

Syllabus for Ph.D. Entrance Examinations to be held from 2022 onwards

Subject: Physics

Max. Marks: 100

Time: 3 Hours

(i) Research Aptitude Component (Section-I): 50 Marks

(ii) Academic Component (Section-II) : 50 Marks

1. **Mathematical physics:** complex variables; Cauchy-Riemann equations, complex integration, Cauchy theorem of residues, Laplace transformation of simple functions and derivatives, L. T of integrals, Fourier Series; determination of Fourier coefficients, Fourier transformation, Differential equations with variable coefficients, special functions.
2. **Quantum Physics:** Schrodinger equation and its application to one dimensional problem, postulates of quantum mechanics, concept of angular momentum and their commutation relations with dynamical variables, Pauli's spin matrices and their properties, time dependent and time independent perturbation theories, Elementary theory of scattering in a central potential, phase shift, partial wave analysis, Born approximation, Identical particles, semiclassical theory of radiation.
3. **Classical Mechanics:** Lagrange's equation for conservative and non conservative systems and its applications, Hamilton's principle, Hamilton's equations from variational principle, Application of Hamilton formulation, Generating functions, properties, examples, Lagrange and Poisson brackets and their relationship, Equation of motion in Poisson bracket notation.
4. **Statistical Physics:** Concept of Phase space, microstate and macrostate, Free energy and connection with thermodynamic quantities, ensemble, Liouville's theorem, Partition function, classical and quantum statistics, Bose-Einstein condensation, Fermi-Dirac gas, Degenerate electron gas, Black body radiation and Planck's distribution law, Einstein and Debye models for lattice specific heat.
5. **Electrodynamics:** Maxwell's equations, wave equation for vector and scalar potential, Retarded potentials, Lienard-Wiechert potentials, Motion of charged particles in electromagnetic field, Radiation from moving charges, Bremsstrahlung, Cerenkov radiation.
6. **Condensed Matter Physics:** Crystal physics and basic crystallography, Reciprocal lattice and experimental X-ray diffraction techniques, Defects in crystals, Electronic and dielectric properties of solids, Ferroelectric phenomenon, Magnetic properties of solids, superconductivity.
7. **Nuclear and Particle Physics:** Properties of nuclei and nuclear forces, Spin and Magnetic moments of nucleus, Parity, angular momentum, quadrupole moments, nuclear interactions, Two body problem, Nuclear reactions, nuclear models, nuclear decay, Elementary particles.
8. **Electronics:** Operational amplifiers, Differential amplifier, inverting and non inverting inputs, CMRR, Applications of operational amplifiers, Combinational logic; Logic gates, Boolean algebra, Karnaugh maps, Demorgan theorems, Sequential logic; Flip-Flops, Counters, Registers, A/D and D/A converters, Introduction to communication electronics and microprocessor.