Physics 114: Quantum Mechanics

Joint Science Department — Fall 2008
TTh 1:15 PM — Keck 101

Professor Steuard Jensen

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Office Hours: M 2:30–3:30; T 3–4; W 10:30–11:30; Th 3–4, or by appointment.

Course description:
In this course, you will learn quantum mechanics as expressed in the language of states and operators. This formalism is particularly convenient when discussing particles' intrinsic spin, but also makes contact with the wave mechanics that you have seen in earlier courses. Along the way, we will discuss a variety of interesting physical systems and gain insight into the fundamental structure of physical laws. When appropriate, class examples and homework will make use of computational or numerical methods.

Textbook: *A Modern Approach to Quantum Mechanics* by John Townsend
Discussion and handouts on **Sakai:** `https://sakai.claremont.edu:8443/portal`
Website: `http://faculty.jsd.claremont.edu/sjensen/teaching/classes/phys114/`

Midterm Exams: There will be **two take-home exams** during the semester: one at the beginning of October covering chapters 1–3 (or most of them) and one just before Thanksgiving probably covering chapters 4–7. I will give more details as the exams approach.

Cumulative Final Exam: Wednesday, Dec. 17, 2:00pm–5:00pm

Grading: Your work will contribute to your final grade with the following weights:

2 Midterms:	20%, 25%
Homework & Class Participation:	20%
Final Exam:	35%

Grades may be scaled up, but never down. You are welcome to ask me for your overall grade at any time. The correspondence between percentages and letter grades is (at worst) as follows:

A	A-	B+	B	B-	C+	C	C-	D+	D	F
92–100	88–92	84–88	80–84	76–80	72–76	68–72	64–68	60–64	52–60	< 52

Grading philosophy
In this class, the focus in grading is on your methods, explanation, and understanding, not simply on whether you got the right answer in the end. You can expect substantial partial credit if you make an effort. The details are on a separate handout. Pay special attention to the fact that part of your grade depends on the *clarity* of your work.

Homework policies
Unless I announce otherwise, homework will be **due Tuesdays in class at the beginning of class**. I strongly encourage you to discuss the assignments with other students in the class, but all work that you turn in must be your own: do not simply copy someone else's work. Also, I ask that you make a serious effort to start each problem on your own before talking to your classmates. If you do get significant help on a problem from another person or a book other than our textbook, briefly give them credit at the beginning or end of your solution. Late homework assignments will receive half credit and should be turned in with the following week's assignment. Assignments over one week late will not be accepted. Your lowest homework score will be dropped from your final grade.

If you feel that any grade on a homework or an exam is unfair, you may ask me to **re-grade** the problem. (Not all grades go up; some go down.) I don't expect any issues of academic honesty to arise, but I will follow your campus policy in cases of suspected cheating on homework or exams. That certainly means zero credit for that assignment and may also include reporting the issue to your Dean of Students or Registrar.

Class discussion
This is a small class, so it would feel a bit silly for me to spend the whole time lecturing as if there were fifty of you. I expect to do some of that, but I also expect that much of the discussion in class will be driven by you and your questions about the material. With that in mind, it is important that you complete the assigned reading before class and come prepared with questions. (I may ask you to submit feedback on the reading prior to lecture.) While the broad outlines of the subject are well-defined, I hope that together we can choose examples and applications that are of the greatest interest to you.

Tentative schedule: We will generally follow Townsend's textbook, but we will certainly not have time to cover it all this semester. We will cover the first three chapters more or less in order. That means we'll start with quantum spin systems, Dirac's bra-ket notation, matrix representations of states and operators, and angular momentum operators. The first midterm (at the beginning of October) will cover these topics.

Next, we'll move on to chapters 4–7. That includes time evolution of quantum states (including the Schrödinger equation), two-spin systems, and wave mechanics in Dirac notation. At that point (in chapter 6) we'll solve the Schrödinger equation for several interesting specific cases (if you haven't seen them before), and then (chapter 7) have a substantial discussion of the simple harmonic operator. These topics will be the focus of the second midterm (in November).

Tragically, we will have to skip chapter 8 on Feynman's beautiful path integral formulation of quantum mechanics. We will continue on from chapter 9, including wave mechanics in three dimensions, the two-body problem, bound states of central potentials, and time independent perturbation theory. We'll do as many examples of perturbation theory as we have time for. If we could talk a bit about identical particles (chapter 12) that would be fantastic, but I won't hold my breath. All of this will be covered on the comprehensive final (along material from throughout the course).