PHYS 709: Applied Quantum Mechanics

TU 2:30, CW 144

Fall 2007

Instructor:
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For questions:

In the past, students have found it useful to have a weekly review session to discuss the homework before it is due. We will discuss this possibility during the first week. You can also email me, stop by my office, or call.

Textbook:

Introduction to Quantum Mechanics, Second Edition, D.J. Griffiths

I will be supplementing this text fairly heavily with additional material, especially homework problems. So, you probably want to get familiar with one or more additional quantum texts (some of which are given below).

Supplements (roughly in order of increasing level):

Physics of Atoms, Molecules, and Nuclei, Eisberg and Resnick
The Picture Book of Quantum Mechanics, Brandt and Dahmen
Principles of Quantum Mechanics, Second Edition, Shankar
Quantum Mechanics, Cohen-Tannoudji, Diu, and Laloë
Modern Quantum Mechanics, Sakurai
Quantum Mechanics, Merzbacher

Grading:

Midterm	20%
Final	30%
Homework	**50%**

Course philosophy:

This course will challenge you. I expect that you will learn the most from the homework, so there will be quite a bit of it: assignments will be given roughly once per week and you should count on them taking 9–10 hours each. I encourage you to discuss the problems with your classmates, but you should write up the assignment *on your own*. Some assignments will require computer and/or numerical work.

Guidelines for homework:

- Discuss your homework with classmates as much as you like, but *write your homework solutions on your own!* There will be a severe grade penalty for copying.
- As a scientist in training, you need to learn to communicate scientific information in an effective, efficient manner. You should consider homework assignments as practice in this art. It is your responsibility to present your homework solutions in a readable, logical manner — not mine to decipher and interpret them. There will be a grade penalty.
- In an incorrect solution, I will reward statements on homework and on exams that show you know it is incorrect and why. I will also reward any effort above and beyond what is explicitly asked for in a problem. Conversely, if you give a grossly incorrect solution, but make no indication that you know it is grossly incorrect, there will be a grade penalty beyond just getting the problem wrong.

Are you ready yet?

Take a look at our departmental exam in quantum mechanics. It is what our department expects someone with a B.S. in physics to know. In other words, what you should know at the end of this course! We won't be able to cover all of the material on that exam, but at the end of this course you should be well enough prepared to be able to pick up the extra topics on your own.

Students with disabilities:

If you have any condition such as a physical or learning disability that will make it difficult to carry out the work as I have outlined it or that will require academic accomodations, please notify me and contact the Disabled Students Office (Holton 202) in the first two weeks of the course.

Plagiarism:

Plagiarism and cheating are serious offenses and may be punished by failure on the exam, paper, or project; failure in the course; and/or expulsion from the University. For more information refer to the "Academic Dishonesty" policy in the *K-State Undergraduate Catalog* and the *Undergraduate Honor System Policy* on the Provost's web page at http://www.ksu.edu/honor/.

Tentative Course Outline:

I will assume that you have a working knowledge of most of Chaps. 1, 2, and 4. The more important material from these chapters will be reviewed in class, but will not be covered completely. If you do not feel comfortable with the material in any of these chapters, then I strongly suggest that you at least read through them.

The following is the tentative list of topics that will be covered in lecture. We may not get to the whole list, other topics may be added, and the order in which it is presented may differ from the text.

App. Linear Algebra
Covered in the first few lectures.

Chap. 1 The Wave Function
Mainly Sec. 1.4 Interpretation. Review canonical pairs of variables.

Chap. 2 Time-independent Schrödinger Equation
1D problems, mainly Secs. 2.4, 2.5, and 2.6. Will also add Kronig-Penney model, transfer matrices, free Gaussian wavepackets, and algebraic solution of simple harmonic oscillator.

Chap. 3 Formalism
Hilbert space and Dirac notation. Postulates of quantum mechanics. Symmetries and their consequences. Direct products.

Chap. 4 Quantum Mechanics in Three Dimensions
Primarily angular momentum — spin, adding angular momentum, matrix representation.

Chap. 5 Identical Particles
Symmetrization. Mostly Secs. 5.1 and 5.2.

Chap. 6 Time-independent Perturbation Theory
Good stuff.

Chap. 7 Variational Principle
Solving real problems.

Chap. 8 WKB Approximation
Mainly tunneling.

Chap. 9 Time-dependent Perturbation Theory
Dynamics! Electromagnetic transitions.

Other chapters and topics, time permitting.