

Quantum Mechanics (Phys 580)

Syllabus

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1 How to Find Me

The best way to reach me is **e-mail**, edis@truman.edu. Otherwise, you can try calling my office at 785–4583, or faxing me at 785–4045. Until 21:00, you can also try me at home, 665–0491.

I will have office hours from 10:30 to 11:00 and from 13:00 to 13:30 every Tuesday and Thursday, and from 11:30 to 12:20 and 15:30 to 16:20 Wednesdays. Of course, there's a good chance I will be around my office at other times as well. To see what hours I am most likely to be available, check my **typical schedule** (www2.truman.edu/~edis/courses/schedule.html).

I will be using the Internet to post course-related notices and documents. Bookmark the Phys 580 home page: www2.truman.edu/~edis/courses/580.

2 Course Description

This is an introduction to nonrelativistic quantum mechanics, covering the basic mathematical apparatus, going on to solve basic 1D problems, the harmonic oscillator, barriers and tunneling, and the hydrogen atom.

There will be *a lot* of mathematical formalism involved. I will assume you already have a solid background in Mathematical Methods (Phys 382), including PDEs (particularly the wave equation), complex numbers, and Fourier analysis. You will also benefit from experience with Linear Algebra, particularly eigenvalue problems. For basic physical background and

motivation, I will assume you remember what you learned in your Modern Physics sequence. Finally, I will also on occasion call on concepts which should be familiar to you from Classical Mechanics, such as Hamiltonians.

This is one of the most advanced courses you will take in your undergraduate career. Perhaps more so than with what you have taken before, just getting the hang of solving some typical problems will not be enough. You will need to *read* your textbooks carefully, and work through the math as you go along. Unfortunately, human brains are not quite built for quantum mechanics; it can be very difficult to get an intuitive physical picture of what's going on. While I will try and use visual illustrations as much as possible to help, in the end, you will get nowhere with quantum mechanics unless you get the hang of the mathematics.

3 Schedule

Class: Tuesday and Thursday 9:00–10:20, MG 1099.
Wednesday 10:30–11:20, MG 3000.

I will not set aside a fixed hour as a recitation, though I will try to do it on Wednesday 11:30 as much as possible. Recitation hours will be devoted to problem solving; how much of this will be done by me and how much by you is something we will negotiate.

4 Course materials

Your primary textbook will be Richard L. Liboff, *Introductory Quantum Mechanics*, 4th edition. This is a classic textbook. I will follow this in outline and many of the details I cover in lectures. Liboff will also be the source for homework assignments. We will probably get to about chapter 11 (out of 16). The other chapters will also be worth looking at for you; Liboff is a good reference book.

5 Homework

Homework is *important*. It will determine 30% of your final grade.

5 HOMEWORK

I will post a list of homework problems most every week. They will be due in one week, unless I explicitly state otherwise.

I do not mind you discussing the homework with one another as well as with me. I will give small hints if you come by my office and ask. However, I expect you to turn in the results of your own efforts—not group solutions, and certainly not solutions directly borrowed from someone else. If I find homeworks too similar to each other, especially if they make the same mistakes, you will have some explaining to do.

I care about maintaining academic integrity, and I will apply all Truman policies. See studentinvolvement.truman.edu/handbook/conduct.html for the **Student Conduct Code**.

Here is the list of your homework and recitation assignments. I will announce in class when they are due.

Chapter	Homework	Recitation
3.	2, 4, 11 , 15, 16, 19, 20, 23	5, 9, 10, 12, 17, 22
4.	5, 8, 9, 12, 14, 16, 35, 36	4, 10, 11, 15, 17, 22
5.	2 , 11, 18, 21, 25 , 28, 50, 51	5, 9, 19, 30, 37, 52
6.	7, 13, 18, 20, 21, 23	11, 16, 19, 32
7.	5, 9, 15, 18, 30	10, 13, 27
7.	37, 40, 45, 57	38, 41, 46
8.	7, 16, 22, 26	8, 9
9.	3, 9, 23, 26	4, 7, 21, 25
10.	9, 10, 19, 24 , 31 , 38 , 43	4, 15, 30, 33, 46
11.	6, 45, 47, 51	7, 17, 50

All homework problems are worth 10 points, except those that are 5 points, **15** points, **20** points, or **25** points.

We will do the recitation problems assigned for each chapter before the homework is due. You won't be graded on the recitations, though I will ask you to come up and solve them before the class. You don't have to get them right, and getting stuck is OK—I'll be there to help. The idea is to have me see you how you approach these things and help set you on the right path.

6 Exams

How we do the exams is up to negotiation. The default option is two take-home exams with somewhat lengthy questions, each determining 35% of your final grade. If you prefer another arrangement, ask in class.

I expect you to work on all exams strictly alone, without discussing it with others.

7 Final grades

As with every other aspect of the course, I intend to be flexible. If you get less than 50% in your overall grade, you will certainly fail, and 90% or better will certainly be an A, but otherwise, I don't want to declare rigid boundaries such as "65%-77% is a C" and so forth.

If you want to know how you are doing, or what sort of performance on the final you would need for an A, or have similar grade-related concerns, just stop by my office and ask. I should be able to give you a fair estimate of where you stand.

8 Make-Ups

It is hard to arrange for make-ups for exams or homeworks in a course like this. So I expect you will do everything possible to turn your work in on time, and so avoid later hassle for both me and yourself. I post solutions on the course web site; once they are up, it's too late to hand that work in.

Nevertheless, you may find you have missed something because of a legitimate excuse like being badly sick or having a death in your family. In this case, come and speak with me, and I will decide, on a case-by-case basis, how to make up what you have missed. I will typically assign you some appropriate extra work, have you take a make-up exam in my office, or something similar.

9 Outline of Topics

I intend to start real quantum mechanics as soon as possible, with little review. You may benefit from reading through Liboff chapter 1, to remind yourself of some classical mechanical concepts. Liboff chapter 2 may be useful to remind you of some of the basic experimental and introductory territory covered in your Modern Physics course. I will, however, leave these to you. I suggest reading them through at least cursorily, and deciding yourself how much you need to refresh your memory.

Liboff chapters 3–5 is the basic formalism of quantum mechanics. We will cover this, sticking fairly close to the book, and skipping very little if any.

Liboff chapter 6 I will cover, but quickly.

Liboff 7.1 to 7.8 we will do in some detail. Liboff 7.9–7.11 we will probably have to skip.

Liboff 8.1–8.3 we will do. Other sections in chapter 8 will depend on how far we have come along; if we are short on time, I will skip them.

Liboff 9.1 to 9.3 on angular momentum, we will do more or less completely. 9.4 and 9.5 I might skip. 10.1–10.6 we will do; others are unlikely.

I will cover the basics of chapter 11, on spin.

Anything more depends of how much time I have left over—I may try and do some basic relativistic quantum mechanics if I have the time.

I may change things in this outline according to how I perceive you're learning things, and where your interests seem to be. To help me make these decisions, please give me feedback as we are going along.