Syllabus for M.Sc. Physics and I-Ph.D. Physics Entrance Examination, IIT Mandi

Mathematical Methods: Vector algebra, Vector Calculus, Multiple integrals, Calculus of single and multiple variables, partial derivatives, Taylor expansion.First order differential equations and linear second order differential equations with constant coefficients. Matrices and determinants, Algebra of complex numbers.

Mechanics : Newton's laws of motion and applications, centrifugal forces, Motion under a central force, Kepler's laws, Gravitational Law and field, Conservative and non-conservative forces. Conservation of linear and angular momentum, conservation of energy, variable mass systems. Elastic and inelastic collisions. Rigid body motion, moments of Inertia. Principal moments and axes.

Oscillations, Waves and Optics: Differential equation for simple harmonic oscillator and its general solutionpropeties. Damped and forced oscillators, resonance. Energy density and energy transmission in waves. Group velocity and phase velocity. Sound waves in media. Fermat's Principle.Interference of light. Fraunhofer diffraction. Rayleigh criterion and resolving power. Diffraction gratings. Polarization: linear, circular and elliptic polarization.

Electricity and Magnetism: Coulomb's law, Gauss's law. Electric field and potential. Electrostatic boundary conditions. Biot-Savart law, Ampere's law, Faraday's law of electromagnetic induction. Alternating currents. Simple DC and AC circuits with R, L and C components. Maxwell's equations, Lorentz Force and motion of charged particles in electric and magnetic fields.

Thermodynamics: Velocity distribution and Equipartition of energy. Ideal gas, van-der-Waals gas and equation of state. Laws of thermodynamics. Carnot cycle. Maxwell's thermodynamic relations. Thermodynamic potentials and their applications.

Modern Physics:Inertial frames and Galilean invariance. Postulates of special relativity. Lorentz transformations. Length contraction, time dilation. Relativistic velocity addition theorem, mass energy equivalence. 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 onedimensional problems. Pauli exclusion principle. Radioactivity and its applications. Laws of radioactive decay.

Solid State Physics and Electronics*:* Crystal structure, Bravais lattices and basis. Miller indices. X-ray diffraction and Bragg's law; Intrinsic and extrinsic semiconductors, variation of resistivity with temperature. BJT: characteristics in CB, CE, CC modes. Single stage amplifier, two stage R-C coupled amplifiers. OPAMP and applications.