PHYS 613 – Statistical Physics I – Winter 2023

Welcome to Statistical Physics 1 (PHYS 613, CRN 24399)! The class meets Tuesdays and Thursdays, 10:00 – 11:50 in 318 Willamette. The class will run for weeks 6–10 of Winter term (first lecture Tuesday, Feb 13).

Course website (Canvas): https://canvas.uoregon.edu/courses/235715. Readings, lecture notes and problem sets will be posted on the Canvas site.

Instructors

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Office hours: see Canvas page for up-to-date information

Graduate TA
See Canvas page for up-to-date information

Description

This is the first course in the graduate sequence on statistical physics. It runs for half a term and leads directly into PHYS 614 in the Spring term, for which this course will be a prerequisite.

Course objectives

We will cover the fundamental principles of statistical mechanics and review thermodynamics. These fundamentals will lead into more diverse and modern applications in PHYS 614.

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

- Foundations of statistical mechanics (5 lectures)
  - Probabilities and entropy
  - Statistical ensembles and fluctuations
  - Two-state systems
- Thermodynamics (3 lectures)
  - Laws of thermodynamics (zeroth to third)
  - Thermodynamic potentials and their connection to statistical mechanics
- Entropy, irreversibility, work
- Ideal classical gases (2 lectures)
  - Statistical ensembles for the monatomic gas
  - Ideal gas laws from statistical mechanics

By "working knowledge", I mean that you will be familiar with concepts and techniques at a level that will let you understand their use in the scientific literature, seminars, and colloquia; and (perhaps with additional resources) use them in your research area.

## Course materials

### Course textbook


You are not required to buy the book, because its contents are available as lecture notes of course 8.333 on [MIT OCW](https://ocw.mit.edu). You will have to work out what section of the lecture notes corresponds to a section of the reading, which is relatively straightforward. For instance, Section 2.4 of the book corresponds to section D of part II of the lecture notes, and is found in lecture note 6.

Solved exercises at the end of chapters in the book are reproduced in the *Exams* portion of the OCW website, and unsolved problems are reproduced in the *Assignments* section.

### Other materials

David Tong's [lecture notes](https://www.physics.wisc.edu/~tong/221/) are highly recommended.

I will post lecture notes that are largely self-contained expositions of the course material.

## Communication

### How I communicate with you:

- Class-wide announcements will be posted as Canvas Announcements which are accessible at the Canvas site, as email, or as texts. Please set your preferred notification method under Account -> Notifications.
- The course materials will be organized as weekly Modules on the Canvas site. I will post readings in advance of each week on Friday of the previous week, as well as lecture materials and problem sets within the module for each week.
- I will get in touch with individual students over email.
How (and why) to communicate with me:
I enjoy talking to students and am happy to discuss any aspect of the course, or talk about science/graduate school life. I strongly believe that every student can succeed in this course – please get in touch with me if you are having trouble with any aspect of it so we can work together to facilitate your success. Ways to get in touch are:

- Attend office hours! I aim to host one in-person session and one Zoom/in-person hybrid session each week. Up-to-date information on times and location will be on the ‘Office hours information’ Canvas page.
- Email me (jpaulose@uoregon.edu). I will try my best to respond within one business day.
- I am happy to make additional time to meet outside office hours if you cannot make them or would like to meet one-on-one. Please send me an email to make an appointment.

Course policies and expectations

Grading policy

Grades will be assigned according to the following rubric:

- Problem sets: 60%
- Final: 40%

Problem sets will be assigned weekly, typically on Thursdays, and will be usually due at the start of class on the following Thursday. Each student gets one “late homework pass” for the course: you will be allowed to hand in one problem set up to one week late (with the understanding that you will not refer to the solutions, or discuss them with your classmates, after the solutions have been posted). To use the pass, simply email the instructors. All future late submissions will receive no credit, unless you have discussed any extenuating circumstances with me before the original due date.

The final will be a take-home exam similar in format to a problem set, except that you are not allowed to discuss the answers with anyone. It will be posted in Week 10 and will be due the Friday of finals week.

Additional course policies

- Cell phone use is prohibited during class. Cell phones should be silenced and put away.
- Laptops and tablets are not to be used, except as a note-taking device.
- Collaborating on the homework is allowed and encouraged. However, you have to turn in your own work. It is up to you to make sure that you understand the material independently. You will not be able to collaborate on the exams.
- Much of the points on homework and exams will be assigned for the arguments leading up to the final answer. You will be expected to show your work and demonstrate that you understand the steps involved.
• The teaching assistant will be involved in grading your coursework. If you have any concerns about this, please discuss the matter with me.
• Please do not hesitate to email me to discuss any aspect of the course, including this syllabus!

How to do well in this course

• Engage in the in-class activities. Active learning is a pillar of science-based teaching practices. The worksheets are designed to test and solidify your understanding of the course content through discussion with your peers and your instructor.
• Start working on the problem sets early, and come prepared with specific queries to office hours.
• Study the problem set solutions after they are posted. Even if you obtained full credit, the solutions might provide details that you skipped. Working through them on your own will ensure that you understand the material independently.

Accessibility

I take my responsibility to create inclusive learning environments seriously. Please notify me if there are aspects of this course that result in barriers to your participation. For more information or assistance, you are also encouraged to contact the Accessible Education Center, 164 Oregon Hall, 346-1155; website: http://aec.uoregon.edu/. The AEC offers a wide range of support services including note-taking, testing services, sign language interpretation and adaptive technology.

Academic integrity

It has become quite easy to find solutions to homework problems online. Use of these solutions or similar materials is not allowed: it goes against the pedagogical purpose of graduate school, is unfair to your classmates, and violates the University Student Conduct Code (available at http://conduct.uoregon.edu).