Course 3: Quantum Mechanics
Course code: MSCPH503 **Credit: 3**

BLOCK – I PRINCIPLES OF QUANTUM MECHANICS

Unit –1 : **Origin of quantum mechanics**: Inadequacy of classical mechanics, classical laws (black body radiation, Rayleigh Jean's law, Planks hypothesis, photoelectric effect, Einstein theory for photoelectric effect, Compton effect, Classical theories of heat capacity of solids, Einstein theory of heat capacity of solids, Debye theory heat capacity of solids, Bohr's theory of H atom, Wilson- Sommerfeld quantisation rule, limitations of classical theories and origin of quantum mechanics.

Unit –2 : **Basics of quantum mechanics**: Dual nature of matter and wave, de Broglie wave, experimental evidence of matter wave, phase and group velocity, Schrodinger wave equation, Time dependent and independent, wave function, Physical significance wave function, normalised wave function, solution of Schrodinger wave equation, expectation values, Probability current density, Ehrenfest's theorem, Uncertainty principle.

Unit –3 : **Application of Schrodinger's equation** : Application of Schrodinger's equation to three dimensional problems, square well potential, potential step, potential barrier, tunneling, α decay, Particle in a box, linear harmonic oscillator, spherically symmetric potentials in hydrogen atom.

BLOCK – II

Unit –4: **Operators and Eigen function** : Dynamical behaviour, Eigen values and eigen functions, eigen vectors, orthogonality of Eigen function, Hermitian operator, unitary operator, projection operator, commutating operator.

Unit –5 : **Matrix formulation of quantum Mechanics:** Vector space, Characteristic equation of a matrix, eigen value and eigen vectors of matrix, hermitian matrix, unitary matrix, State vectors and operators in Hilbert space, Matrix form of operator, Schrodinger, Heisenberg and nitration matrix representations, Dirac's bra and ket vectors.

Unit –6 : **Identical Particles and Spin angular momentum**: identical particles, symmetric and anti-symmetric wave functions, distinguishability of identical particles, Pauli exclusion principle, connection with statistical mechanics, Spin angular momentum, spin matrix, Stern Gerlach experiment, Pauli spin matrices.

Unit –7: **Orbital angular momentum**: Orbital angular momentum operator, total angular momentum, eigen values and eigen functions of angular momentum, Addition angular momenta, Clabsch-Gorden coefficients.

BLOCK – III

Unit –8: **Approximation Methods:** Time independent perturbation theory, first order perturbation, second order perturbation, perturbation of harmonic oscillator, Degeneracy, Zeeman effect, First order Stark effect in H atom, Variation method, WKB approximation, Fermi Golden rule.

Unit –9: **Elementary theory of scattering:** Classical theory of scattering, cross section, scattering amplitude, quantum theory of scattering, Born approximation, partial wave, Phase shift.

Reference Books:

1. P.M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, Tata McGraw-Hill, New Delhi.
2. L.I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill.
3. V. Devanathan, Quantum Mechanics, Narosa Publishing House, New Delhi.
4. Satya Prakash, Advanced Quantum mechanics
5. B S Rajput, Advanced Quantum mechanics
6. Thankappan, Quantum mechanics