PHYS 2210: Quantum Physics I

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Fall 2023

This Fall 2023 4-credit course consists of 14 weeks of lectures (each lecture will last 110 minutes) scheduled each Tuesday/Friday at 10:00am-11:50am. Final grades will be calculated as an average of grades from homework assignments, in-class assignments and exams, as explained below. Rensselaer integrity rules strictly apply to this course.

Course instruction will be held in-person. Office hours will be held online. Assignments will be turned in electronically (please use the pdf format). Graded assignments will be returned via gradescope.

The course will be taught in a flipped classroom format: (i) problems will be solved in class. (ii) students should discuss with one or more classmates when working on assignments.

You are encouraged to use Discord for communicating with your classmates. Teaching assistants and class facilitators can also be reached using Discord.

1 Office hours

Two office hours will be available each week.

- Instructor: Tuesdays at 2pm or by appointment (online, https://rensselaer.webex.com/rensselaer/j.php?MTID=m0d691a78830cdeb1b67a136e5075b2ed)
- Teaching Assistant:
  - Kai Wagoner-Oshima (wagonk2@rpi.edu), office hours: HBH, JROWL 1C28, Thursday, 11pm to 1pm
- Classroom Facilitators:
  - TBA
- Links to lectures and office hours will be posted on LMS.

2 Reference Materials

The course will closely follow 'Quantum Physics: A Fundamental Approach to Modern Physics' by John S. Townsend, First Edition. University Science books. Lecture notes will be made available on LMS. LMS will be the main means for information sharing (including all homework submission).

3 Prerequisites

Required coursework: PHYS 1200 (Physics II) or PHYS 1250 (Honors Physics II). MATH 1020 (Calculus II). Please see me if you have concerns about this.

4 Assignments and Grading

Attendance: Attending classes is required.
In-class assignments: Students will use a loose leaf notebook to do the in-class assignments. Upload an electronic version of the assignment to LMS by midnight the day of the lecture.

Exams: Three exams will be organized. Students will be tested on their ability to solve problems similar to the ones covered in class and in homework assignments. Students will be allowed to use a one-sided crib sheet. Each exam will have two parts: (i) students work individually to solve problems, (ii) students work in pairs to solve problems. Two scores are calculated, the individual score and the mean of the paired work scores. The higher of the two scores is used as the final score.

Homework: No late homework. Homework must reflect the student's own ability and effort. Discussions with classmates and TAs are encouraged. Work copied from the solution book or similar resources will not be graded.

- Homework assignments: 10% (see schedule for due dates)
- In-class problems: 20% (due at the end of each class)
- Exam-1: 20% (10/05/2023, class time)
- Exam-2: 20% (11/07/2023, class time)
- Final exam: 30% (12/08/2023, class time)

5 Syllabus

A list of the topics to be covered is presented below. See the class schedule for details.

1. Math Background I
2. Math background II
3. Wave nature of light
4. Particle nature of light
5. Wave nature of matter
6. Schrödinger Equation
7. Wave packets
8. Expectation values
9. Particle in a box
10. Functional vector space
11. Energy eigenvalue problems
12. Simple harmonic oscillators
13. Finite potential wells
14. Scattering from stepped potentials
15. Quantum tunneling
16. Quantum postulates
17. Commutation relationships
18. 3D problems
19. Angular momentum
20. Spherical harmonics
21. Hydrogen atom
22. Zeeman effect
23. Intrinsic spins
24. More on quantum mechanics

6 Diversity

We value the voice of every student in the course. Our diversity as a class – in race, gender, sex, religion, language, ability, veteran status, place of origin – is an asset to our learning experience. As a result, we will design inclusive lessons and assignments that provide you with the opportunity to speak and be heard, explore your own understanding, and encounter each other.

7 Accommodations

We all learn differently, and we want every student to succeed in the course. If you have a learning need or disability, please contact Student Life office so that they can provide the appropriate documentation for accommodations.

8 Academic Integrity Policy

Students taking courses at Rensselaer have a right to expect that their work will be evaluated fairly with respect to other students. They have a right to expect that other students will not attempt to enhance their own grades or the grades of their friends by cheating. Professors have a right to expect that their students are honest and submit work reflecting their own efforts. In an atmosphere of academic integrity, students and professors are on the same team trying to achieve the same learning objectives. If you attempt to cheat, you are placing yourself in a position where you are at odds with your professors and the vast majority of your fellow students. Academic dishonesty is a serious offense and we will treat it accordingly.

Students are expected to actively participate in a collaborative group when working on the in-class activity. You can obtain help from other students in the class when you are working on your project. However, the final product must be your own. Turning in work that is not your own will result in an F for the course and a letter will be sent to the Dean of Students.

Cheating in any of the graded activities in this course will result in an F for the course.