

TCIS, Hyderabad

Course: Quantum Mechanics-I

Start Date: August 2023

Coordinates: Tuesday and Thursday between 8:30 am to 10.00 am, Classroom-4, First-floor

Instructor: Dr. Raghunathan Ramakrishnan (ramakrishnan@tifrh.res.in)

Syllabus:

- 1) Foundation topics:** Linear vector spaces; Linear operators; Transformations; The eigenvalue problem; Recapitulation of results from classical mechanics: Lagrangian and Hamiltonian formalism; Wave-particle duality; Double-slit experiment; Matter waves; Postulates of quantum mechanics; The Schrodinger equation; Heisenberg's uncertainty relation; Minimum uncertainty state (Gaussian wavepacket); Energy-time uncertainty; Classical limit of quantum mechanical results (Chapters: 1, 2, 3, 4, 6, 9)
- 2) Simple problems:** One-dimensional problems: free-particle, wavepackets, infinite-square-well, step-potential, barriers, finite-wells, Kronig-Penney model; Continuity equation; Harmonic oscillator; Harmonic oscillator using ladder operators; Hydrogen atom; SO(4) symmetry for the degeneracy of hydrogen atom's spectrum (Chapters: 5, 7, 13)
- 3) Theory of angular momentum:** Rotations; Operators in curvilinear coordinates; Angular momentum in three dimensions; Rotational invariance; Addition of angular momentum; Irreducible tensors (Chapters: 12, 15)
- 4) Approximation methods:** Variational method, Time-independent perturbation theory; Degenerate perturbation theory; WKB method (Chapters: 16, 17)
- 5) Miscellaneous topics:** N -particles; Symmetries; Parity; Time-reversal; Spin; Spin-dynamics; Path-integrals: free-particle propagator; derivation of path integrals (Chapters: 8, 10, 11, 14, 21)

Required Text

1. *Principles of Quantum Mechanics*, R. Shankar (Edition-2, 1994, Springer).

Evaluation Method:

Assignment (6x5=30%), closed-book mid-term exam (30%), closed-book final exam (40%).