's theory of hydrogen atom. Electron spin, Optical and X-ray Spectra. Stern- Gerlach experiment and spatial quantization. Vector model of the atom, spectral terms, fine structure of spectral lines. J-J and L-S coupling. Zeeman effect,

Pauli's exclusion principle, spectral terms of two equivalent and non-equivalent electrons. Gross and fine structure of electronic band Spectra. Raman effect Photoelectric effect. Compton effect, de Broglie waves. Wave particle duality and uncertainty principle. Schrodinger wave equation with application to (i) particle in a box. (ii) motion across a step potential, One dimensional harmonic oscillator Eigen values and Eigen functions. Uncertainty Principle Radio activity, Alpha, beta and gamma radiations. Elementary theory of the alpha decay. Nuclear binding energy. Mass Spectroscopy, Semi empirical mass formula. Nuclear fission and fusion. Elementary Reactor physics. Elementary particles and their classification. Strong, and Weak Electromagnetic interactions. Particle accelerators ; Cyclotron. Linear accelerations, Elementary ideas of Super conductivity.

- 3. Electronics** : Band theory of Solids : Conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors. P-N junction. Thermistors, Zenner diodes and transistors for rectification, amplification, oscillation modulation and detection of r.f. waves. Transistor receiver. Television Logic Gates.

