PHY 369:
Quantum Mechanics II

Lehigh University, Spring 2022

Instructor: Timm Wrase, Lewis Lab 418

Office hours: Monday 2-3pm or any other time by email appointment (timm.wrase@lehigh.edu)

Class time and place: Tuesday and Thursday 1:35-2:50pm in Lewis Lab 512 (Virtual on Zoom during the first week!)

Website: https://coursesite.lehigh.edu/

Textbook: "Introduction to Quantum Mechanics" 3rd edition by Griffith and Schroeter

General course requirements:

- Read the relevant sections in the book before or after each class.
- Attend all classes.
- Complete all assignments on time.
- See me if you are having trouble or any questions, concerns or comments about the course!

Overview: In applying quantum mechanics to realistic problems in areas such as atomic, molecular, and solid-state physics, you will benefit from some concepts and techniques beyond the foundations that you learn in a first-semester course. In this second-semester quantum mechanics course, you will learn some of the primary methods for solving realistic problems. In particular, you will learn approximation methods, and techniques for describing interactions between two or more quantum systems.

Course Outline:

- Review of quantum mechanics (Chapters 1-6)
- Time-independent perturbation theory (Chapter 7)
- The Variational Principle (Chapter 8)
- The WKB Approximation (Chapter 9)
- Quantum scattering (Chapter 10)
- Quantum Dynamics: Time-dependent perturbation theory (Chapter 11 if time permits)

Homework: Homework will be assigned each Tuesday and is due the following Tuesday in class. You may work together on the homework, but please make sure that you are able to complete the problems on your own. The work turned in must be your own. No homework will be assigned during the two weeks before the two midterms on Tuesday 2/22/2022 and 3/29/2022.

Exams: The course will have two midterm exams: one on Tuesday 3/01/2022 and one on Tuesday 4/5/2022. The final exam date will be decided later in the semester by the registrar's office. The final will be comprehensive and will consist of material covered in this class.

Grading: The final grades in the course will be based on, homework (30%), midterms (20% each) and the final exam (30%).

Initial Competencies: Students should have some working knowledge of quantum mechanics and multivariate calculus.

Final Competencies:
After completing the course, students will be able to:

- Solve problems using time-independent and time-dependent perturbation theory
- Describe the state of a composite system consisting of two angular momenta
- Understand how angular momentum coupling determines the fine and hyperfine structure of atomic energy levels
- Explain how the Pauli exclusion principle follows from the symmetrization postulate for identical particles
- Understand the meaning of the scattering cross section and be able to calculate scattering properties using the Born approximation and the partial wave expansion
- Describe how measurements are correlated in entangled quantum states

Accommodations for Students with Disabilities: Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at https://studentaffairs.lehigh.edu/disabilities.

The Principles of Our Equitable Community: Lehigh University endorses The Principles of Our Equitable Community. We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.