PHYS 7720 Quantum Mechanics 1 2016

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TEXTBOOKS:
There is no required textbook for this course. Course notes will be published online. However, you might want to consult some of the textbooks listed below:

1) J.J. Sakurai, *Modern Quantum Mechanics* (Addison-Wesley, 1994).
2) R. Shankar, *Principles of Quantum Mechanics* (Springer, 1994).
A book which does offer a lot of information about the mathematical framework of QM.
3) Albert Messiah, *Quantum Mechanics I+II* (North Holland Publishing).
A classic textbook, lots of examples, worth consulting. Recent single volume reprint available.

1. FOUNDATIONS OF QUANTUM MECHANICS:
   - Relation to other fields of physics, typical length and energy scales
   - Quantum nature of light (Photoelectric and Compton effect)
   - Wave description of particles, Wave-particle duality
   - Schroedinger equation, correspondence principle
   - Continuity equation, expectation values, commutators
   - Stationary states, eigenvalue problem

2. SIMPLE PROBLEMS (RECAP)
   - Particle in a limited region of space, particle in a piecewise constant potential
   - Harmonic oscillator
   - Momentum representation

3. MATHEMATICAL FORMULATION OF QUANTUM MECHANICS
   - Dirac formalism: vectors, operators, basis, representations
   - The eigenvalue problem
   - The measuring process, Heisenberg uncertainty relation
   - Quantum statistics, density operators
   - Time evolution: Schroedinger and Heisenberg picture

4. SYMMETRIES AND CONSERVED QUANTITIES
   - Translational and rotational invariance, momentum and angular momentum operators
   - Angular operator algebra
   - Hydrogen atom
   - Electric and magnetic fields

5. SPIN
   - Stern-Gerlach experiment
   - Pauli matrices
   - Addition of angular momenta

6. PERTURBATION THEORY AND VARIATIONAL APPROACHES
   - Non-degenerate/degenerate perturbation theory
   - Variational principle

7. SCATTERING THEORY
   - Time-dependent perturbation theory
   - Scattering amplitude, Born approximation
   - Phase shifts and partial waves

8. PATH INTEGRALS AND/OR IDENTICAL PARTICLES (?)