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**Course home page:**

[http://atomoptics-nas.uoregon.edu/~dsteck/teaching/20spring/phys633](http://atomoptics-nas.uoregon.edu/~dsteck/teaching/20spring/phys633)

**Nominal Schedule:** TTh 10-11:50a (not meeting times; see below)  
**Virtual Meeting Schedule:** TTh 11a-12p, WF 12p-1p (see notes page for Zoom meeting info)  
**Course reference number:** 35209  
**Credits:** 4  
**Prerequisite:** PHYS 632

**Links:** news, readings/notes, homework sets and keys.

**Course overview**

This course is a more-or-less standard introduction to quantum mechanics at the graduate level, one of the core components of your Ph.D. studies. This is the third of a 3-quarter sequence.

**Text:**

You don’t need to purchase a textbook for this course. The main reference for this course will be online notes posted [here](http://atomoptics-nas.uoregon.edu/~dsteck/teaching/20spring/phys633). You will also receive specially formatted daily versions of the relevant notes.
Philosophy of This Course:

By this point, you have already survived two terms of quantum mechanics at the graduate level. Good work! I intend for this third term to be a little different, more of a transitional course between core and advanced graduate physics courses. This means: less focus on you proving that you can handle graduate-level material; less formality in exams than in previous terms; more advanced material; and solving more sophisticated problems.

In particular, unlike previous terms, there will be no midterm exam; most of your graded work this term is homework, and working through notes (more on this below). There will be an oral final exam. More on this soon.

Special Considerations:

The COVID-19 pandemic is complicating things a bit this term. Consistent with UO's operations statement, all meetings for this class must be remote. This is a new regime for this class, so I'll outline the initial plan here (as we discussed in class last term). But we should be flexible, and we may need to change things as the term goes along if this isn't working.

In place of traditional lectures I'll give you a set of written notes on each lecture day, roughly equivalent to what we'd cover in a normal lecture. These will be edited and more self contained compared to the corresponding material in the main set of notes, with short exercises sprinked throughout where you will fill in some intermediate steps and answer simple questions. The idea is that the time when you should work through these is during the nominal lecture time, but of course this is somewhat flexible. We will then have virtual meetings to discuss the material:

- One Zoom meeting in the second hour of each nominal lecture time (TTh 11-12); the idea of these meetings is for you to have a chance to ask questions if you got stuck on any of the material. These would generally be questions that you'd ask individually, but of course anyone can join the meeting and listen in.
- One Zoom meeting on the day after each nominal lecture time (WF 12-1); the idea is that you've gone through the reading of the day by this point, and we can talk about the material as a group. This is a good chance to hear what your classmates thought, to ask questions, and to hear what questions other people have.

The online meetings are optional, but I highly recommend taking advantage of them. I'm nominally budgeting an hour for each meetings, but I'd guess that they won't usually go
that long, which is fine. It's also fine if they go longer. Of course, you can also ask me questions by email or set up other meeting times.

The reason I really like this approach for this term is that it models how you learn new things as a professional scientist. Researchers learn new things all the time, and usually don't have access to courses on the subject, just books, articles, lectures, and conferences. You will have to experiment a bit to see what works for you, but for me personally, writing out and working through the steps on paper (or in LaTeX) is how I learn things that I actually need to understand. The difference between reading material (or hearing it in a talk) and really working through it is literally the difference between a vague understanding and a solid understanding of the subject. Even after this, you may not understand everything (or you may not have made all the connections that you can to other things you know), in which case discussing the material with colleagues and in particular tracking down experts and asking them questions gets you to the next level of mastery. (This is why physics departments have visitors to give seminars and colloquia, after all.)

Grades

Again, the intent is for this to be a transitional class between core and advanced graduate courses, and as such will be less formal in terms of evaluation. Grades for the course will be based on completing the reading assignments, homework problems, and a final exam. (No midterm) The relative weights will be as follows:

- Daily Reading: 20%
- Homework: 40%
- Final exam: 40%

Daily Reading: this is the reading for each lecture day mentioned above. These will be available online by the night before each lecture day. You should turn in (by email) your work through the daily readings for each week together, by the following Monday. I'll grade these mostly on completion (if you do a reasonable job, you should get full credit). Please try to make legible, data-efficient scans. You probably won't have access to department scanners, so if you have a scanner at home use that; otherwise, try out a scanner app for your phone or tablet (I've used Scanner Pro on iOS, which is cheap and works well, but there are many other options available).

Homework: each daily reading will include a homework problem or two. You should assemble your solutions and email them to Wes every two weeks. (Thus there will be five total assignments.)
Final exam: The final exam will be an oral exam. These will be scheduled individually during finals week or the last week of class (as convenient for you, to avoid conflicts with other exams). Details remain to be worked out, but Zoom will be involved.

Pass/fail grading option: Since this is a core graduate course, you should take the graded option.

Syllabus

This is an incredibly tentative list of topics we will cover this term. Note that the topics listed are too much to go through in one term, and I'll have to rethink some of these given the lectureless nature of the course.

1. Hydrogen atom (overview)
2. Resolvent operator
3. Time-independent perturbation theory (continuation and applications)
4. Time-dependent perturbation theory
5. Fermi Golden rule, decaying quantum systems
6. Path-integral quantization
7. Dissipation in quantum mechanics (?)
8. Scattering theory (?)
9. Second quantization (?)
10. Relativistic quantum mechanics (?)
11. Constrained quantization (?)