Phys 451X: Statistical Physics Syllabus

Spring 2025

Instructor Information

Instructor	Email	Office Location & Hours
Wang Xu (Caleb)	wxu3@alaska.edu	REIC 110, TBD

General Information

Course Description

Physics 451 is a two-credit course that utilizes probability theory and statistics to investigate the behavior of systems made up of large groups of non-interacting classical or quantum particles. These systems include classical examples such as ideal gases and diatomic molecules studied through Boltzmann statistics, as well as quantum systems, like fermions and bosons, which encompass Einstein and Debye solids and blackbody radiation studied through quantum statistics. The course aims to predict and explain the measurable properties of a macroscopic system based on its microscopic states and their probability distributions, all of which can be represented by the partition function. By the end of the course, we will continue to challenge ourselves to investigate a system in which particles interact with one another.

Lecture Schedule

Lectures: REIC 203/Mondays and Wednesdays, 3:30-4:30 pm

Required Text

An Introduction to Thermal Physics by Daniel V. Schroeder (Addison Wesley Longman ISBN: 0-201-38027-7)

Grading Policy

Homework	Quizzes & Attendance	Midterm	Final	Total
45%	20%	15%	20%	100%

Your final grade for this course will be based on a bell curve. The average of the curve will be the breakpoint between letter grades B- and C+. The standard deviation of the grade point distribution will separate subsequent letter grades.

Lecture Schedule

Week	Topic	Reading	Dates	HWK Due Date
Week 1	The Boltzmann Factor	Ch6:1, 6:1-2	01/13, *01/15*	01/24
Week 2	Average Values	Holiday, 6:2	~~01/20~~, *01/22*	01/31
Week 3	The Equipartition Theorem & The Maxwell Speed Dis.	Ch6:3, 6:4	01/27, *01/29*	02/07
Week 4	Partition Function and Free Energy & PF for Composite Systems	Ch6:5, 6:6	02/03, *02/05*	02/14
Week 5	Ideal Gas Revisited	Ch6:7, 6:7	02/10, *02/12*	02/21
Week 6	The Gibbs Factor	Ch7:1, 7:1	02/17, *02/19*	02/28
Week 7	Bosons and Fermions	Ch7:2, 7:2	02/24, *02/26*	03/07
Week 8	Reviews	Review, **Midterm**	03/03, ***03/05***	03/21
Week 9		Spring Break	~~03/10,03/12~~	
Week 10	Degenerated Fermi Gases	Ch7:3, 7:3	03/17, *03/19*	03/28
Week 11	Blackbody Radiation	Ch7:4, 7:4	03/24, *03/26*	04/04
Week 12	Debye Theory of Solids	Ch7:5, 7:5	03/31, *04/02*	04/11
Week 13	Bose-Einstein Condensation	Ch7:6, 7:6	04/07, *04/09*	04/18
Week 14	Weakly Interacting Gases	Ch8:1, 8:1	04/14, *04/16*	04/25
Week 15	The Ising Model of Ferromagnet	Ch8:2, 8:2	04/21, *04/23*	04/30* (optional)
Week 16	Reviews	Review, **Final**	04/28, ***04/30***	

Exam Schedule

Date	Time	Subject
03/05	03:30 pm - 04:30 pm	Mid-term
04/30	03:15 pm - 05:15 pm	Final Exam (TBD)

Additional Requirements & Policy

Attendance Policy:

You are expected to attend classes regularly. If you are absent without a proper excuse for more than 50% of lectures, you will receive a failing grade. Regular quizzes are not counted as lectures.

Homework:

On average, 1-5 problems will be assigned each week on Wednesday. The homework will be due by 3:30 pm the following Wednesday. All homework assignments must be turned in on Canvas. No emailed or otherwise electronically submitted assignments will be accepted. **No late homework will be accepted. No exceptions** (barring emergencies and extreme situations). Group work is encouraged to solve problems. Students are welcome to consult the instructor during office hours or by appointment for additional help with homework. All homework you submit should reflect your own work. Copying homework is absolutely unacceptable and will result in a grade of zero for the assignment.

Quizzes:

Lecture questions will be given in class during the semester. They will be used as an open-book quiz and for attendance. Therefore, group discussions and calculators will be allowed (if needed). After each lecture, your answers to the lecture questions must be submitted to Canvas before the next lecture.

Exams:

There will be one midterm and one final comprehensive exam. The midterm will test the material covered in the first seven weeks, and the final will include material from the beginning of the semester, with more emphasis on the material covered after the second midterm (weeks 9-15). NO MAKE-UP QUIZZES OR EXAMS WILL BE GIVEN. If a student must miss a quiz or an exam and has a legitimate reason, they must notify the instructor prior to the exam that it will be missed. The student must present written, verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc., clearly stating the date AND time of the mitigating problem. If these conditions are met, the makeup quiz or exam will take place within a month of the quiz or exam that the student missed. Otherwise, a ZERO score will be given for the missed quiz or exam. In the event that the Final Exam is taken, under rare circumstances where a student has a legitimate reason for missing it, a make-up final exam will be administered.

Student Code of Conduct:

You are expected to submit work that is your own and properly acknowledge the work of others. You are responsible for understanding and adhering to the Student Code of Conduct that is printed in the UAF Course Catalog. Violations of the Code will be reported to the Dean of Students.

Disabilities Services:

If applicable, it is your responsibility to arrange for these services. The UAF Center for Health and Counseling provides services for UAF students with disabilities to ensure equal access to educational opportunities. The Center's Disability Services Program ensures compliance with §504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990. If you believe you are eligible for 504 and/or ADA accommodations, please contact them at 474-7043 (WHIT 203).