

Quantum Mechanics (PHYS 580)

Syllabus

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1 How to Find Me

The best way to reach me is [e-mail](mailto:edis@truman.edu), edis@truman.edu. I usually respond within a few hours, even late at night.

My office is MG 3004, and my office hours are: Tuesdays and Thursdays: 12:00–13:20 and 16:30–17:20; Wednesdays: 11:30–12:20 and 15:30–16:20. If you want to see me then, come by my office.

I'm also available most times when I am not actually teaching or have another meeting scheduled: see my [calendar](https://edis.sites.truman.edu/schedule/) (edis.sites.truman.edu/schedule/). We can also Zoom. Email me ahead of time to set up a time that is good for both of us; my Zoom meeting ID is **taneredis**.

Bookmark edis.sites.truman.edu/quantum-mechanics/, the Quantum Mechanics home page. I will post course-related documents there, especially homework and exam solutions.

2 Course Description

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

I will assume you already have a solid background in Mathematical Methods (PHYS 382), including PDEs, complex numbers, and Fourier analysis.

5 HOMEWORK AND RECITATIONS

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 refer to concepts that should be familiar to you from Classical Mechanics, such as Hamiltonians.

This is one of the more advanced courses you will take in your undergraduate career. Just getting the hang of solving some typical problems will not be enough. You will need to *read* your textbook carefully, and work through the math as you go along. It can be very difficult to get an intuitive physical picture of what's going on. You will not get far with quantum mechanics unless you get the hang of the mathematics.

3 Schedule

Class: Tuesday and Thursday 13:30–14:50, MG 3000.
Wednesday 12:30–13:20, MG 3000.

4 Course materials

Your textbook will be David H. McIntyre, *Quantum Mechanics*. I am not going to follow every detail—I picked it as a textbook so that you can see a slightly different approach than what I will present in lectures. Between me and the book I hope you will find something that will work for you.

Depending on our pace, we should have about two weeks toward the end of the semester to play with some more advanced topics of your choice. If you prefer an introduction to condensed matter and many-body quantum mechanics, we will use some of the related material in the book, plus I will give you some outside information in class. If you prefer an introduction to relativistic quantum mechanics, we will have to go entirely outside the book.

5 Homework and Recitations

Homework is *important*. It will determine 25% of your final grade.

I will announce an upcoming set of homework problems approximately every week, and tell you the due date.

I do not mind you discussing the homework with one another as well as with me. I will give 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 taken 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.

Before each homework set is due, we will also solve a couple of recitation problems in class. I won't grade you 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 fine—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.

Chapter	Homework	Recitation
1.	1, 11, 15	12, 14
2.	7, 9, 17, 23	6, 12
3.	2, 6, 9, 14	8, 12
5.	2, 5, 8, 17	9, 20
6.	2ii, 4, 26, 29	2i, 25
7.	15, 26, 29, 11.4	16, 23
8.	7, 8, 11, 13	6, 9
9.	6, 9, 16, 22	11, 15
10.	10, 18, 24	17, 23
13.	3, 8, 11	7, 12

6 Exams

The default option is four take-home exams with somewhat lengthy questions, each determining 25% of your final grade. If you prefer another arrangement, ask in class.

I expect you to work on all exams strictly alone, without *any* discussion with others inside and outside of class. Do not use online resources such as web sites and discussion groups to give you hints or solutions.

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. This is a small class and I will get to know how you do physics fairly well. What will matter most for your grade is my professional judgement about how well you come to understand the fundamentals of quantum mechanics.

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 Attendance Policy

You will need to be present in the classroom to do well in this course. But it's *your* responsibility to make sure you do well. I will not spend time keeping track of your attendance, and if you're not there, I will assume you have good reason to be absent. For example, if you are sick, please stay home! You don't need to tell me when you expect not to be present.

It is very hard to arrange for make-ups for exams or homework 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 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 Academic Integrity

I care about maintaining academic integrity, and I will apply all Truman

11 LAWYER AVOIDANCE

policies concerning **academic dishonesty**. I expect you to be familiar with the **Student Conduct Code**.

Do not present something that is not your own work as your own, whether you get it from another student or online. You will have plenty of opportunity and time to consult me about anything you're not sure about, including during exams. I'm much more concerned with you learning how to think about physics than showing an ability to spit out correct answers on demand.

10 Learning Objectives

By the end of the course, students should be able to:

- Deal with quantum states as vectors in Hilbert space, using Dirac notation.
- Solve basic eigenvalue, measurement probability and time evolution problems, for both discrete and continuous cases.
- Handle linear operators and commutators and know their significance in quantum mechanics.
- Know the more advanced mathematical treatment associated with topics such as symmetry and raising and lowering operators.
- Know the fundamentals of scattering problems.
- Solve rotationally invariant 3D systems, such as the H atom.
- Know the basics of perturbation theory.

11 Lawyer Avoidance

Some of the required small print.

Truman policy and federal regulations require that students demonstrate that they are academically engaged in the courses they take. You must meet this requirement within the first calendar week of the semester, beginning at 12:00 am on Monday, August 18 and ending 11:59 pm Saturday August 23. Failure to do so, or to provide an explanation of an extenuating circumstance by that date and time will result in your removal from the course. Under certain circumstances, removal could impact your scholarship eligibility or financial aid. For the purposes of this class, establishing academic engagement requires, at a minimum, showing up at a lecture or lab.

The minimum investment of time by the average Truman student necessary to achieve the learning goals in this course are not less than one hour (50 minutes) of classroom instruction and a minimum of two hours of out of class student work each week per credit hour awarded or at least the equivalent of three hours (2:50) of laboratory work, internships, practica, and other academic work each week per credit hour awarded. This average time per week for an average student may have weekly variations. This class is worth 4 credit hours. Students will be expected to spend about 8 hours on coursework, which will consist of work on the current assignment due, extra problem solving, exam preparation, and finishing up of lab write-ups.

Education records are protected by the Family Education Right to Privacy Act (**FERPA**). As a result, course grades, assignments, advising records, etc. cannot be released to third parties without your permission. There are, however, several exceptions about which you should be aware. For example, education records can be disclosed to employees or offices at Truman who have an "educational need to know." These employees and offices may include your academic advisor, the Institutional Compliance Officer, the Registrar's Office, or Student Affairs depending on the type of information.

Behavior that persistently or flagrantly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be asked to leave class pending discussion and resolution of the problem and may be reported to the Office of Student Conduct.