PHYS 4386 Quantum Mechanics 3 2019

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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. RECAP:
   - Relation to other fields of physics, typical length and energy scales
   - Schroedinger equation, correspondence principle
   - Continuity equation, expectation values, commutators
   - Stationary states, eigenvalue problem
   - Momentum representation

2*. SIMPLE PROBLEMS
   - Particle in a limited region of space, particle in a piecewise constant potential
   - Harmonic oscillator

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
- Helium atom

7. SCATTERING THEORY
   - Time-dependent perturbation theory
   - Transition probabilities, Fermi's golden rule
   - Scattering amplitude, Born approximation
   - Phase shifts and partial waves
   - Lippmann-Schwinger Equation

8. IDENTICAL PARTICLES
   - Bose and Fermi statistics
   - Pauli exclusion principle
   - Slater determinant
   - Ideal Fermi gas