Physics 362: Quantum Mechanics I
Lehigh University, Fall 2020

Instructor: Ariel Sommer
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Office hours: by appointment (please email)
Class: TR 12:10 – 1:25 pm, online

In this course, you will learn quantum mechanics. Quantum mechanics describes the behavior of matter in the microscopic realm, such as within atoms, molecules, solids, and nuclei.

Textbook: McIntyre, *Quantum Mechanics: A Paradigms Approach*, Pearson, 2012

Chapters/Topics:
- Ch1: Quantum states, spin-½, Stern-Gerlach Experiment
- Ch2: Operators and Measurement
- Ch3: Schrödinger Time Evolution
- Ch5: Position space and bound states
- Ch6: Free particles and 1D scattering
- Ch7: Angular momentum in quantum mechanics
- Ch8: The hydrogen atom
- Ch9: The quantum harmonic oscillator

Homework: Homework will be assigned weekly. You are expected to turn in homework on time. You may work together on the homework, but make sure that you are able to complete the problems on your own. The work you turn in must be your own. To turn in your homework, you will upload a PDF file of your handwritten work to Coursesite. You can prepare this file by photographing or scanning your work, or you can write directly on your computer or tablet using a stylus and export a PDF.

Late homework: Please contact me if you would like to request an extension due to illness or other circumstances. Homework turned in late without an extension will receive partial credit up to 1 week after the assignment was due. 10% will be deducted for each full day late.

Quizzes/Exams: The course will have approximately seven end-of-chapter quizzes throughout the term, plus a final exam. The quizzes will be given during the regularly scheduled class time. For students residing outside of the US, an alternative time will be arranged that better suits your time zone. You will turn in quizzes by uploading a PDF of your work and/or answering online quiz questions depending on the format of the particular quiz.

Missed quizzes: Notify me in advance if you will miss a quiz, and we will schedule an alternative time for you to take it. Missed quizzes without prior notification will have 10% credit deducted.

Grading: Final grades in the course will be based on homework (40%), quizzes (40%), and the final exam (20%).

Office Hours: Students should email the instructor if they would like to meet. Meetings that can be effectively held online will be held online. Students can also arrange to meet with the instructor in person. For in-person meetings, the instructor and students will comply with all current public health guidelines such as social distancing and wearing masks. The instructor will provide specific information about meeting location and reminders about applicable safety measures per meeting.

Learning Outcomes:
After completing the course, students will be able to:

- Describe the quantum state of a system using state vectors in Dirac and matrix notation
- Predict the possible outcomes and probabilities of measurements on quantum systems
- Represent quantum states in different bases
- Use the eigenvalues and eigenstates of a Hermitian operator to predict the possible values of a physical quantity and the state of a quantum system after measurement
- Predict the time evolution of a quantum system using the Schrödinger equation
- Calculate the possible energy values of a quantum system
- Calculate the probability density of a particle from its spatial wavefunction
- Solve for stationary states in piecewise-constant potential wells
- Describe the state of a free particle using momentum eigenstates
- Predict the expectation value of momentum using the momentum operator
- Describe the state of a particle in terms of its orbital angular momentum
- Calculate the expectation values of quantities involving angular momentum
- Predict allowed states and transitions in hydrogen
- Calculate expectation values and probabilities of microscopic variables for hydrogen
- Calculate expectation values of position and momentum-dependent quantities for the harmonic oscillator using wavefunctions or ladder operators
- Approximate realistic systems (such as diatomic molecules) as quantum harmonic oscillators to estimate their properties

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 [http://www.lehigh.edu/~inprv/initiatives/PrinciplesEquity_Sheet_v2_032212.pdf]. 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.