Quantum Mechanics II

Physics 442

January 22nd, 2024

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Lecture and Office Hours
Lecture meets on M-W-F from 10:00–10:50 a.m. in Physics 122.

Office hours will be held on M,W, Th 3–4 p.m., Tu 1–2 p.m., Th 11–noon.

Text: David J. Griffiths & Darrell F. Schroeter, "Introduction to Quantum Mechanics," Third edition, Cambridge University Press, 2020.

Website: http://people.reed.edu/∼jfrankli/Courses/P442.S24/

Course Structure: Lecture notes, including reading assignments, will be posted on the course website. Homework will be available on the course website on Fridays by 5 p.m., due the next Friday by noon. The homework will consist of both "ordinary" problems to be turned in on the course gradescope site, and "presentation" problems. For the presentation problems, students will either write up "lecture notes" on the problem, or prepare a ~ 15 minute description of the problem and its solution to be presented in class on Fridays (in-class presentations will occur roughly every other Friday). As a general rule, the presentation, whether written or in class, should include:

- A clear statement of the problem in your own words, and with your own emphasis. (20%)
- The problem's connection to work we have done in class. (20%)
- A clear and correct solution to the problem. (40%)
- Possible extensions or implications stemming from your solution. (20%)

Each student is expected to prepare two of these problems during the course of the semester, one written, one in person (although all students should think

about and solve these problems as part of homework). Presentations will be assigned on Monday after students have had a chance to take a look at the problems for the week.

In addition to homework and presentations, there will be a take-home midterm examination given the week of Monday, March 4th (due on Friday, March 8th), an in-class final examination scheduled during finals week, and an in-class "preterm" examination meant to provide an opportunity to review content from Quantum Mechanics I, given on Friday, January 26th.

The weighting of these components is as follows:

Homework	20%
Presentation - written	20%
Presentation - in-class	20%
Midterm	15%
Final examination	15%
Preterm	10%

Learning Goals

This is an advanced topics course in quantum mechanics. There are a variety of tools and techniques for solving quantum mechanical problems that we will develop, in addition to thinking about the structure of the theory, and, near the end of the semester, its relativistic form(s). By the end of the course, students should be able to

1. Solve for the energy and eigenstates of particles moving under the influence of electromagnetic potentials, exactly and approximately (scattering is one application area).
2. Understand the role of symmetry in conservation laws, both classically and in quantum mechanics.
3. Apply perturbative methods to problems involving realistic potentials in order to find spectra and wavefunctions (in both non-degenerate and degenerate cases).
4. Use time-dependent perturbation theory to compute energy transitions in model and real systems.

Topics:. Here is a list of the topics, including chapter numbers from Griffiths/Schroeter, that we will cover.

- Magnetism and Hamiltonians (Chapter 4).
- Symmetries and conservation laws (Chapter 6).
- Time-independent perturbation theory (Chapter 7).
- The variational principle (Chapter 8).
- Scattering (Chapter 10).
- Dynamics (Chapter 11).
- Quantum mechanics and special relativity.
- Multiple particle formulation.