Instructor: Dr. Paul Simmonds

Contact info. (208) 426-3787; paulsimmonds@boisestate.edu

Note: I will respond to emails received after 5pm by 10am the next day. For emails received at the weekend, this means the following Monday.

Office MP422 (Multipurpose Classroom Building, MPCB).

Office hours Mondays, 11am–12pm; Wednesdays, 2–3pm; or by appointment.

Class prerequisites PHYS 212 (Physics II w/ calc.); MATH 275 (Multivariate vector calc.).

Class time/place Tuesdays/Thursdays, 4.30–5.45pm, MP108 (MPCB)

Class website See Blackboard for syllabus, lecture notes and assignments.

1. Class objective

To develop a working knowledge of the principles governing quantum physics, forming a basis for critical and analytical reasoning, and leading to continued learning. We will apply concepts in class to describe the elementary behavior of electrons, atoms, molecules and condensed matter. This material is applicable to many fields, including chemistry, materials science, and microelectronics.

This objective aligns with University Learning Outcome 8: “Disciplinary Lens: Natural, Physical, and Applied Sciences - Apply knowledge and the methods characteristic of scientific inquiry to think critically about and solve theoretical and practical problems about physical structures and processes.”

2. Summary

Regular classes will consist mainly of a lecture with mathematical derivations and qualitative reasoning, along with class discussions. Final grades will be based on homework, just-in-time teaching assignments, and exams.

Although attendance and active participation is expected at all lectures, I also appreciate that on rare occasions people may miss a lecture for a legitimate reason (e.g. sickness). However, the onus is on you to find out from your classmates what you missed and catch up. Each lecture builds on previous
ones. If you miss a lecture but don’t catch up on the class notes, reading or assignments, it is likely that you will find subsequent lectures difficult/impossible to follow.

In general, if you are having trouble with the course, tests, homework, anything, please let me know **as soon as possible**. I’m very reasonable and approachable, and I know that some of the material we will cover is tough! If you have struggled with a problem and tried your best, asking for help is not admitting defeat! Remember to take advantage of office hours to go over things that don’t make sense.

3. **Accommodating disabilities**

Students with disabilities needing accommodations to fully participate in this class should contact the Disability Resource Center (DRC). All accommodations must be approved through the DRC prior to being implemented. To learn more visit the DRC website.

4. **University support of student wellbeing**

Boise State is committed to the safety and wellbeing of students, faculty and staff. You can help identify and assist members of our campus community who may be at risk. If you are concerned about someone’s behavior or safety, or are in need of support yourself, please submit a report to the CARE Team.

5. **Academic integrity**

Academic integrity will be strongly enforced in this course. Any student caught cheating on any assignment or exam may fail the assignment or exam in question, or fail this course, dependent on a hearing with the course instructor. Additional disciplinary action may be pursued through the Office of the Dean of Students. All students are required to adhere to Boise State’s **Student Code of Conduct**, in particular to Sections 4D and 7 on academic dishonesty, cheating, classroom misconduct, and plagiarism. Plagiarism (presenting other people’s work as your own) can include copying another student’s work, using exam or problem solutions from a previous semester, or solutions found on the Internet. Allowing others to copy your work will be treated the same way as plagiarism. Plagiarism will not be tolerated and could have severe consequences.

**Bottom line:** *be honest, and contact me if you have any questions.*

6. **Textbooks**


See Blackboard for important note regarding this text and possible alternatives.
7. Lecture schedule and assigned reading

This schedule may change during the semester. Use the assigned reading to supplement the material presented in class. The reading sections correspond to *Thornton and Rex*; if using an alternative text and need guidance, see me. *Before class, you are expected to read both the text and class notes, and complete any JTT assignments. Use office hours or class to ask any questions.*

