

M.Sc Physics Semester I Paper III
Quantum Mechanics –I22PHY21C3

Theory Marks:80

Internal Assessment Marks:20

Time: 3 Hours

COURSE OUTCOMES

CO1 Student would be able to understand the concepts of operators in Quantum mechanics.

CO2 Students would be able to apply Pauli spin matrices to explain angular momentum.

CO3 Students would be capable to solve problems such as hydrogen atom.

CO4 Students can determine energies and wave functions of first and second order.

Unit I

General formalism of Quantum Mechanics: States and operators; Representation of States and dynamical variables; Linear vector space; Bra Ket notation, Linear operators; Orthonormal set of vectors, Completeness relation; Hermitian operators, their eigenvalues and eigenvectors, The fundamental commutation relation; Commutation rule and the uncertainty relation; Simultaneous eigenstates of commuting operators; The unitary transformation; Dirac delta function; Relation between kets and wave functions; Matrix representation of operators; Solution of linear harmonic oscillator problem by operator methods

Unit II

Angular momentum operator: Angular momentum operators and their representation in spherical polar co-ordinates; Eigenvalues and eigenvectors of L^2 , spherical harmonics; Commutation relations among L_x L_y L_z ; Rotational symmetry and conservation of angular momentum; Eigenvalues of J^2 and J_z and their matrix representation; Pauli spin matrices; Addition of angular momentum

Unit III

Solution of Schrodinger equation for three dimensional problems: The three-dimensional harmonic oscillator in both cartesian and spherical polar coordinates, eigenvalues, eigenfunctions and the degeneracy of the states; Solution of the hydrogen atom problem, the eigenvalues, eigenfunctions and the degeneracy

Unit IV

Perturbation Theory : Time independent perturbation theory; Non degenerate case, the energies and wave functions in first order the energy in second order; Anharmonic perturbations of the form λx^3 and λx^4 ; Degenerate perturbation theory; Stark effect of the first excited state of hydrogen.

Note:The syllabus is divided into four units. Nine questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit. A student has to attempt five questions in all.

Text and Reference Books:

- [1] Quantum Mechanics by Ghatak and Loknathan
- [2] Quantum Mechanics by Powell and Craseman
- [3] Quantum Mechanics by S. Gasiorowicz
- [4] Quantum Mechanics by A.P.Messiah
- [5] Modern Quantum Mechanics by J.J.Sakurai
- [6] Quantum Mechanics by L.I.Schiff
- [7] Quantum Mechanics by Mathews and Venkatesan