Physics 115A, spring 2013

Classes T Th 1:40-3:00 in Roessler 55

Professor: Steven Carlip

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Required text:

D. J. Griffiths, *Introduction to Quantum Mechanics, second edition*

Griffiths gives a good, focused explanation, and is generally considered to be clear and well-written; it is probably the most widely used undergraduate textbook. But it contains relatively few examples or worked-out problems, and some key points are left as exercises. I will put several other texts on reserve at Shields; see the list below.

Grading:

Homework	35%
Midterm	25%
Final exam	40%

Late homework will be accepted for a short period after the due date, but with a substantial deduction in the grade. (You need to keep up with the homework in order to understand the course!)

Rough course plan (details will certainly change over the quarter)

(“G x” means “Griffiths section x”)

April 2-4	Wave functions and the Schrodinger equation (G 1.1-1.4, Prob. 1.14)
April 9	Momentum, operators, uncertainty principle (G 1.5-1.6, Prob. 1.7)
April 11-18	Stationary states, infinite square well (G 2.1-2.2)
April 18-30	Harmonic oscillator (G 2.3)
April 30 - May 2	Free particle, momentum space (G 2.4); delta function potential (G2.5)
May 2-7	Finite square wells (G 2.5-2.6)

May 9	The scattering matrix (G Prob. 2.52); the WKB approximation (G 8.1-8.2); review
May 14	Midterm
May 16-21	Some math: linear algebra, Hilbert spaces, operators, Dirac notation (G 3.1-3.3,3.6,Appendix)
May 23	"Axioms" of quantum mechanics; uncertainty relations (G 3.4,3.5)
May 28	Two-state systems (G Example 3.8, other examples)
May 30	More wo-state systems; entanglement (G 12.1)
June 4	Fun stuff: EPR paradox, Bell’s inequality, hidden variables (G 12 plus extra material)
June 6	Review
June 11	Final exam (8-10am)

Books on reserve:

Different people learn better from different sources. If one book is too confusing, it sometimes helps to read a different author's approach, or to look at some worked out problems related to the point you're confused about. So in addition to the required class textbook, I am arranging to have the following books placed on reserve at Shields Library:

1. Saxon, David, *Elementary Quantum Mechanics* (an old but good, short undergraduate textbook; the library may not be able to find a copy)
2. Liboff, Richard L, *Introductory Quantum Mechanics* (a much longer textbook -- more complete, but maybe too much material)
3. Ohanian, Hans C, *Principles of Quantum Mechanics* (comparable to the required text, slightly different presentation)
4. Zettili, Nouredine, *Quantum Mechanics: Concepts and Applications* (a book based on problems, some with worked out solutions; very useful if you learn best from examples)
5. Sakurai, J J, *Modern Quantum Mechanics* (a more advanced textbook, for graduate and undergraduate students)
6. Griffiths, David J, *Introduction to Quantum Mechanics* (the course textbook)
7. Silverman, Mark P, *And Yet It Moves: Strange Systems and Subtle Questions in Physics* (not a textbook, but a beautiful description of a bunch of specific, strange quantum systems)

Some general advice:

The course assumes basic knowledge of calculus and of mathematical methods in physics, as well as classical mechanics (including the Hamiltonian formulation). If you have trouble with the background material, please see me; I can suggest extra background reading, and help you pin down the specifics you need to catch up.

It would be a very good idea for you to read ahead—use the outline in this syllabus and be sure to read each section before it is the class topic. The class website (through UCD SmartSite) will have a regularly updated set of reading assignments. In my lectures, I will assume that you have done and understood the homework. If you get stuck on a point, there will be lots of office hours available. If you get stuck and you think you are not alone, though, tell me—it may mean that I should cover some issue in more detail in lecture.

Feel free to use the SmartSite chat room. Don't assume I will be following it—it's mainly for the use of students —but also don't assume it's secret from me.

If you email me with a question, please be sure it is as clear and specific as possible: "I don't understand how the textbook got from equation 2.151 to 2.152," not "I'm confused about square wells" or "Could you repeat in an email everything you said in yesterday's lecture?" You may find that when you try to formulate your question clearly, that will lead you to an answer. Also, please don't assume that I'll be able to reply immediately, and *please* don't send me an email at 10 pm and expect an answer by midnight.

Warning: homework and plagiarism

Your homework assignments are expected to be your own work. You may certainly discuss assignments with others, in person or online, but in the end I expect you to each do the calculations yourself. If I receive homework that is obviously copied directly from someone else, I will find out what has happened, and may give you a 0 for the assignment. If you repeatedly plagiarize, I will turn you in to Student Judicial Affairs, and the consequences can be quite severe.

Two thoughts to keep in mind when you get confused during this course:

> *"Because atomic behavior is so unlike ordinary experience, it is very difficult to get used to, and it appears peculiar and mysterious to everyone—both to the novice and to the experienced physicist. Even the experts do not understand it the way they would like to, and it is perfectly reasonable that they should not, because all of direct, human experience and of human intuition applies to large objects. We know how large objects will act, but things on a small scale just do not act that way. So we have to learn about them in a sort of abstract or imaginative fashion and not by connection with our direct experience."*

– Richard Feynman

> *"Anyone who is not shocked by quantum theory has not understood it."*

– Neils Bohr