Physics 115B, fall 2012

Professor: Steven Carlip

[redacted]

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's 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. It's also too long for a two-quarter course; I've had to select some pieces and leave out others that are just as interesting and useful.

People have different learning styles, and may get more from one textbook than another. I will put a few other texts on reserve at Shields;see below.

Grading:

Homework	35%
Midterm	25%
Final exam	40%

Late homework will be accepted, but with a *substantial* deduction in the grade.
(You need to keep up with the homework in order to understand the course!)

Exams will typically have two sections, one with short problems that test concepts and one with longer problems to work out. As those of you who took my class last quarter know, the exams will be *hard* -- very few students get nearly perfect scores.

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

(“G x” means “Griffiths section x”)

September 28	Quantum mechanics in 3D (G 4.1.1)
October 1-8	Angular momentum (G 4.1.2, 4.3)
October 10-17	Spherical well, hydrogen atom (G 4.1.3, 4.2, example 4.1)
October 19-22	Spin and statistics (G 4.4, 5.1, maybe 5.4)
October 24	Midterm
October 26	Addition of angular momentum (G 4.4.3)
October 29-November 2	Time-independent perturbation theory (G 6.1-6.2)
November 5-7	Some applications of perturbation theory (G 6.3-6.5 + extra material)
November 9-16	Time-dependent perturbation theory (G 9.1)
November 19-21	Transition probabilities, Fermi's Golden Rule (G 9.2-9.3 + extra material)
November 26-30	Scattering theory (G 11.1, 11.4, maybe 11.2-3)

December 3-5	Variational principle (G 7.1-7.3)
December 7	Review
December 13	Final exam

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 other 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 and angular momentum. I will also assume that you took Physics 115A last quarter (spring 2012) or the equivalent. That course basically covered chapters 1-3 of Griffith.

If you have trouble with the background material, please see me for help.

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 are office hours available, both to see me and to see the TA. 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.

Warning: homework and plagiarism

Your homework assignments are expected to be your own work. I encourage you to discuss assignments with others in the class, in person or online, and to share ideas. In the end, though, I expect you to each do the calculations for each problem by yourself -- by the time the course is over, you have to know how to do the work on your own. For example, while it's a very good idea to have study groups, do *not* divide up homework and have one person do problem 1, one person do problem 2, etc.; you should each work through each problem. 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