

Siddharth University,
Kapilvastu, Siddharthnagar

Department of Physics

Pre-Ph.D. Course Work

Syllabus

2024

Paper III

General Physics –I

Code: DPH103

[credit: 03]

Unit I

Mathematical Physics: Vector calculus, Linear ordinary differential equations of first & second order, special functions and applications (Hermite, Bessel, Laguerre and Legendre functions), Fourier series, Fourier and Laplace transforms, elements of complex analysis, analytic functions.

Solutions of differential equations using numerical techniques like Runge-Kutta method and other predictor-corrector methods Fourier series, Fourier and Laplace transforms

Unit II

Classical Mechanics: Central force motion, Rigid body dynamics, Lagrangian and Hamiltonian formalism and equations of motion, phase space dynamics, Generalized coordinates, Conservation laws and cyclic coordinates, Principle of least action.

Moment of inertia tensor, Non-inertial frames and pseudo forces, small oscillations, normal modes, variational principle, generalized coordinates,

Unit III

Quantum Mechanics: Wave-particle duality, Schrödinger equation, Eigenvalue problems - potential well, potential barrier, Symmetric and antisymmetric wave functions, Slater's determinant wave functions Schrodinger equation (time-dependent and time-independent), Hydrogen atom, Eigen value problems (particle in a box, harmonic oscillator in 3D etc.), Tunneling through a barrier, Time independent perturbation theory and applications, WKB approximation.

References

1. Mathematical Methods for Physicist by Arfken and Weber, Academic Press
2. Finite dimensional Vector Spaces by P. Halmos, Springer
3. Mathematics of Classical and Quantum Physics by F. W. Byron and R.W. Fuller, Dover Publications
4. Classical Mechanics by H. Goldstein, Pearson
5. Classical Mechanics by B.P. Cowan, Springer
6. Quantum Mechanics: Concepts and Applications by Nouredine Zettili, Wiley
7. Introduction to Quantum Mechanics by David J. Griffiths, Cambridge University Press

Paper IV

General Physics –II

Code: DPH104

[credit: 03]

Unit I

Statistical & Laser Physics: Phase space, micro and macro states, micro-canonical, canonical and grand-canonical ensembles and partition functions, thermo-dynamical functions, classical and quantum statistics, ideal Bose and Fermi gases, Bose-Einstein condensation.

Basic principles of laser operation, Stimulated emission, population inversion, Laser cavity design and components, pumping mechanisms like electrical, chemical and optical, Different types of lasers invented till now.

Unit II

Condensed matter physics & Nano Science: Periodic array of atoms, fundamental types of lattices and Bravais lattice; Reciprocal lattice, Construction of reciprocal lattices, Reciprocal lattice of SC, BCC, FCC, Concept of Brillouin zone, Dielectric properties of materials, Superconductivity. Background to Nanotechnology, Types of Nanomaterials and their properties, Applications of Nanomaterials.

Unit III

Spectroscopy and Computational Approximations: Rotational, vibrational and electronic spectroscopy, Raman spectra of diatomic molecules. Self-consistent field (SCF) theory, Hartree-Fock theory, Density functional theory (DFT): Hohenberg-Kohn's Theorem, Kohn-Sham equations, Electron correlation, local density approximation, generalized gradient approximation, hybrid density functional.

References:

1. Statistical Mechanics by R.K. Pathria, Elsevier
2. Statistical Mechanics by Kerson Huang, Wiley
3. Condensed Matter Physics by M.P. Marder, Wiley
4. Condensed Matter Physics by A. Isihara, Dover books
5. Solid State Physics by Charls Kittel, Wiley India
6. Nanostructures and Nanomaterials: Synthesis, properties and applications- G.Cao, Imperial College Press, 2004.
7. Atomic and Molecular Physics by H. E. White, East-West Press
8. Molecular Spectra and Molecular Structure, G. Herzberg, D. Van Nostrand and Co. Inc.
9. Atomic and Molecular Spectroscopy: Basic Concepts and applications by Rita Kakkar, Cambridge University Press
10. Fundamental of Molecular Spectroscopy by Colin N. Banwell, McGraw-Hill Education
11. Quantum Chemistry, Seventh Edition By Ira N. Levine, Pearson