MANGALORE UNIVERSITY

Department of Physics

MSc Physics

PHH 402: QUANTUM MECHANICS I

[52 hrs.]

Course outcome

CO1 A basic understanding of the general formulations of quantum mechanics.

CO2 Able to apply Matrix formalism of quantum mechanics.

CO3 Students have proficient in the theory of angular momentum.

CO4 Will be able to solve one dimensional problem in quantum mechanics.

CO5 Will be able to solve three dimensional problems in quantum mechanics.

Unit I General formulation of quantum mechanics

Schrodinger wave equation - review of concepts of wave particle duality, matter waves, wave packet and uncertainty principle. Schrodinger's equation for free particle in one and three dimensions - equation subject to forces. Probability interpretation of the wave function, probability current density - normalisation of the wave function, box normalisation, expectation values and Ehrenfest's theorem.

[13 hrs]

Unit II Fundamental postulates of QM

Representation of states, dynamical variables - Adjoint of an operator. Eigen value problem - degeneracy. Eigenvalues and eigenfunctions. The Dirac-delta function. Completeness and normalisation of eigen functions. Closure. Physical interpretation of eigen values, eigen functions and expansion coefficients. Momentum eigen functions. [13 hrs]

Unit III Stationary states and eigen value problems

The time independent Schrodinger equation - particle in square well - bound states - normalised states. Potential step and rectangular potential barrier - reflection and transmission coefficients - tunnelling of particles.

Simple harmonic oscillator - Schrodinger equation and energy eigen values - Energy eigen functions. Properties of stationary states. [13 hrs]

Unit IV Angular momentum, parity and scattering

Angular momentum operators, eigen value equation for L^2 and L_z - Separation of variables. Admissibility conditions on solutions - eigen values, eigen functions. Physical interpretation. Concept of parity. Rigid rotator. Particle in a central potential - radial equation.

Three-dimensional square well. The hydrogen atom - solution of the radial equation - energy levels. Stationary state wave functions - bound states. Theory of scattering - the scattering experiment, differential and total cross-section, scattering amplitude, method of partial waves, scattering by a square well potential. [13 hrs]

Text Books:

1.Powell and Crassman, 'Quantum Mechanics'(Addison Wesley, 1961)
2. Mathews P M and Venkatesan K, 'A Text Book of Quantum Mechanics' (Tata McGraw Hill, 1977)
3. Ghatak A K and Lokanathan S, 'Quantum Mechanics', III Edn. (McMillan India, 1985)
4. Sakurai J J, 'Modern Quantum Mechanics', Revised Edn. (Addison Wesley, 1994)

Reference Books:

1. Cohen Tannoudji C, Diu B and Laloe, 'Quantum Mechanics', Vol. I (John Wiley, 1977)
2. Schiff L I, 'Quantum Mechanics', III Edn. (McGraw Hill, 1968)
3. Shankar R, 'Principles of Quantum Mechanics' (Plenum, 1980)
4. French A P and Taylor E F, `An introduction to Quantum Physics' (W W Norton, 1978)
5. Gasirowicz, 'Quantum Physics' (Wiley, 1974)
6. Wichmann E H, 'Quantum Physics' (McGraw Hill, 1971)