SEMESTER-VI
BPC-61

(ELEMENTARY QUANTUM MECHANICS)

FULL MARKS: 50 (40 + 10) CP: 4 LECTURES: 50

1.Role of experiment and theory in Physics. Quantum mechanics as paradigm shift from Classical Mechanics: determinism-equation of motion to probability density-expectation-uncertainty. (1)

2.**Failure of classical physics:** black body radiation, photo-electric effect; Planck's quantum hypothesis; Einstein's photo-electric equation; Bohr's atomic model and quantization of angular momentum and atomic spectra; Franck and Hertz's experiment; Stern and Gerlach's experiment; de Broglie's hypothesis, Davisson and Germer's experiment; Young's double slit experiment in the light of quantum hypothesis, wave-particle duality and complementarity. (8)

3.**Wave-function:** interpretation of wave function; Schrodinger Equation – time dependent and time independent forms; conditions to be satisfied by wave functions; observables, expectation value, operator representation, and measurements; stationary states; Ehrenfest's theorem; superposition of states and dynamism. (8)

4.**Wave functions and energies in one dimension with idea of barrier penetration:** infinite square well potential, delta function potential, finite square well potential, step function potential, free particle (illustrating uncertainty principle). (12)

5.**Formalism:** Operators, eigenvalues and eigenfunctions; linear operators, product of two operators, commutation relations, simultaneous eigenfunctions, orthogonal functions; Dirac notation, dual space, inner and outer products of wave functions, projection and identity operators; Hermitian adjoint of an operator, Hermitian operators, their eigenvalues, expectation values; generalized uncertainty principle. (5)

6.**Harmonic oscillator problem:** algebraic and analytic solutions and their correspondence; ground and excited states, zero point energy; comparison with classical oscillator. (4)

7.**Schrodinger equation in three dimensions:** Cartesian coordinates, particle in a rectangular box, degeneracy; spherical coordinates, angular and radial equations, spherical harmonics; hydrogen atom problem; Orbital angular momentum, Cartesian components, raising and lowering operators, commutation relations, eigenvalues; electron spin, explanation of observations from Stern and Gerlach's experiment, Pauli matrices. (12)

Recommended References:

1. Quantum Mechanics, D. Griffiths
2.Quantum Mechanics, Gasiorowich
3.Quantum Mechanics, Mathews & Venkatasnan
4.Quantum Mechanics, Ghatak & Loknathan