

Core theory course (Disciplinary)

CPH-401: MATHEMATICAL PHYSICS -I AND QUANTUM MECHANICS - I

UNIT - I

Function of a Complex Variable :

Introduction, Analytic functions, Contour Integrals, Laurent series, Residue Theorem, Methods of Finding Residues, Evaluation of Definite Integrals by use of the Residue theorem, The point of Infinity, residue of infinity, Mapping, Some Applications of conformal mapping.

Basic reference:

Mathematical Methods in Physical Sciences by M. L. Boas 2nd edition, Jhon / Wiley & Sons.

UNIT - II

Integral Transforms:

Introduction, Laplace Transforms, Solution of Differential Equation by Laplace Transforms, Fourier Transforms, Convolution: Parseval's Theorem, Inverse Laplace Transform (Bromwich Integral), the Dirac delta function, Green functions, Integral transform solutions of partial differential equations.

Basic reference :

Mathematical Methods in Physical Sciences by M. L. Boas 2nd edition, Jhon / Wiley & Sons.

UNIT - III

(a) Some exactly soluble Three-dimensional problem in quantum mechanics :

Anisotropic oscillator, The isotropic oscillator, Normal modes of a coupled system of particles.

(b) Approximation methods for stationary states:

Perturbation theory for Discrete level, Equation in various orders of perturbation, theory, Non degenerate case, The degenerate case - removal of degeneracy, The effect of electric field on energy level of an atom (Stark effect), Two electron atoms. The variation method; Upper bound on ground state energy, Applications to excited state, Trial function Linear in variational parameters, Hydrogen molecule, Exchange interaction .

Basic reference :

A textbook of Quantum mechanics by P. M. Mathews and K. Venkatesan 1976 TMH New Delhi.

UNIT - IV

(a)WKB Approximation:

The one dimensional Schrödinger equation (inclusive all cases & discussion relevant to perturbation theory/WKB method, The Bohr-Sommerfeld quantum condition, The WKB solution of radial wave equation.

(b) Evolution with Time:

Exact Formal Solutions :The Schrödinger equation: General Solution, Propagators, Alteration of Hamiltonian: Transitions; Sudden Approximation.

Perturbation theory for Time Evolution Problems: Perturbative Solution for Transition Amplitude, Selection rules, First Order Transitions: Constant Perturbation, Transitions in the Second Order: Constant Perturbation.

Basic reference :

A textbook of Quantum mechanics by P. M. Mathews and K. Venkatesan 1976 TMH New Delhi.

Other references :

- (1) Mathematical Methods for Physicist by G. B. Arfken & H. J. Weber 5th Edition 2001 Harcot (India Pvt.Ltd.)
- (2) Mathematical physics by P.K.Chattopahyay, 1990 New age international (P) - Ltd, New Delhi. Chapter 8 (Reprint 2001)
- (3) Mathematical Physics by H. K. Dass.
- (4) Mathematical Physics by Styaprakash, S.Chand.
- (5) Quantum Mechanics by L. I. Schiff, McGraw-Hill International student edition (1961).
- (6) Quantum Mechanics Vol I & II A. Messiah, Jhon Wiley & Sons, INC (1968)
- (7) Introduction to Quantum Mechanics by Powell and Crasemann Addison-Wesley (1961).
- (8) Quantum Mechanics by V.K. Thankappan, Wiely eastern Ltd.
- (9) Quantum Mechanics : Theory and applications by A. Ghatak and S. Lokanathan.