Instructor: Dr. Paul Simmonds

Contact info. MP422; (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 hours

With me: Tuesdays, MP422, 3:00–4:00pm (or by appointment).
With TA: Thursdays, MP304, 1:30–3:30pm.

Class time/place Tuesdays & Thursdays, 4:30–5:45pm, MP211

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

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

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 JiTT assignments. Use office hours or class to ask any questions.

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<tr>
<th>Week</th>
<th>Monday date</th>
<th>Topics</th>
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| 1    | 8/22        | Motivation / Blackbody radiation  
Tue. Historical intro.; Thu. 3.5 |
| 2    | 8/29        | Photoelectric effect / Bohr hydrogen model  
Tue. 3.6; Thu. 4.3–4.5 |
| 3    | 9/5         | Probability / Wave functions and operators  
Tue. 5.2, 5.5; Thu. 5.7, 6.2 |
| 4    | 9/12        | Schrödinger equation / Superposition of states  
Tue. 6.2; Thu. 6.1 |
| 5    | 9/19        | Free particles: Wave packets / Uncertainty principle  
Tue. 6.1 (cont’d); Thu. 5.4, 5.6 |
| 6    | 9/26        | Square well potential; Review session / Exam 1  
Tue. 6.3–6.5 (plus review all above); Thu. Exam 1: Sep. 29th |
| 7    | 10/3        | Simple harmonic oscillator / Barriers and tunneling  
Tue. 6.6; Thu. 6.7 |
| 8    | 10/10       | Barriers and tunneling (cont’d) / Angular momentum  
Tue. 6.7; Thu. 7.1–7.2 |
| 9    | 10/17       | Angular momentum (cont’d) / Hydrogen atom  
Tue. 7.3; Thu. 7.2–7.3 |
| 10   | 10/24       | Zeeman effect / Spin  
Tue. 7.4; Thu. 7.5 |
| 11   | 10/31       | Pauli exclusion principle; Review session / Exam 2  
Tue. 7.5, 8.2 (plus review all above); Thu. Exam 2: Nov. 3rd |
| 12   | 11/7        | Statistical physics: Classical thermodynamics  
Tue. 9.1, 9.3; Thu. 9.5 |
| 13   | 11/14       | Statistical physics: Quantum statistical mechanics  
Tue. 9.6; Thu. 9.7 |
| 14   | 11/21       | Band theory of solids / Thanksgiving - No Class  
Tue. 11.1; Thu. 11.2 |
| 15   | 11/28       | Semiconductor materials / Semiconductor devices  
Tue. 11.3; Thu. TBA |
| 16   | 12/5        | Quantum nanostructures / Review session  
Review all reading above |
| 17   | 12/12       | Finals  
Final exam Thursday, Dec 15th, 3.00–5.00pm |

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8 Course work

8.1 Just-in-time teaching (JiTT) questions 10% of your grade is based on JiTT assignments. In JiTT you will 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, textbooks, online materials, etc. **Answers are due two hours before the beginning of class**, and I will use your responses to tailor our discussion during class. There may not be a JiTT question for each class: please check Blackboard for JiTT assignments.

**Points JiTT scoring criteria**

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<tr>
<th>Points</th>
<th>Description</th>
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<tbody>
<tr>
<td>10</td>
<td>Student attempts JiTT question and provides correct answer.</td>
</tr>
<tr>
<td>8</td>
<td>Student attempts JiTT question but provides incorrect answer.</td>
</tr>
<tr>
<td>0</td>
<td>Student does not answer the JiTT question.</td>
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JiTT questions differ from homework in that most credit goes towards effort rather than getting the answer correct.

8.2 Homework: 25% of your grade is based on homework. Homework problems are posted on Blackboard, and are due every Friday at 4pm in MP420. This is a strict deadline: NO LATE HOMEWORK IS ACCEPTED. Answers must be clearly written, easy to follow, and with the final result clearly marked in each problem. Show all your work for full credit.

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 Exams: 65% 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 mid-term exams (worth 20% each) and a final exam (worth 25%), all held in our usual classroom.

**NO MAKE-UP EXAMS WILL BE GIVEN.** I will provide a formula sheet for each exam. Please bring paper on which to write your answers, and a stapler. With the exception of scientific calculators, no electronic devices are allowed. Discussion with other students is not allowed.

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

8.4 Optional Class Project: You are all invited to take part in a new interdisciplinary project that involves working with students from the College of Education. Participation in this project is entirely optional, but those of you who choose to take part and complete the project requirements will be allowed to drop the lowest of your two mid-term exam scores (i.e. Exam 1 or Exam 2 on page 3 above - this does not include your Final Exam). To help you decide whether you would like to take part, we will discuss details of this project early in the semester.
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: 75–87 % (B–: 75–77 %; B+: 85–87 %)
C: 60–74 % (C–: 60–62 %; C+: 73–74 %)
D: 45–59 %