Physics 722 is the second semester graduate-level course in quantum mechanics (QM) that follows Physics 721. This course will trace fairly closely the second half of Sakurai and Napolitano's "Modern Quantum Mechanics," 3rd edition, and in principle cover a large selection of topics in chapters 4 through 8. I will, however, devote several lectures at the beginning of the course to a brief review of some aspects of the first three chapters. The goal of the course will be to introduce (1) symmetries in QM, (2) approximation methods, (3) scattering theory, (4) identical particles, and (5) relativistic QM. The chapter sections give a rough idea of the topics that may be covered, and on the next page I have drawn up a tentative outline, but the definitive list will be developed as we go along. In addition, I may draw material from other sources and/or change notation.

Note that lecture attendance is expected.

Homework will be assigned roughly every other week. Solutions are to be uploaded to Canvas in readable PDF format. Homework must be uploaded on time (complete or partly complete). **Late submissions will be docked 25% and no work will be accepted after two days.** Your lowest scoring assignment will be dropped to allow for an unexpected event. The TA for the course is senior graduate student Cxxx Kxxxx. Homework is open book. **You may discuss homework with others but not copy other solutions (code of conduct). This proviso applies to copying AI output as well (AI answers may be wrong and you'll fail to develop skills and understanding).** Your write-up must be your own individual effort and have annotation of steps that indicates that you understood the problem.

There will be one midterm exam and a final exam. The midterm exam will be in-class on February 26. The final exam is on Saturday, May 2, between 4 and 7 PM. Course assessment will be based on the homework (40%), the midterm (30%), and the final (30%).

The University calendar shows that we have no class on Tuesday March 17 and Thursday March 19 (spring break) and Thursday April 2 (wellness day). Last day of class is Thursday April 23. Office hours will be after lectures. Otherwise contact me by email (evans@physics.unc.edu) to schedule a meeting. My new 'office' is in Phillips 126. The supplement at the end of this syllabus gives University policies and the code of conduct.

References:

- Sakurai and Napolitano, *Modern Quantum Mechanics*, 3rd edition
- Le Bellac, *Quantum Physics*
- Dirac, *Principles of Quantum Mechanics*

Rough Outline of Lecture Topics

- Review of Fundamental Concepts
- Mathematics of Quantum Mechanics and Hilbert Space
- Quantum Dynamics
- Schrödinger and Heisenberg Pictures
- Hydrogen Atom
- Discrete and Continuous Symmetries
- Parity, Space-Inversion Symmetry
- Time-Reversal Symmetry
- Time-Independent Perturbation Theory
- Hydrogen Fine Structure and Zeeman Effect
- Time-Dependent Potentials
- Interaction Picture
- NMR, Masers, and Rabi Oscillations
- Time-Dependent Perturbation Theory
- Interactions with EM Radiation Field
- Scattering Theory
- Scattering as Time-Dependent Perturbation
- T-Matrix, S-Matrix
- Born Approximation
- Phase Shifts, Cross-Sections
- Low-Energy Scattering, Poles of S-Matrix
- Identical Particles
- Two-Electron System
- Fermions, Bosons
- Quantum Fields
- Relativistic Quantum Mechanics
- Klein-Gordon Equation
- Dirac Equation
- Intro to Relativistic Quantum Field Theory