

**PHYSICS—CODE NO. (12)****1. Mechanics and Waves :**

Dimensional analysis. Newton's laws of motion and applications, variable mass systems, projectiles. Rotational dynamics-kinetic energy, angular momentum, theorems of moment of inertia and calculations in simple cases. Conservative forces, frictional forces. Gravitational potential and intensity due to spherical objects. Central forces, Kepler's problem, escape velocity and artificial satellites (including GPS). Streamline motion, viscosity, Poiseuille's equation. Applications of Bernoulli's equation and Stokes' law.

Special relativity and Lorentz transformation-length contraction, time dilation, mass-energy relation.

Simple harmonic motion, lissajous figures. Damped oscillation, forced oscillation and resonance. Beats, Phase and group velocities. Stationary waves, vibration of strings and air columns, longitudinal waves in solids. Doppler effect. Ultrasonics and applications.

**2. Geometrical and Physical Optics :**

Laws of reflection and refraction from Fermat's principle. Matrix method in paraxial optics—thin lens formula, nodal planes, system of two thin lenses. Chromatic and spherical aberrations. Simple optical instruments-magnifier, eyepieces, telescopes and microscopes.

Huygens' principle—reflection and refraction of waves. Interference of light—Young's experiment, Newton's rings, interference by thin films. Michelson interferometer. Fraunhofer diffraction—single slit, double slit, diffraction grating, resolving power. Fresnel diffraction—half-period zones and zone plate. Production and detection of linearly, circularly and elliptically polarised light. Double refraction, quarter—wave plates and half-wave plates. Polarizing sheets. Optical activity and applications. Raman & Rayleigh scattering and applications.

Elements of fibre optics—attenuation; pulse dispersion in step index and parabolic index fibres; material dispersion. Lasers, characteristics of laser light—spatial and temporal coherence. Focussing of laser beams and applications.

**3. Heat and Thermodynamics :**

Thermal equilibrium and temperature. The zeroth law of thermodynamics. Heat and the first law of thermodynamics. Efficiency of Carnot engines. Entropy and the second law of thermodynamics. Kinetic theory and the equation of state of an ideal gas. Mean free path, distribution of molecular speeds and energies. Transport phenomena. Andrew's experiments—van der Waals equation and applications. Joule—Kelvin effect and applications. Brownian motion. Thermodynamic potentials—Maxwell relations. Phase transitions. Kirchhoff's laws. Black-body radiation—Stefan-Boltzmann law, spectral radiance, Wien displacement law, application to the cosmic microwave background radiation, Planck radiation law.

#### 4. Electricity and Magnetism :

Electric charge, Coulomb's law, electric field, Gauss' law. Electric potential, van de Graaff accelerator. Capacitors, dielectrics and polarization. Ohm's law, Kirchhoff's first and second rules, resistors in series and parallel, applications to two-loop circuits. Magnetic field—Gauss' law for magnetism, atomic and nuclear magnetism, magnetic susceptibility, classification of magnetic materials. Circulating charges, cyclotron, synchrotron. Hall effect. Biot-Savart law, Ampere's law, Faraday's law of induction, Lenz's law. Inductance. Alternating current circuits—RC, LR, single-loop LRC circuits, impedance, resonance, power in AC circuits. displacement current, Maxwell's equations (MKS units), electromagnetic waves, energy, transport and Poynting vector.

#### 5. Atomic and Nuclear Physics :

Photoelectric effect, Einstein's photon theory. Bohr's theory of hydrogen atom. Stern-Gerlach experiment, quantisation of angular momentum, electron spin. Pauli exclusion principle and applications. Zeeman effect. X-ray spectrum, Bragg's law, Bohr's theory of the Mosley plot. Compton effect, Compton wave length. Wave nature of matter, de Broglie wavelength, wave-particle duality. Heisenberg's uncertainty relationships. Schrodinger's equation—eigenvalues and eigenfunctions of (i) particle in a box, (ii) simple harmonic oscillator and (iii) hydrogen atom. Potential step and barrier penetration. Natural and artificial radioactivity. Binding energy of *nuclei*, nuclear fission and fusion. Classification of elementary particles and their interactions.

#### 6. Electronics :

Diodes in half-wave and full-wave rectification, qualitative ideas of semiconductors, p type and n type semiconductors, junction diode, Zener diode, transistors, binary numbers, Logic gates and truth tables, Elements of microprocessors and computers.