Lectures: MWF, 2:30 – 3:20pm, COB 263
Discussion: Th, 3:00 – 3:50pm, COB 282

Instructor: Carrie Menke, cmenke@ucmerced.edu, COB 305
Office Hours: see CROPS site for current schedule, and by appointment

Textbook: *Introduction to Quantum Mechanics*, 2nd ed., by David Griffiths

Course Description: This course covers the fundamentals of quantum mechanics, which forms the foundation of our modern understanding of matter at the atomic and molecular level. Topics include the Schrödinger equation, Hilbert spaces, the operator formalism, the Heisenberg Uncertainty Principle, tunneling, perturbation and WKB theory, fermions, and bosons. Pre-reqs: Phys 10, Math 23, and Math 24

Learning Objectives & Outcomes

Objectives	Outcomes
Develop a conceptual understanding of quantum mechanics	Students will be able to identify and explain the key differences between quantum mechanical and classical approaches to physics.
Learn how to use the tools of quantum mechanics	Students will be able to: • normalize wavefunctions • use operators • apply perturbation techniques • derive the wavefunction for a given potential energy landscape.
Apply foundational mathematics to quantum mechanics.	Students will be able to: • write down the general solution to the time-dependent Schrödinger equation and then describe the physical significance of this representation • use linear algebra, vectors and matrices, compute inner products, find eigenvectors and eigenvalues, and perform useful transformations • describe the physical significance of these operations in the context of quantum mechanics.
Prepare for the GRE	Students will see and solve questions resembling those included in the Physics Graduate Record Exam.
Communicate their understanding	Students will • work with the literature and summarize a peer-reviewed journal article. • create a compelling video that explains an interesting aspect of quantum mechanics to a freshman audience.
Have fun	Students will identify 4 topics applicable to CORE 90X and create a video explaining one of them. In particular, students should be able to convey enthusiasm to a quantum mechanics novice.

Course Policies & Structure

Grading:

Homework	25%	Grades will be given using the *approximate* framework: A:
Article Summary	10%	100-90%, B: 90-80%, C: 80-70%, D: 70-60%. The flavor of letter
QM Video	10%	grade (+, even, -) will be determined when final grades are
Midterms (2)	30%	assigned.
Final Exam	25%	

CROPS site: The CROPS website (F12-PHYS 137 001) will be used extensively throughout the course. Look there for announcements, resources (i.e. homework assignments, articles, etc.), and grades. Also, the most recent course information, office hours and contact information will be posted on the home page.

Homework: Homework assignments are posted on CROPS approximately one week before the due date. All assignments are due at the beginning of lecture unless otherwise noted. Collaboration is encouraged, but make sure to write up your own work. If you work with or receive appreciable help from a classmate, then reference them in your assignment. *No late homework is accepted.*

Article Summary: You'll summarize one of the journal articles posted on CROPS. *If you would like to choose the paper you summarize (highly encouraged), approve it with Dr. Menke beforehand.* ***Due by 5pm on November 1st at turnitin.com. No extensions.***

QM Video: In groups, you'll be creating a 5 to 10-minute video that explains some aspect of quantum mechanics to novices in a compelling way. Professor Mitchell may use these videos in CORE 90X: Modern World of the Quantum, his freshman seminar course. ***Due by 5pm on December 1st. No extensions.***

Exams: There will be two closed-book exams. There is also a closed-book, comprehensive final exam. *There will be no make-up exams or early exams!* If you are sick during an exam, bring a note from your doctor verifying your illness. Your missed exam score will be replaced by the appropriately scaled score on the portion of the final exam that covers the same material as the missed exam.

Discussion Sessions: Discussion session time will be devoted to answering your questions, clarifying lecture material, mini-lectures on mathematical techniques (as needed), students presenting homework problems, working through examples, discussing relevant research topics, etc. Attendance is expected.

Collaboration: Collaborating is an essential skill in science and engineering. Find partners and work together. However, it is also important that you OWN the material. Limit yourself to verbal help; don't take written information from others (don't write down notes when you talk to others). This will ensure that you think things through independently after you get help. If you do well on homework and poorly on exams, you are probably getting too much

help. In general, no credit will be given for a correct answer unless accompanied by a complete and correct derivation. The point is not to find the answer, but to find out how to *construct* the answer. There will be time for peer discussion during classes: try to help your partners get over confusions, listen to them, ask each other questions, critique, teach each other. You will learn a lot this way!
Note: *While collaboration is the rule in technical work, evaluations of individuals also play an important role. Exams will be done without help from others. For* all assignments, *the work you turn in must in the end be* your own: *in your own words, reflecting your own understanding.*

Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Academic Integrity (summarized): Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy.

- *Any work submitted by a student in this course for academic credit will be the student's own work*. Collaborating is allowed in discussions, homework, and the QM video. (See the relevant sections above.)
- You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy. ***Should copying occur****, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment*. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
- During **examinations**, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. *Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.*
- The full UCMerced Academic Honesty Policy is located at studentlife.ucmerced.edu → Student Judicial Affairs → UC Conduct Standards → Academic Honesty Policy.

Tentative List of Topics to Cover

1. Concepts of Probability & The Quantum Mechanical Wave Function.
2. Solutions of the Time-Independent Schrodinger Equation in One Dimension
3. Quantum Mechanics using Dirac Notation
4. The Time-Independent Schrodinger Equation in Three Dimensions, Using Spin
5. Identical Particles and Simple Quantum Statistical Mechanics
6. Time-Independent Perturbation Theory
7. Time-Dependent Perturbation Theory
8. Scattering
9. Special Topics, time depending