PHYS 614 – Statistical Physics II – Spring 2024

Welcome to Statistical Physics II! The class meets Tuesdays and Thursdays, 10:00 – 11:50 in 318 Willamette.

**Course website (Canvas):** [https://canvas.uoregon.edu/courses/242285](https://canvas.uoregon.edu/courses/242285). Readings, lecture notes and problem sets will be posted on the Canvas site.

**Instructors**

**Jayson Paulose**  
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Email: [jpaulose@uoregon.edu](mailto:jpaulose@uoregon.edu)  
Office hours: see Canvas page for up-to-date information

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

**Description**

This is the second course in the graduate sequence on statistical physics. It builds on material introduced in PHYS 613, which is a prerequisite for this course.

**Course objectives**

We will study advanced topics in statistical mechanics and their applications to a variety of fields of physics.

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

- Quantum statistical mechanics (8 lectures)  
  - Motivations: Diatomic gas  
  - Fundamentals  
  - Ideal Bose gases: Bose-Einstein condensation, photons, phonons  
  - Ideal Fermi gases: White dwarf stars, Pauli paramagnetism
- Interacting systems (6 lectures)  
  - Non-ideal or imperfect gases  
  - The Ising model  
- Phase transitions (4 lectures)  
  - Mean-field theory  
  - Landau theory

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.

**Materials**

Readings will be assigned from the following sources, all available online. See the [Links to online course materials](https://canvas.uoregon.edu/courses/242285) page on Canvas to find all electronic resources in one place.

- *Entropy, Order Parameters, and Complexity*, by James Sethna (Second Edition, 2020; electronic version available [here](https://canvas.uoregon.edu/courses/242285)).
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.

Grading policy, classroom expectations, and attendance

Grades will be assigned according to the following mix:

- Problem sets: 60%
- Midterm: 15%
- Final: 25%

Readings related to each week’s lectures will be posted the week before. Reading the specified sections before class will be useful to follow the lecture and to make the most of the in-class worksheets. In-class worksheets and participation in discussion around them are integral to learning in this course.

Problem sets will be assigned weekly, typically on Thursdays, and will be usually due at the start of class on the following Thursday. The lowest problem set score will be dropped when your aggregate score is calculated.

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 last problem set will be due during the last week of classes (Dead Week). The late homework pass cannot be used for the last problem set.

The midterm will be a take-home exam, to be completed over two hours during a 24-hour period on May 2 (Week 5 Thursday). If it helps your grade, your score on the midterm can be replaced by your score on the final (i.e. the final will count for 40% of the grade).
The final will be a take-home exam. It will be posted during Week 10 and will be due on 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).