Professor Tim Cohen

PHYS 415

Quantum Physics

Winter 2017

MW, 10:00 - 11:50 am

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Course website (Canvas): `https://canvas.uoregon.edu/courses/77270`

This syllabus serves to establish the rules of the course and a sense of what material will be covered. Note that some aspects may evolve as the semester progresses.

Course Description: The purpose of this course is to build on the foundation set in PHYS 414. Particular emphasis will be placed on computing the spectrum of Hydrogen, including the fine and hyperfine structure corrections. In the process we will also cover how to quantize spin and angular momentum, including the addition of multiple contributions to the total angular momentum of a system. In order to round out the course, two additional topics will be covered. The first is the WKB approximation and the application to tunneling phenomena. The second will be to formulate quantum mechanics using the path integral approach.

Prerequisite(s): PHYS 414.
Credit Hours: 4

Required Text: *Introduction to Quantum Mechanics*, 2nd Edition
Author: David J. Griffiths; **ISBN-13:** 978-0131118928

Supplementary Text: *A Modern Approach to Quantum Mechanics*, 2nd Edition
Author: John S. Townsend; **ISBN-13:** 978-1891389788

Supplementary (Advanced) Text: *Lectures on Quantum Mechanics*, 2nd Edition
Author: Steven Weinberg; **ISBN-13:** 978-1107028722

Course Objectives:

At the completion of this course, students will have knowledge of the following topics:

1. Quantum mechanics in 3D
2. Angular momentum, spin, and addition of angular momentum
3. The Hydrogen atom, including fine and hyperfine structure
4. Perturbation theory
5. The WKB approximation and tunneling
6. The path integral

Grade Distribution:

Homework	25%
Midterm Exam	35%
Final Exam	40%

Letter Grade Distribution:

A	≥ 90
B	< 90 and ≥ 80
C	< 80 and ≥ 70
D	< 70 and ≥ 60
F	< 60 and ≥ 50

Note that + and − beyond the letter grades will be assigned as appropriate. I reserve the right to curve grades up if I feel it is warranted.

Course Policies:

- **General**
  - Computers and tablets are not to be used. If you think you can take notes with your device, discuss it with me and if I will consider granting an exception.
  - Cell phones should be silenced, and are not allowed to show their glowing little faces.
  - Exams are closed book, closed notes.
  - **No makeup exams will be given unless previously discussed.**
- **Homework Assignments**
  - Homework will be assigned every Monday.
  - Homework is due at the beginning of class each Monday.
  - **No late assignments will be accepted under any circumstances**.
  - The final homework will be assigned during dead week.
  - Each homework problem will be graded on a $\checkmark^+$, $\checkmark$, $\checkmark^-$, $\emptyset$ scale. Problems can be weighted as different percentages of the total score.
  - The lowest homework will be dropped.
  - Solutions to the homework will be posted online (via canvas) in a timely fashion.
  - It is *highly* recommended that you work on the homework together in groups (but of course you must turn in your own work).

Academic Honesty:

Clearly cheating is not acceptable. In particular, you might find solutions manuals to the problems online. Use of these solutions is not allowed. If it becomes clear that your homework is derived from the online solutions then disciplinary action will be taken.

The UO policy on academic honesty can be found here
`https://uodos.uoregon.edu/StudentConductandCommunityStandards/AcademicMisconduct.aspx`

(Very) Tentative Course Outline:
QM is very confusing and it is unlikely that just listening to lectures and working problems is enough. In other words, I highly recommend reading our book (and others). This schedule will give you a sense of the topics I hope to cover and the pace I would like to keep. This is pretty aggressive and so the dates are very likely to be pushed back. That is why we have a buffer week at the end.

Date	Content
1/9 (M)	• Review the syllabus • Schrdinger equation in spherical coordinates • Reading assignment: Ch. 4.1
1/11 (W)	• Infinite spherical well and Hydrogen • Reading assignment: Ch. 4.1 and 4.2
1/16 (M)	• No class (MLK day)
1/18 (W)	• The Hydrogen atom • Reading assignment: Ch. 4.2
1/23 (M)	• Angular momentum • Reading assignment: Ch. 4.3
1/25 (W) and 1/30 (M)	• Spin • Reading assignment: Ch. 4.4
2/1 (W)	• Addition of angular momenta • Reading assignment: Ch. 4.4.3
2/6 (M)	• Buffer/review
2/8 (W)	• **Tentative Mid-term**
2/13 (M)	• Nondegenerate perturbation theory • Reading assignment: Ch. 6.1
2/15 (W)	• Degenerate perturbation theory • Reading assignment: Ch. 6.2
2/20 (M) and 2/22 (W)	• The fine structure of hydrogen and hyperfine splitting • Reading assignment: Ch. 6.3, 6.5
2/27 (M)	• The Zeeman Effect • Reading assignment: Ch. 6.4
3/1 (W) and 3/6 (M)	• The WKB approximation and tunneling • Reading assignment: Ch. 8
3/8 (W) and 3/13 (M)	• The path integral • Reading assignment: Handout
3/15 (W)	• Buffer/review