8.322 MIT Quantum Theory II

Spring 2007

Organization and Policies

- Lecturer: Prof. Robert Jaffe, NE25-4027, x3-4858, jaffe@mit.edu.
- Section Instructor: Mr. Guido Festuccia, NE25-4030, x3-55349, guido@mit.edu
- Teaching Assistant: Mr. Cody Nave, 12-127, cpnave@mit.edu
- Lectures: Mondays and Wednesday 11:00 – 12:30 in 4-153
  Fridays 11:00 — 12:30 are held for alternate lecture times.
- Sections:
  - Section I: Thursdays, 3:00 — 4:00, 12-142.
  - Section II: Fridays, 11:00 — 12:00, 4-265.
- Office hours: Bob Jaffe, Wednesdays 2:30 — 4:00. Also available after lecture from 12:30 — 1:00 in 4-153.
- Office hours: Guido Festuccia, Fridays 1:30 — 3:00.
- Office hours: Cody Nave, Thursdays 5:30 — 7:00.
- Course administrator: Ms. Monica Wolf, 4-352, x 3-4855.

General comments and prerequisites

8.322, Quantum Theory II, is the continuation of Quantum Theory I, taught this past fall term. The course continues the development of quantum theory at the graduate level. Although it is the second term of a two part course, 8.322 can be taken independent of last term's 8.321.

The formal prerequisites for 8.322 are 8.321 and 8.07, MIT's undergraduate course on electrodynamics. You can review the material covered in 8.321 by going to the URL:

https://web.mit.edu/8.321/8321_Syllabus.pdf

where the 8.321 syllabus (as actually taught) is posted. The requirement of 8.07 can be substituted by a good undergraduate course in electrodynamics that treats Maxwell's equations, electrodynamic potentials, and radiation (at least at an elementary level). If you have any question about your background for 8.322, please contact Prof. Jaffe.

Use of the Web

The course website is web.mit.edu/8.322/. All course-related documents (syllabus, notes, problem sets and solutions, handouts, announcements, etc.) will be distributed electronically over the web. No course material will be distributed in printed form.

There is a course mailing list. If you register for 8.322, you will automatically be added to this mailing list. If you are a listener (whether formally or informally), you should contact Monica Wolf to make sure you are on the mailing list. Sometimes announcements and corrections to problem sets, *etc.* will be sent out to the mailing list a day or two before they appear on the website.

Students should check the 8.322 Home Page regularly for updates and announcements. Students can also send comments to the teaching staff anonymously, using the form provided on the web page. Please be constructive!

Grades will be posted on the web using the Physics Department's grade management system. You can enter this system using the links on the 8.322 home page.

Textbook

- J. J. Sakurai, *Modern Quantum Mechanics*, Revised Edition, Addison Wesley, 1994.
- Latexed notes will be posted to provide supplementary material on several subjects.

Other books

There are so many good texts on quantum mechanics that it does not make sense to reserve a small subset. Instead students should look for books that match their style (terse, explicit, formal, full of examples, ...). Here are some (personal) comments on a few of the ones I know:

- Gottfried and Yan (*Quantum Mechanics: Fundamentals*, Second Edition, Springer, 2003) I used this as a required text last year, but the match to 8.322 was not as good as I had hoped. I will assign reading from it this year (and scan and post the necessary pages on the 8.322 website).
- Shankar (*Principles of Quantum Mechanics*, Second Edition, Plenum, 1994) A very good book, written in Shankar's ideosyncratic style.
- Cohen Tannoudji (*Quantum Mechanics*, Wiley, 1977) (Over)-complete, explicit. For students who want to see everything worked out (and who want to gain arm strength from carrying it around).
- Messiah (*Quantum Mechanics*, Dover, 1999, Vols 1 & 2): Now somewhat outdated. Rather mathematically inclined. More formal than average.
- Landau & Lifshitz (*Quantum Mechanics*, 3rd Ed., Butterworth, Heinemann (Elsevier), 1977) emphasizes wave mechanics. Brilliant and ideosyncratic. Especially good on semi-classical methods.
- Schiff (*Quantum Mechanics, 3rd Edition*, McGraw-Hill, 1968) stiff and, to some, boring. Good on scattering, and the level is right. Notation is sometimes unusual.

- Merzbacher (*Quantum Mechanics*, 3rd Edition, John Wiley & Sons, 1998) Emphasizes wave mechanics. Explicit.

- Griffiths (*An Introduction to Quantum Mechanics*, 2nd Edition, Prentice Hall, 1999) Text for 8.05/8.06, good for background.

- Bethe & Jackiw (*Intermediate Quantum Mechanics, 3rd Edition*, Benjamin, 1986) focused on atomic and molecular physics, where it is good, though often terse.

The following books emphasize the fundamentals and are closer to the syllabus of 8.321 than 8.322.

- Dirac (*Principles of Quantum Mechanics, 4th Edition*, Oxford University Press, Oxford, 1958). Beautiful, if terse.

- Griffiths (*An Introduction to Quantum Mechanics, 2nd Edition*, Prentice Hall, 1999) Text for 8.05/8.06, good for background.

- Schwinger (*Quantum Kinematics and Dynamics*, Benjamin, 1970) an ideosyncratic but insightful formulation of quantum mechanics by one of the best.

- von Neumann (*The Mathematical Foundations of Quantum Mechanics*, Princeton, 1955, 1983) for the mathematically inclined.

Problem Sets

Problem sets are an essential part of 8.322. You cannot learn quantum theory without working your own way through challenging problems. This year I will be using some of the same problems as last year. Solutions were posted on the web last year, so copies may be available. I *strongly* urge you not to obtain, look at, or copy those solutions in your effort to do problem sets. Since your grade will be in part determined by the problem sets, copying is cheating. Of course, the only one you'd fool is yourself, but if it is discovered, the penalty will be severe.

Problem sets will be posted on the course web page

http://web.mit.edu/8.322

on Mondays if possible. They will be due **at 5:30 pm on Friday afternoon of the next week**. Most weeks, solutions will be posted on the web page the next day. Graded problem sets will be returned in section the following week. We do not accept problem sets after they are due except with the written support of your physician or an MIT counselling Dean. However, your lowest problem set score will be discarded at the end of the semester; only the remaining $n - 1$ will be used in determining your grade.

Exams

I have not yet decided how to handle the end of term in 8.322. There may be a final exam or a final problem set (a "take home exam"). I'll seek your input at the beginning of term.

Grading

If there is a final exam, it will carry 40% of the grade. Otherwise your grade will be determined by your work on problem sets and on class participation.

The course will be graded at the graduate level for all who take it.