Mechanics and General Properties of Matter: Newton's laws of motion and applications, Velocity and acceleration in Cartesian, polar and cylindrical coordinate systems, centrifugal and Coriolis forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. Center of mass (CM), the equation of motion of the CM, conservation of linear and angular momentum. Elastic and inelastic collisions. Rigid body motion, fixed axis rotations, rotation and translation, moments of Inertia and products of Inertia, parallel and perpendicular axes theorem.

Kinetic theory and Thermodynamics: Elements of Kinetic theory of gases. Velocity distribution and Equipartition of energy. Specific heat of Mono-, di- and tri-atomic gases. Ideal gas, van-der-Waals gas and equation of state. Mean free path. Laws of thermodynamics. Zeroth law and the concept of thermal equilibrium. First law and its consequences. Isothermal and adiabatic processes. Reversible, irreversible and quasi-static processes. Second law and entropy. Carnot cycle.Maxwell's thermodynamic relations and simple applications. Thermodynamic potentials and their applications. Phase transitions and Clausius-Clapeyron equation.

Oscillations, Waves, and Optics: Differential equation for the simple harmonic oscillator and its general solution, Superposition of two or more simple harmonic oscillators; Lissajous figures; Damped and forced oscillators, resonance; Wave equation, travelling and standing waves in one dimension. Group velocity and phase velocity, Sound waves in media. Doppler Effect; Fermat's Principle; Interference of light, optical path retardation; Fresnel's biprism, Interference in thin film, Newton's rings, Michelson Interferometer. Fraunhofer diffraction, Rayleigh criterion and resolving power. Diffraction Gratings. Polarization: linear, circular and elliptic polarization. Double refraction and optical rotation.

Electricity and Magnetism: Coulomb's law, Gauss's law, Electric field and potential. Electrostatic boundary conditions, Solution of Laplace's equation for simple cases, Conductors, capacitors, dielectrics, dielectric polarization, volume and surface charges, electrostatic energy; Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction, Self and mutual inductance; Alternating currents, Simple DC and AC circuits with R, L and C components; Lorentz Force and motion of charged particles in electric and magnetic fields.

Modern Physics: Inertial frames and Galilean invariance, Postulates of special relativity. Lorentz transformations, Length contraction, time dilation, Relativistic velocity addition theorem, mass-energy equivalence; Blackbody radiation, photoelectric effect, Compton effect, Bohr's atomic model, X-rays; Wave-particle duality, Uncertainty principle, the superposition principle, calculation of expectation values, Schrödinger equation and its solution for one, two and three-dimensional boxes, A solution of Schrödinger equation for the one-dimensional harmonic oscillator, Reflection and transmission at a step potential, Pauli exclusion principle.

Solid State Physics, Devices and Electronics: Crystal structure, Bravais lattices, and basis, Miller indices, X-ray diffraction and Bragg's law; Intrinsic and extrinsic semiconductors, a variation of resistivity with temperature. Fermi level, p-n junction diode, I-V characteristics, Zener diode, Half wave and full wave rectification, Voltage stabilization, BJT: characteristics in CB, CE, CC modes.