P-205: Quantum Mechanics II

Syllabus:

1. *Revision of vector spaces and linear operators*: basis, eigenvalues and eigenstates, inner products, Cauchy-Schwarz inequality, orthonormal vectors, dual space, matrix representations of linear operators, Hermitian and unitary operators, change of basis; Hilbert space.

2. *Formal structure of Quantum Mechanics*: quantum theory of measurement, state vectors, operators, matrix mechanics, uncertainty relation, position and momentum representations, eigenvalues and eigenstates for harmonic oscillator: creation and annihilation operators, time evolution of states: Schrödinger and Heisenberg pictures.

3. *General treatment of angular momentum*: raising and lowering operators, spin, spin-statistics theorem, rotation group, coupling of angular momenta, Clebsch-Gordan coefficients, Wigner-Eckart theorem.

4. *Density matrices and quantum statistics*: identical particles, density matrix, canonical and other ensembles, properties of density matrix, polarization, quantum statistics, coherent and incoherent states.

5. *Time-dependent perturbation theory*: transition amplitudes, Fermi's golden rule, harmonic perturbations, sudden and adiabatic approximations, radioactive decay law.

6. *Scattering theory*: Born approximation, Born-Neumann series, scattering from a central potential, partial waves and phase shifts, scattering of two identical particles.

Special topics:

1. *Semiclassical treatment of radiation*: absorption and induced emission, spontaneous emission, selection rules.

Recommended textbooks:

1. J. J. Sakurai : Modern Quantum Mechanics (Addison Wesley)
2. L. I. Schiff : Quantum Mechanics (Mcgraw-Hill)
3. Cohen-Tannoudji : Quantum Mechanics (John Wiley and Sons)
4. E. Merzbacher : Quantum Mechanics (John Wiley and Sons)
5. K. Gottfried and T-M Yan: Quantum Mechanics : Fundamentals (Springer)