KRISTU JAYANTI
(DEEMED TO BE UNIVERSITY)
Under Section 3 of UGC Act 1956
A CMI INSTITUTION | BENGALURU | INDIA

Centre for Research and Development

Office of Doctoral Studies

Syllabus for the Part B of

Kristu Jayanti University Entrance Test (KJUET)

Ph. D. Programme in Physics

Unit I: Mathematical Physics

Vector calculus; Fourier series and Fourier transform; Laplace transform; complex analysis; special functions – Legendre, Bessel, Hermite and Laguerre polynomials; linear algebra including matrices, eigenvalues and eigenvectors; ordinary and partial differential equations; Green's functions; probability and statistics; numerical methods and error analysis.

Unit II: Quantum Mechanics and Electromagnetic Theory

Postulates of quantum mechanics; Schrödinger equation (time-dependent and independent); exactly solvable systems – particle in a box, harmonic oscillator, hydrogen atom; angular momentum, spin and addition of angular momenta; approximation methods – WKB, variational principle, time-independent perturbation theory; scattering theory – Born approximation and partial wave analysis; identical particles and Pauli exclusion principle; basics of relativistic quantum mechanics and Dirac equation. Electrostatics and magnetostatics; Poisson and Laplace equations; multipole expansion; Maxwell's equations in free space and in matter; electromagnetic waves in vacuum, conductors and dielectrics; reflection, refraction, polarization and dispersion; waveguides and transmission lines; radiation from moving charges. Special relativity – Lorentz transformations and energy–momentum relations.

Unit III: Atomic, Molecular, Nuclear & Particle Physics

Atomic spectra of hydrogenic systems; fine structure and hyperfine structure; Zeeman and Stark effects; LS and jj coupling; selection rules. Molecular spectra – rotational, vibrational and electronic transitions; Raman effect. Nuclear properties; binding energy and semi-empirical mass formula; radioactive decays (α, β, γ); nuclear reactions and cross-sections; nuclear models – liquid drop and shell models. Particle physics – fundamental interactions, conservation laws, classification of particles, symmetries and quark model.

Unit IV: Lasers and Condensed Matter Physics

Principles of lasers – spontaneous and stimulated emission, population inversion, Einstein coefficients, optical resonators; types of lasers – gas, solid state, dye, semiconductor; applications in spectroscopy, communication and material processing.

Condensed matter physics – crystal structures and X-ray diffraction; lattice vibrations and phonons; thermal properties of solids; free electron and band theory; semiconductors; magnetic properties – dia-, para-, ferro-magnetism; superconductivity – Meissner effect and BCS theory; nanomaterials and applications.

Unit V: Electronics and Astrophysics

Semiconductor devices – diodes, transistors, field-effect devices, operational amplifiers; digital electronics – logic gates, flip-flops, counters, microprocessor basics; signal processing and data acquisition; detectors and particle accelerators. Astrophysics – stellar structure and evolution; nucleosynthesis; Chandrasekhar limit; white dwarfs, neutron stars and black holes; Hubble's law and expanding universe; cosmic microwave background radiation; basics of dark matter and dark energy.