# Quantum Mechanics (Spring 2016)

## Syllabus:

- Revision of formalism: States, operators, measurement. Evolution in Schroedinger and Heisenberg picture. Density matrices, decohrence.

- Angular momentum: Raising and lowering operators, addition of angular momenta, Clebsch-Gordan coefficients. Effect of rotation on states and operators. Wigner-Eckart theorem, applications: selection rules, atomic transitions

- Approximation methods: Semiclassical (WKB) approximation, variational principle for ground state energy

- Time-independent perturbation theory: Problem definition, first and second order corrections, examples (anharmonic oscillator, quadratic Stark effect). Dealing with subtleties of degenerate energy levels, examples (linear Stark effect). Electron in an atom: fine and hyperfine splittings, Zeeman and Paschen-Back effects

- Time-dependent perturbation theory: Interaction picture, Dyson series, Fermi's golden rule, particle decay and Bright-Wigner shape. Harmonic perturbation: absorption and stimulated emission, interactions of atomic states with EM fields. Adiabatic vs. Sudden approximations

- Scattering: Lippman-Schwinger equation, scattering amplitude, differential scattering cross section, Born approximation. Spherically symmetric potentials: phase shifts and energy dependence, scattering length, low and high energy scattering limits. Forward scattering amplitude, optical theorem, resonant scattering.

*Additional topics depending on availability of time: Eikonal approximation, scattering of identical particles, time-dependent scattering, inelastic scattering, scattering on long-range potentials.*

## Reference books:

- *Main text: Modern Quantum Mechanics (Sakurai)*

- Quantum Mechanics: non-relativistic theory (Landau-Lifshitz)

- Quantum Mechanics (Schiff)