Physics 162a – Quantum Mechanics

Syllabus for Fall 2008

1 Course outline

Some changes may occur, but this is a pretty good indication of what we will cover.

1. Motivation (1/2 week). Chapter 1 of Baym, Chapters 1-3, Feynman lectures.

   Vector Spaces.
   Hilbert Spaces.
   Linear Operators.
   Eigenvalues and Eigenvectors.

3. The Principles of Quantum Mechanics (1/2 week). Chapter 4 of Shankar, chapter 1.4 of Sakurai

4. Illustrating and exploring the basic principles (1 week). Feynman lectures v. 6, 9-11. Sakurai
   Two state systems.
   Density matrices.
   Correlations, EPR, Bells Theorem.


6. Quantum Dynamics. (1 week) Chapters 3 and 5 of Baym, chapter 2.1-2.4 of Sakurai, chapter 4.3 of Shankar.
   Time development.
   Schrodinger and Heisenberg Pictures.
   Schrodinger and Heisenberg Equations of Motion.
   Uncertainty Principles, chapter 9 of Shankar.
How do we construct a Hamiltonian?

7. Feynman path integrals (1 weeks) Chapters 8, 21 of Shankar. Chapter 2.5 of Sakurai. Feynman and Hibbs.

8. Simple Examples. (1.5 weeks) – Chapter 5.1, 7 of Shankar, 2.3, 2.5 and 2.6 of Sakurai.
   The free particle, again. Propagators and Green functions.
   The free particle in a magnetic field. Aharanov-Bohm.

   The WKB approximation.
   Measuring a quantum system with a classical measuring device.

10. Symmetries and angular momentum (2 weeks). Chapter 6 of Baym.
    Chapters 3 of Sakurai. Chapters 11, 12, 14 and 15 of Shankar.
    Symmetries in quantum mechanics.
    Representations of the rotation group.
    Addition of angular momenta.
    Wigner-Eckhardt theorem.

11. The Hydrogen Atom (1 week) Chapter 7 of Baym.

2 Reading, handouts, etc.

The required book is Baym’s ”Lectures on Quantum Mechanics”. Sakurai’s book ”Modern Quantum Mechanics” is also strongly recommended. Shankar’s ”Principles of Quantum Mechanics” is also very good. I have placed and will place other books on reserve in the library. Supplementary notes, the syllabus, problem sets, important WWW links, and anything I can put online will appear on the course website.

Course website:
http://www.brandeis.edu/~albion/162a/course.html
3 Reading

Much of the reading I will assign will cover the same topics I cover in lecture, perhaps in a slightly different way. I will also assign some supplementary reading, to illustrate a point I make in the lectures, or to prepare you for an upcoming topic. All are fair game for the exams.

4 Problem sets

Problem sets will be handed out on Wednesdays. Unless I state otherwise at the time, they will be due at the beginning of class the following Wednesday. If we miss or reschedule a class, it will be due the next class that takes place after that Friday. Barring a family or serious health emergency, I will not accept late assignments unless you will be out of town for physics reasons (eg conference) or something serious like your own wedding, in which case I require a week’s advance notice.

I expect the students to work through every assigned problem. Some of them may seem longer than you are used to. It is still important that you have the experience of working through them. It may happen that I assign a problem on a subject I have not yet covered in class.

5 Exams

There will be a midterm and a final exam, both in class. The purpose of the midterm exam is mostly diagnostic, for you and for me, so it does not count for much. For graduate students, the final is part of your written qualifier.

6 Grading

The basis of grades in this course will be:
1) Homework – 60%.
2) Midterm – 10%.
3) Final – 30%
7 Office hours and availability

Office hours to be negotiated.

Don’t feel embarrassed or shy about asking questions. It is common to think something is obvious when it is not. Also, I don’t bite.

8 Feedback from students

Feedback from students is encouraged! If you have questions or concerns about the course as it is progressing, you should feel free to talk to me. There is also of course an end-of-term evaluation.

9 Expectations

The course is designed around the lectures, so while I won’t grade on attendance, it is important that you come to class. I will use the lectures to motivate material, and will be taking questions then, so you can get clarifications in real time.

You are strongly encouraged to discuss the problem sets with each other. By this I mean discussing what the question means, and what techniques and strategies you might use to solve them. I feel that physics is best learned socially, with your peers.

That said, the solutions you present should be your own; you should have understood the solution and explained it yourself, in your own way, in the problem set. Simply copying other people’s problem set solutions constitutes plagiarism and will be dealt with as such. Furthermore, I find that the lack of independent work shows up in the final exam and in the qualifiers.