PHYSICS 481, QUANTUM MECHANICS I

1. Basic principles (superposition; states as vectors; operators as observables; measurement; Bell's inequality; quantum computing and information).

2. Quantum mechanics in one dimension: (a) Time independent Schrödinger equation, bound and scattering states, well, barrier, double barrier and resonance, Bloch's theorem, symmetries of S- and T-matrices, Lattice quantum mechanics. (b) Time dependent Schrödinger equation: Free particle, Feynman path integral for a particle in one dimension, scattering of wave-packets.

3. Harmonic Oscillator (wave functions; ladder-operators; path-integral treatment, coherent states, Bogolyubov transformations).

4. Angular momentum: As generator of rotation; algebraic analysis; addition of angular momentum.

5. Hydrogen atom: Coulomb problem, Pauli equation.

6. Symmetry in quantum mechanics: rotations, SU(3) and time-reversal, spontaneously broken symmetry.

7. Time independent perturbation theory, Van der Waals forces.

8. Electron in a magnetic field: Gauge invariance, Landau levels, Aharonov-Bohm effect, magnetic monopoles.

9. Scattering in three dimensions: Cross section, phase shift analysis, Born approximation, Lipmann-Schwinger equation, inelastic scattering.

10. Dirac Equation: Formulation, solution, relativistic invariance, applications.

Recommended Text: “Principles of Quantum Mechanics”, by R. Shankar (Plenum, 2nd edition).