PPH103: QUANTUM MECHANICS

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Course Objectives: To give exposure about the various tools employed to analyze the quantum mechanical problems.

Introduction to Quantum Mechanics: Experimental background and inadequacy of classical Physics, Complimentary principle**.**

Schrödinger Wave Equation: Development of wave equation, Schrödinger's time dependent and independent wave equation, Interpretation and normalization of wave function, Probability current density, Expectation value and Ehrenfest theorem. Wave packet.

Solution of Schrödinger Equation: Constant potential in one dimension: Potential Step, Rectangular Potential Barrier and tunneling, Linear Harmonic Oscillator, Rigid Rotator and Hydrogen atom.

Angular Momentum in Quantum Mechanics: General solution to the Eigen value problem of angular momentum J and the angular momentum matrices, Eigenvectors for spin ½ particles, Addition of two angular momenta, Clebsch-Gordan coefficient, System of identical particles, Indistinguishability principle, Symmetry of wave functions, Spin statistics.

Perturbation Theory: Time independent perturbation theory: (1) Non degenerate case: First order perturbation, Second order perturbation, Perturbation of an oscillator. (2) Degenerate case: Removal of degeneracy in second order, Zeeman effect without electron spin, First order Stark effect in Hydrogen.
Time dependent perturbation theory: The equation of motion in interaction picture, Transition probability and Fermi-Golden Rule, Selection Rules.

WKB Approximation: Method, the connection Formula, Tunneling through a barrier**.**

Introduction to Theory of Scattering: Total and Differential Scattering cross section, Partial wave and Phase shift, Optical Theorem, Born approximation and scattering by one dimensional Potential barrier, and Coulomb Field.

Course Learning Outcomes (CLO):
Students will have understanding of:

1. importance of quantum mechanics compared to classical mechanics at microscopic level.
2. various tools to calculate Eigen values and total angular momentum of particles.
3. application of approximation methods and scattering theories.

Recommended Books:

1. *Schiff, L.I., Quantum Mechanics, McGraw Hill (2008).*
2. *Ghatak, A. and Loknathan, S., Quantum Mechanics, MacMillan (2004).*
3. *Thankapan, V.K., Quantum Mechanics, New Age International (2004).*
4. *Sakurai, J.J., Advanced Quantum Mechanics, Pearson Education (2007).*