

UNIVERSITY OF VERMONT
DEPARTMENT OF PHYSICS

PHYSICS 4500: APPLICATIONS OF QUANTUM MECHANICS

Spring 2024

Instructor: Dr. Dennis Clougherty	Time: MWF 10:50-11:40 AM
Email: dennis.clougherty+PHYS4500@uvm.edu	Place: Discovery

Course Description: Applications of quantum mechanics including quantum statistical mechanics, time-independent and time-dependent perturbation theory, WKB approximation, variational principle and scattering.

Prerequisites: PHYS 3500

Objective: Students will learn to apply quantum mechanics in variety of applications in astrophysics, atomic and molecular physics, condensed matter physics, and particle and nuclear physics.

Course Personnel:

Ms. Beth Stinebring, administrative assistant (physics@uvm.edu).

Office Hours: W 2-3 PM & by appointment.

References:

1. David J. Griffiths and D.F. Schroeter, *Introduction to Quantum Mechanics*, 3rd edition, (Cambridge University Press, 2018). (This is the required text for the course.)
2. S. Gasiorowicz, *Quantum Physics*.
3. G. Baym, *Lectures on Quantum Mechanics*.
4. R.P. Feynman, R.B. Leighton and M. Sands, *Feynman Lectures on Physics*, Vol. III.
<https://www.feynmanlectures.caltech.edu>. (This recommended text is available online for free.)
5. H. Ohanian, *Principles of Quantum Mechanics*.

Course Outline:

1. Review of Dirac Notation and Vector Spaces: Bras, kets and operators
2. Time-independent perturbation theory
3. Non-degenerate perturbation theory
4. Degenerate perturbation theory
5. Variational principle
6. Time-dependent perturbation theory
7. Adiabatic approximation and geometric phase
8. Scattering Theory

Online Resources:

1. Course web site: <http://brightspace.uvm.edu>
2. UVM Physics help sessions web site: <https://www.uvm.edu/cas/physics/help-sessions>
3. UVM tutoring center web site: https://www.uvm.edu/academicsuccess/tutoring_center
4. UVM Physics web site: <http://www.uvm.edu/physics/>
5. UVM student accessibility services (SAS): <http://www.uvm.edu/access>
6. Prof. Clougherty's web site: <http://go.uvm.edu/dpc/>

Grading Policy:

Homework (30%), Exams (15% each), Final (25%).

Important Dates:

Exam #1	February 16, 2024
Exam #2	March 22, 2024
Exam #3	April 19, 2024
Final Exam	May, 2024

Please mark these dates in your calendar now. Exams will take precedence over medical appointments, travel plans, athletic events, and other personal activities. If you miss an exam, you will receive a score of zero unless excused by Professor Clougherty prior to the exam. As a general rule, only a verifiable illness is reason to miss an exam.

Class expectations:

1. *Attendance:* Regular attendance is important in mastering the material.
2. *Preparation:* Students are required to read the assigned text in advance of class. Please come to class with questions stimulated by your readings.
3. *Homework:* Homework assignments will be posted to the course web site on Brightspace. Please write up your complete and detailed solutions neatly. Please upload a scanned pdf of your solution to Brightspace in advance of the posted deadline.
4. *Exams:* Exams will be based on the homework problems. Exams are closed-book, but you can bring a single-page sheet with notes to use during the exam.
5. *Class recordings:* Our class sessions may be recorded for students in the class to refer back to, and for enrolled students who are unable to attend live. Students who participate online with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who unmute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the “chat” feature, which allows students to type questions and comments live.

Accommodations: In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. See <http://www.uvm.edu/access> for more information.

Academic Integrity: It is expected that all students will adhere to the University code of academic integrity. Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example, homework or a take-home examination). Violations will be handled under UVM’s Intellectual Property policy and Code of Academic Integrity.

(<https://www.uvm.edu/sites/default/files/UVM-Policies/policies/acadintegrity.pdf>)