Physics 451/551 **Winter 2026**

Quantum Mechanics

Class: MWF 12-12:50 pm, Weniger 328

Instructor: Oksana Ostroverkhova, oksana@science.oregonstate.edu,
https://sites.science.oregonstate.edu/~ostroveo/index.html
Office: Weniger 413

Class TA: Kalista Wayt, waytk@oregonstate.edu

Class LAs: Jake Bullard (bullarja@oregonstate.edu), Kien Peter (peterk@oregonstate.edu)

Textbook: *Quantum Mechanics*, D. McIntyre

References:
1. *Principles of Quantum Mechanics*, R. Shankar
2. *Quantum Mechanics,* B. H. Bransden and C. J. Joachain
3. *Quantum Mechanics* (vol. 1), C. Cohen Tannoudji, B. Diu, F. Laloe
4. *Modern Quantum Mechanics*, S. Sakurai, J. Napolitano

Office hours: MF 2-3 pm or upon request

Course website:
https://sites.science.oregonstate.edu/~ostroveo/COURSES/ph451/index.html

Course outline:

Fundamentals of QM: review	(Ch. 1-8)	week 1
Quantum harmonic oscillator	(Ch. 9)	week 1-2
Perturbation theory	(Ch. 10)	week 3-4
Addition of angular momenta	(Ch. 11)	week 5-6
Fine and hyperfine structure of H-atom	(Ch. 12)	week 7
Identical particles	(Ch. 13)	week 8
Time-dependent perturbation theory	(Ch. 14)	week 9
Interaction with the EM fields	(Ch. 14)	week 10

Homework:

There will be one homework assignment per week, typically due each Wednesday; check the course web for current assignments due. Homework (physical copy) is to be turned in by the beginning of the class; late homework is not accepted. The homework solutions will be available immediately after the due time.

The PH 451 homework will be graded using two scores: one for completion (assessing completeness of the submitted work) and one based on the in-depth assessment of solution of one problem randomly chosen each week.

The PH 551 homework will contain more advanced problems, and solutions of all assigned problems will be graded.

Worksheets:

To help you check your understanding of the material and provide feedback for me, worksheets will be distributed at (almost) every lecture for the in-class work. The PH 551 students will have additional/more advanced questions to work through. Please submit the filled-out worksheets at the end of the class. The worksheets will be graded and returned as soon as possible.

Exams:

We will have one in-class midterm (tentative date February 11) and a final exam (registrar-scheduled date is Thursday, March 19, 9:30 am).

Grading Policy:

Homework (total)	20%
Worksheets (total)	20%
Midterm	25%
Final	35%

Learning Outcomes:

By the end of the course, students in PH 451/551 should be familiar with and display some practical mastery of the concepts, definitions, and problem-solving methods associated with the following topic areas and skills:

• Describe the properties of solutions to the eigenvalue problem for the simple harmonic oscillator and associated mathematical methods (including raising and lowering operators) and apply these tools to solving practical problems involving molecular and other vibrating quantum systems.

• Describe the properties of angular momentum in quantum mechanics and use the associated mathematical methods (including addition of angular momenta using Clebsch-Gordon coefficients) to solve practical problems in physical systems carrying angular momentum.

• State the main results of time-independent perturbation theory and apply them to find approximate solutions to the energy eigenvalue problem in a variety of physical systems for which this problem cannot be exactly solved.

• Describe the electronic structure of Hydrogenic atoms.

• Describe the physics of various physical effects (e.g., spin-orbit coupling, Stark effect, Zeeman effect, relativistic corrections) that modify the electronic structure of Hydrogenic atoms and apply time-independent perturbation theory to calculate changes in electronic structure due to these effects.

• State the main results (including Fermi's Gold Rule) of time-dependent perturbation theory for quantum transition probabilities in systems for which the time evolution problem cannot be solved exactly.

• Apply the results of time-dependent perturbation theory to solve problems involving the interaction of atomic systems with electromagnetic fields.

• Describe the properties of quantum states of many-particle systems involving identical particles, including quantum Bose-Einstein and Fermi-Dirac statistics, and apply these properties to evaluate the effects of particle identity in atomic and other quantum systems.

Oregon State University Course Policies

Academic Calendar

All students are subject to the registration and refund deadlines as stated in the Academic Calendar: registrar.oregonstate.edu/osu-academic-calendar.

Statement Regarding Students with Disabilities

Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Student Conduct Expectations

All students are expected to conduct themselves in accordance with the OSU Student Code of Conduct: beav.es/codeofconduct.

Student Bill of Rights

OSU has twelve established student rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: asosu.oregonstate.edu/advocacy/rights.

Reach Out for Success

University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)

Student Learning Experience Survey

During Fall, Winter, and Spring term the online Student Learning Experience surveys open to students the Wednesday of week 9 and close the Sunday before Finals Week. Students will receive notification, instructions and the link through their ONID email. They may also log into the survey via MyOregonState or directly at

https://beav.es/Student-Learning-Survey. Survey results are extremely important and are used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to "sign" their comments, agreeing to relinquish anonymity of written comments) and are not available to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.

Miscellaneous

Cell phones and other electronic devices

Please no phone use in class. Laptops and tablets for note-taking are fine.

Credit

If you work with people on problems or use various sources including AI, please include the proper acknowledgement and/or citation. In case of AI use, your citation should include the AI engine you queried (including version and URL), the date accessed, the precise prompt you used, and the full text of the AI's response to the prompt and/or transcript of your session. Use of AI without citation, as with use of any other outside source without citation, is plagiarism.