Faculty of Science

M.Sc. (Physics)

Mechanics *: Concept of inertial and non-inertial frames of reference, fictitious forces, conservative and non-conservative forces. System of particles: Centre of mass for a system of particles, motion of the centre of mass, Expressions for kinetic energy, linear momentum and angular momentum for a system of particles in terms of centre of mass values. Central forces and the law of conservation of angular momentum.*
Rotational Motion:Transformation equations for a frame of reference rotating with respect to an inertial frame of reference, Coriolis force. Rotation of a rigid body: Energy and moment of inertia and moment of inertia as a tensor, principal axes, angular momentum and kinetic energy of rotation with respect to principal axis, moment of inertia for a spherical shell and solid sphere, rolling bodies. Central force, Kepler's laws.

Special Relativity: Postulates of special theory of relativity, Lorentz transformations, velocity addition, length contraction and time dilation, variation of mass with velocity, relativistic form of Newton's second law, equivalence of mass and energy, relativistic transformations of momentum and energy.

Electricity and Magnetism : Gauss's law, Dielectrics, polarization of dielectrics, Poisson and Laplace's equations in dielectric, polarizability, Clausius-Mossotti relation. Capacitors. Continuity equation, transient currents, growth and decay of d.c. in LCR circuits, Thevenin's theorem, superposition theorem and maximum power transfer theorem. Alternating currents: LCR circuit, series resonance, sharpness of resonance and Q-factor, power in AC circuits.

Optics:Fermat's principle and its applications. Chromatic and spherical aberrations, removal. Coma, astigmatism, curvature of the field, distortion.Interference of light waves, coherence. Fresnel's biprism. Newton's rings. Michelson's interferometer. Polarization of light waves. Production of polarized light. Brewster's law, Malus' law. Double refraction. Quarter and half wave plates. Analysis of polarized light.

Fraunhofer diffraction: Fraunhofer diffraction at two and N slits, diffraction grating, grating spectrum, Rayleigh criterion of resolution, resolving power of grating.

Electronics : BJT Amplifier;α, β and their relation, hybrid parameters. Characteristics of their simple circuits, load line, Q-point and its change due to temperature variation. BJT biasing: fixed biasing, self-bias, stability factor. RC coupled amplifier, its frequency response characteristics. Feedback in amplifiers, advantages of negative feedback amplifier. Positive feedback and Barkhausen criterion for oscillations, circuit diagrams and working for RC phase-shift, Wein's bridge oscillators. RC differentiator and integrator.

Mathematical Method :Cauchy's integral theorem, Cauchy's integral formula, Taylor and Laurent series, Cauchy's residue theorem, Gradient, divergence and curl. Gauss's theorem, Green's theorem, Stoke's theorem.

Legendre function: The polynomial solution of the Legendre equation, the Legendre function of the second kind, the generating function, upper bound for $|P_n(x)|$, Rodrigues' formula, orthogonality relation. Associated Legendre functions and its orthogonality property. Laguerre functions.

Quantum Mechanics :The basic postulates of quantum mechanics, properties, physical significance and Born interpretation of wave functions in quantum mechanics, probability density. Operator algebra in quantum mechanics.Ehrenfest theorem, Heisenberg's uncertainty principle and its simple applications .Time dependent and independent Schrodinger equations. Stationary states, continuity equation.One dimensional problem: Free particle, particle in a box, potential step, potential barrier (tunneling). Particle in One dimensional infinite square well, Finite Square well, linear harmonic oscillator.Schrodinger equation for two particles and its reduction in terms of central of mass and relative motion. Schrodinger equation in spherical coordinates with central potential. The free particle in spherical coordinates. Orbital angular momentum operators and their communication relations, Eigen values and eigen functions of L^2 and L_z.

Thermal Physics :First law of thermodynamics, heat capacities, internal energy, Carnot cycle, efficiency of reversible heat engine and refrigerator; second law of thermodynamics, entropy, entropy changes in reversible and irreversible processes, entropy of an ideal gas, Gibb's paradox.e TdS equations, energy equations, expressions for the difference and the ratio of heat capacities, enthalpy, Helmholtz and Gibb's functions, Maxwell's equations.Third law of thermodynamics.

Atomic and Molecular Physics :One valence electron atom: Electronic configuration and atomic states, spin-orbit interaction , fine structure, intensity rules for structure doublets, selection rules. Two valence electron atoms: LS and jj coupling scheme, terms and levels. Hund's rules. Zeeman effect.
Diatomic molecule as rigid and non-rigid rotator, rotational spectrum. The vibrating diatomic molecule: harmonic and anharmonic oscillator models, vibrating-rotator and its spectrum. Raman and Electronic spectra of diatomic molecules.

Laser Physics: Basic principle, Properties of laser beam. Einstein's A and B coefficients, spontaneous and stimulated emissions, population inversion, resonator. Principle and working of He-Ne laser.

Solid State Physics: Crystalline and amorphous structure: Lattice, basis, primitive cell, unit cell, Wigner-Seitz cell, Bravais Lattices, common crystal structures, index system for directions and planes. Atomic cohesion and crystal binding, concept of reciprocal lattice, Bragg law, Brillouin zones. Lattice vibrations: Normal modes of a one-dimensional monatomic chain, the periodic boundary condition, dispersion curve, salient features, normal modes of a diatomic chain, acoustical and optical modes, dispersion curves.

Nuclear Physics: General properties of the atomic nuclei: Constituents of the nucleus. Size of the nucleus. Nuclear charge. Nuclear mass, mass defect and binding energy, variation of binding energy with atomic mass, elementary idea of nuclear fission and fusion.

Nuclear angular momentum, Nuclear magnetic dipole moment, nuclear electric quadrupole moment. Nature of nuclear forces: short range, saturation, charge independence, charge symmetry, state dependence, tensor nature. alpha, beta and gamma-decays. Energy loss of heavy charged particles, semi-empirical formula for energy loss, Interaction of gamma radiation with matter: photoelectric effect, Compton effect and pair production.

Particle Physics

Basic interactions and their mediating quanta, classification of particles; Fermions and Bosons, leptons and hadrons, particles and antiparticles, conservation rules in fundamental interactions.