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<tr>
<th>Week</th>
<th>Monday date</th>
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| 1    | 8/24        | Motivation / Blackbody radiation  
Tue. Historical intro.; Thu. 3.5 |
| 2    | 8/31        | Photoelectric effect / Bohr hydrogen model  
Tue. 3.6; Thu. 4.3–4.5 |
| 3    | 9/7         | Probability / Wave functions and operators  
Tue. 5.2, 5.5; Thu. 5.7, 6.2 |
| 4    | 9/14        | Schrödinger equation / Copenhagen interpretation  
Tue. 6.2; Thu. 6.1 |
| 5    | 9/21        | Free particles: Wave packets / Uncertainty principle  
Tue. 6.1 (cont’d); Thu. 5.4, 5.6 |
| 6    | 9/28        | Square well potential; Review session / Exam 1  
Tue. 6.3–6.5 (plus review all above); Thu. Exam 1: Oct. 1st |
| 7    | 10/5        | Reading week – No class  
Tue. 6.1–6.7; Thu. 7.1–7.5 |
| 8    | 10/12       | Simple harmonic oscillator / Barriers and tunneling  
Tue. 6.6; Thu. 6.7 |
| 9    | 10/19       | Barriers and tunneling (cont’d) / Angular momentum  
Tue. 6.7; Thu. 7.1–7.2 |
| 10   | 10/26       | Angular momentum (cont’d) / Hydrogen atom  
Tue. 7.3; Thu. 7.2–7.3 |
| 11   | 11/2        | Zeeman effect / Spin  
Tue. 7.4; Thu. 7.5 |
| 12   | 11/9        | Pauli exclusion principle; Review session / Exam 2  
Tue. 7.5, 8.2 (plus review all above); Thu. Exam 2: Nov. 12th |
| 13   | 11/16       | Statistical physics: Classical thermodynamics  
Tue. 9.1, 9.3; Thu. 9.5 |
| 14   | 11/23       | Statistical physics: Quantum statistical mechanics  
Tue. 9.6; Thu. 9.7 |
| 15   | 11/30       | Band theory of solids / Semiconductors  
Tue. 11.1; Thu. 11.2 |
| 16   | 12/7        | Semiconductor devices / Review session  
Tue. 11.3; Thu. Review all reading above |
| 17   | 12/14       | Finals  
Final exam Tuesday, Dec 15th, 5.00–7.00pm |
8 Course work

8.1 Exams: 60% of your grade is based on the exams. The exams are based on the textbook readings, the examples in the text, the homework, and the class lectures and notes. There will be two in-class exams (worth 15% each) and a final exam (worth 30%) all in MP108.

ALL EXAMS WILL BE COUNTED, AND NO MAKE-UP EXAMS WILL BE GIVEN. Scientific and graphing calculators are allowed during exams, but no cell phones, tablets, computers, etc. Students are not allowed to discuss the problems with other students. You may bring one 8.5” by 11” sheet of formulas for each exam.

For both homework and exams, include units of physical quantities or you will lose points.

8.2 Homework: 25% of your grade is based on homework. A list of homework problems and their due dates will be posted on Blackboard. Hand in what you have on the due date, at the beginning of class. NO LATE HOMEWORK ACCEPTED. Homework must be clearly written and easy to follow. Show all your work for full credit. Clearly mark the final result(s) in each problem.

Homework problems will form the basis of many exam problems. Review graded homework and posted solutions, to ensure you understand and can complete every assigned problem.

8.3 Just-in-time teaching (JiTT) questions: 15% of your grade is based on JiTT assignments. JiTT is a teaching pedagogy in which students answer a small number of questions about material in an upcoming lecture. You can use any resource to answer the questions, which will usually necessitate the reading ahead of class notes, textbook resources, online research, etc. Answers are due two hours before the beginning of class, and I will use your responses to tailor the discussion of the relevant material during the class period. There may not be a JiTT question for each class: please check Blackboard for JiTT assignments.
JiTT questions are scored using the following rubric. Note that these questions differ from the homework in that most credit goes towards level of effort rather than accuracy of the answer.

**Points JiTT scoring criteria**

2 Student shows prior knowledge; may use terminology, and appropriate information from the text or lecture notes to answer the JiTT question. *(Correct/partially correct answer)*.

1 Student attempts an answer but shows no evidence of previous knowledge, or may reveal misunderstanding of concepts. Student does not use information from the text or lecture notes to answer the question. *(Incorrect answer)*.

0 Student does not answer the JiTT question.

**9 Grading**

Grades will be curved, according to those who turn in each assignment. Not handing in work will thus not lower the curve and will likely be quite detrimental to your final grade.

- **A:** 88–100 % *(A−: 88–90 %; A+: 98–100 %)*
- **B:** 75–88 % *(B−: 75–77 %; B+: 85–87 %)*
- **C:** 60–75 % *(C−: 60–62 %; C+: 73–75 %)*
- **D:** 45–60 %