

## PHYSICS 5302: QUANTUM MECHANICS 2

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**schedule:** MWF, 9:00 - 9:50, Sci 112

**Textbook:** R. Shankar, *Principles of Quantum Mechanics*, 2<sup>nd</sup> ed. (Kluwer, NY, 1994)

### Covered in PHYS 5301:

1. **Introduction to QM** (more than in chapter 3)
2. **Mathematical background and notation needed for QM** (chapter 1)
3. **From Classical Mechanics to QM: key points of the Lagrange and Hamilton formulations** (chapter 2)
4. **Postulates of QM** (chapter 4, parts of chapter 9)
5. **Problems in 1 dimension: free particle, potentials, harmonic oscillator, tunneling** (chapter 5+7)
6. **3D problems: angular momentum, free particle, harmonic oscillator, H atom** (parts of chapters 11-13)
7. **The spin** (chapter 14)

### Coverage in PHYS 5302:

1. **Review: key results of PHYS 5301**
2. **Finish the spin** (chapter 14), **addition of angular momenta** (chapter 15)
3. **Time-independent perturbation theory** (chapter 17)
4. **Time-dependent perturbation theory** (chapter 18)
5. **Systems of identical particles** (parts of chapter 10)
6. **Scattering theory** (parts of chapter 19)
7. **Introduction to relativistic QM** (parts of chapter 20)
8. **Special project to be selected by the students**

### Grades:

Four **homeworks** will be assigned and graded.

Two **tests** are scheduled from 8:30 to 9:50 am on Fridays February 20 and April 17. They will consist of general questions and problems.

Each student will select a **special project**, write a *report* and give a *15-minutes lecture* in class on the topic. The written report and the presentation will be graded. There will be no final.

The **semester average** is calculated as {avg. HW + test1 + test2 + project report & talk}/4.

**Grades:** A = 100-86; B = 85-72. Should you decide to perform below that, C's extend from 71 to 62 and D's from 61 to 52. Don't make an F.

The special project must be an extension of the material covered in PHYS 5302, that is begin with material covered in class and then move on to new territory. We must agree on your topic by Monday February 23. The written report is due on Wednesday April 15. The report is limited to 6 single-spaced one-sided letter-size pages, 12pt font. It includes (a) an introduction explaining the connection to material covered in class, (b) basic theory (mathematical formulation), (c) application, (d) conclusion and references.

### Objectives:

Develop an understanding of the foundations of QM, including time-independent and time-dependent perturbation theory, scattering theory, quantum statistics of fermions and bosons, scattering theory, and basic relativistic quantum mechanics.

### Outcomes:

After completing this course, graduate students should be

...familiar with all the aspects of fundamental quantum mechanics, their physical meaning and implications,

...comfortable with the mathematical tools specific to QM,

...able to apply QM to the issues such as atomic transitions and lasers, stellar evolution, the origin of the spin.

In-class discussions, problems in the homeworks and tests, and a special project will address the attainment of these issues.

### Students with disabilities:

Any student who, because of a disability, may require special arrangements in order to meet the course requirements should contact the instructor as soon as possible to make any necessary arrangements. Students should present appropriate verification from Student Disability Services during the instructor's office hours. Please note instructors are not allowed to provide classroom accommodations to a student until appropriate verification from Student Disability Services has been provided. For additional information, you may contact the Student Disability Services office at 335 West Hall or 806-742-2405.

### Religious holy days:

Texas House Bill 256 requires institutions of higher education to excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holy day. The student shall also be excused for the time necessary to travel. An institution may not penalize the student for the action and allows for the student to take an exam or complete an assignment from which the student is excused. No prior notification of the instructor is required [**note added:** but would be highly appreciated because exams in this class are easy to reschedule].