Phys 521 Quantum Mechanics I **Fall 2011**

Objectives, Content, Pedagogy, Evaluation, and Policies

2011 August 22

This course will be administered through its web site:
http://info.phys.unm.edu/∼caves/phys521-f11/info.html .

All the documents mentioned herein, including the course syllabus and this document, can be found on the web page. There are links to the course web site on the P&A web page and on my home page (http://info.phys.unm.edu/∼caves). The course syllabus provides a complete schedule for the course and is your gateway to all course materials, including lecture notes, special handouts, homework assignments, challenge problems, exams, and solution sets, which will be available as pdf files linked to the course syllabus.

This is the first semester of the department's two-semester graduate course in quantum mechanics. Quantum mechanics provides the fundamental framework for all of physical law. You can't be a physicist without a thorough understanding of and a facility in the use of quantum mechanics.

I. Objectives.

The primary objective of this course is to develop familiarity with the *physical concepts* and facility with the *mathematical methods* of quantum mechanics. A secondary, but still very important objective is to cultivate your skills at formulating and solving physics problems. A subsidiary objective is to encourage the development of self-discipline and work habits that are useful both in academic course work and in the real world.

II. Content

The topics to be covered are the following: the Schrödinger equation; 1d square potentials; WKB approximation; mathematical structure of quantum mechanics; postulates of quantum mechanics; quantum description of the harmonic oscillator; two-level systems; angular momentum in quantum mechanics; and the quantum description of central potentials.

III. Pedagogy

The pedagogical component of the course concerns how the material is transmitted to you, the goal being that you develop confidence in your understanding of the physical concepts and mastery of the mathematical methods.

A. Textbook and supplementary materials. Study of the textbook and supplementary materials is the primary way for you to develop understanding of the material. The primary textbook is voluminous, covering an enormous range of topics. The syllabus attempts to guide your assault on the textbook by listing the parts of the text that are essential for the course; it also lists parts of supplementary texts that might be useful for review and perspective and for material that is absent from the primary textbook.

B. Lectures. The lectures provide an additional avenue for transmitting the course material to you. It is impossible and unnecessary for the lectures to cover all the material in the primary textbook, so the lectures aim to emphasize key concepts and techniques, to provide (sometimes) a different point of view from the text, and to allow you to ask questions about the material as it is presented. *Please ask questions. There is no such thing as a dumb question! It is more important that you be comfortable with your understanding of the material than it is that the lectures cover some fixed set of topics.* The value of the lectures is enhanced by your having given the material a first reading *before* the lecture. The topic of each lecture and the relevant reading material is listed on the syllabus; lecture notes and occasional special handouts will be available as pdf files linked to the syllabus.

C. Homework assignments. To learn physics requires doing problems, both to gain familiarity with the material and to master problem-solving techniques. The nine homework assignments listed on the syllabus are aimed at providing a representative sample of problems. Homework assignments are due at the lecture on the due date or *in the TA's mailbox. Do not deposit homework assignments in my mailbox.* The due date for a homework assignment can be deduced from the syllabus and appears prominently on the assignment. *Late homework assignments will not be accepted unless a prior arrangement has been made with the TA.*

One of the most effective ways to learn is to work with peers, so you are encouraged to consult other students about homework problems and to work in groups, but the *final product you hand in must be prepared solely by you.*

Your involvement with a homework assignment does not end when you hand in the assignment or even when the graded assignment is returned to you. You should examine your work critically with an eye to making sure you *really* understand the problem and its solution. The best way to improve your understanding is to consult the solution set, which represents many hours of faculty time in writing a solution that helps you to improve your understanding. Even on problems that you did successfully, it is advisable to consult the solution set, because it might present a more thorough solution or alternative approaches that you haven't considered. If you still have questions about a homework assignment after carefully going over the solution set, you should see me or the TA. It is very much to your advantage to make sure you understand the homework problems, because *the exam problems will be modeled after the homework problems.*

The homework assignments and solution sets will be available as pdf files linked to the syllabus. Homework assignments will be available from the web site by the distribution date (called Out on the syllabus). Occasionally I will add problems to an assignment, informing you of such additions. Solution sets for homework assignments will be posted to the syllabus immediately after the assignments are due.

D. Problem sessions. This course has an associated problem session (Phys 551.056, *Problems for Phys 521*, Call #40001), which is held on Thursday evening from 7:00 pm to 9:00 pm. *You should register for one hour of credit in the problem session.* At the problem session you will be divided into three- to four-person groups to work on a *challenge problem*, which will be distributed at the problem session and appended to the current homework assignment. The purpose of the challenge problems is to allow you to work on a problem

in an interactive environment, where other students, the TA, and I can help identify and correct misconceptions. Challenge problems will be distributed at the problem session, but will also be posted to the syllabus after the session.

The schedule of problem sessions is contained in the syllabus.

IV. Evaluation

The evaluation of your performance in the course and the assignment of a course grade will be based on the homework assignments, which will contribute 36% to the course grade, and on four midterm exams, each of which will contribute 16% to the course grade.

The four midterm exams will be take-home exams, each given over a period of two days. The exams will be posted to the web site in the morning on the date listed on the syllabus and will be due two days later; specific posting and due times for each midterm are listed in the syllabus. *You must set aside the four midterm dates now.* There are two reasons for giving four midterms: (i) each exam covers a better defined and smaller set of material that is fresh in your mind, and (ii) each exam is a smaller fraction of your grade, thus (I hope) making the exams less stressful.

These take-home exams will be open book. You may use the textbook, your own notes, your own homework assignments, all class handouts, including solution sets for homework assignments, but you should not consult books other than our primary textbook. You may use as much time as you want to complete the exam, as long as it is turned in by the deadline. Your completed exam must be solely your own work; you should not consult anyone else in doing the exam. The reason for giving open-book, take-home exams is that in real life we generally do physics problems without time pressure and with access to resource materials, and I want to see how you perform under those circumstances.

Solution sets for the exams will be available as pdf files linked to the syllabus after the exams are turned in.

V. Additional course policies

1. Prerequisites. This course assumes that you have taken an undergraduate course in quantum mechanics on the level of our department's two-semester sequence, Phys 491 and Phys 492. If you do not have the necessary background, you might have to scramble to keep up in this course.

2. Punctuality. Lectures and other class meetings will start precisely on time; if you're late, tough luck.

3. Getting help from the instructor and TA. You are my first priority, and you are encouraged to get personal help from me at any time. During my office hours, which are 11:00 am to 3:00 pm on Thursdays, I will generally be available to talk to you; at other times I will talk to you unless I have some other, overriding obligation. I am unlikely to be in the department on Mondays and on Friday mornings. You can also get help from the TA, Matthew Chase, at times that will be announced shortly after the semester begins.

4. The instructor's attitude. You will find that you get different responses from me depending on what you're asking about. If you want to discuss any physics aspect of the

course, I pledge to be friendly and to engage you in casual discussion. If you want to know about bureaucratic aspects of the course, I will be more formal—even frosty if I think the information has already been provided to you. If you want an exception to standard procedures—e.g., if you want some special consideration on an exam or if you want an exam problem re-graded—I will require you to write me a memo explaining and justifying your request. If the memo is poorly written, I will return it to you for rewriting.