

# PHYSICS 4230 SYLLABUS, Spring 2021

Lectures: MWF 4:10-5pm (DLC 1B70)  
Instructor: Prof. Bethany Wilcox  
Email: [Bethany.Wilcox@colorado.edu](mailto:Bethany.Wilcox@colorado.edu) (best way to get a hold of me outside of class)  
Office: Duane F-1017 (physics tower)

Office hours (tentative):  
After class for quick questions via Zoom  
Help Sessions (via [Gather.Town](#)):  
Monday 5-6pm  
Tuesday 4-5:30pm  
Or by appointment (just email!)

Web page: **CHECK THIS REGULARLY!**  
<http://www.colorado.edu/physics/phys4230> is the public page.  
This will link to Canvas where all course materials will be hosted.

*Any information in this syllabus is as accurate as possible at the time of writing. Announcements about changes of any kind will be made in class, and posted on the web, and will take precedence over this syllabus. You are responsible for what is said in class, whether or not you are in attendance.*

## Course Overview

Thermodynamics and statistical physics are our basic framework for understanding the behavior of physical systems made up of a large number of particles. Thermodynamics, which we will study first, tells us how macroscopic properties like energy, entropy, and temperature, are related to each other. These relationships are extraordinarily general, and don't depend much on a detailed knowledge of the system being studied. For example, while much of thermodynamics was developed in the 19th century and was motivated by the study of steam engines, it places fundamental limits on the performance of digital computers! Statistical mechanics, among other things, gives us a means to calculate thermodynamic quantities for particular systems. In the first part of the course, we'll develop the basic concepts of thermodynamics and, to help understand these concepts, we'll introduce and study some simple macroscopic systems along the way (using some simple statistical mechanics). In particular, we'll use the ideal gas and the Einstein model of a solid to get intuition about thermodynamical ideas. In the later part of the course, we'll turn our attention more fully to statistical mechanics, learning about partition functions and what they're good for, and looking at the quantum statistical mechanics of identical particles.

## **Required Prerequisites:**

Students in Physics 4230 should already have taken PHYS 1110, 1120, 2170, and 2210. Junior level courses in quantum mechanics (PHYS3220) and electromagnetism (PHYS3310) would be helpful but are not required.

## **Required resources:**

- 1) "Introduction to Thermal Physics," by Daniel Schroeder. (We will skip chapter 8.)  
This book is fairly conversational and may not feel as 'mathematically robust' as some other senior-level physics texts (this in part a function of the material itself and in part a function of Schroeder's writing style). It is the standard text used by more than 70% of thermal physics course in the US and provides ample opportunity for you to engage conceptually with the material as well as practice some of the estimating and statistical techniques that are fundamental to this topic area.

2) "iClicker Reef", available [here](#).

We will use concept tests (clicker questions) during lectures (for extra credit), to help you learn the material. You need to activate your free i-Clicker Reef account at the link above.

## **Classroom Structure and Expectations**

**Reading is an essential part of 4230!** Reading the text *before* class is very important. Lecture is to *clarify* your understanding, to help you make sense of the material. We will assume you have done the required readings in advance! Schroder is one of the best thermal physics texts we know of - it *will* make a huge difference if you spend the time and effort to carefully read and follow the text.

**Preflight assignments** will be due to review ideas from the reading each week. These preflights will be designed to review important ideas, highlight ideas from the reading, and/or get you thinking about specific ideas before seeing the material in class. Preflights will be graded for participation only (unless I get the sense people are abusing this). I do not expect that the preflights will be easy or that you will be able to get all the questions correct every time. They are designed to get you thinking about the material in authentic and sometimes challenging ways. Do not be concerned if you find them difficult, but recall, they are for participation only.

**Classroom Etiquette:** This has changes somewhat in the COVID-19 era. Here is what I expect, and we will further develop our classroom norms as the semester progresses.

- **I strongly encourage attendance at the synchronous lectures:** The lecture is intended to be interactive; we will do group activities and regularly answer questions – be prepared to be engaged and present. Try to close all other windows on your computer during lecture and focus only on the class; this will help you get the most out of it. During the live lecture, we will have folks keep their cameras off, but have the ability to unmute themselves. It is perfectly OK to interrupt the lecture by typing “Question!” into the chat window, at which point I will stop and have you unmute yourself to ask your question. **Questions in lecture are always good and are strongly encouraged!**
- If you cannot attend the live lectures, an asynchronous option will be available; this option is intended only for those that absolutely need it. Since this option will be less interactive and you will not have the opportunity to engage or ask questions, I believe any student participating only asynchronously will not learn as effectively. If you miss one of the live lectures, you will have 24hrs to answer the clicker questions asynchronously to receive credit.

**Homework:** There will be a homework due every Thursday (except exam weeks) at 11:59pm via a scanned pdf uploaded to Canvas. No late homework will be accepted - but your lowest score will be dropped automatically. After grading the annotated homework will be available for you to review on Canvas. If you feel that your homework was unfairly or incorrectly graded, please write short email about it and send it to Dr. Wilcox to request a regrading within two weeks after return of the homework.

- **Homework revisions** (optional): After submitting your homework, you will have a ~36 hour window to review the homework solutions and make comments directly on your homework describing what you did wrong and what the correct approach should have been. The graders will then score your homework taking into account your corrections and you will be able to receive full credit for your revised solution. Notes:
  - **IMPORTANT:** You must write your revisions in the margins of your submitted pdf using a green-colored font and the "point" annotation tool in Canvas. (Do not ever resubmit a pdf after our solutions have posted)
  - A rework must include an explicit contemplative statement: What was incorrect or error prone about your original approach that led to your solution being wrong? This statement is the most important part. You might also comment on any checks you could do to avoid similar mistakes

in the future e.g., checking dimensional consistency, limiting cases, symmetries, etc., or other mathematical approaches you could use to simplify your solutions.

- You cannot submit corrections for a question you did not attempt in your original submission
- The graders will only score your corrections if your original submission demonstrates that you tried your best to fully answer the question the first time.
- **Late homework:** No late homework will be accepted. However, life happens; if you miss a homework for a documentable reason, let me know and I will excuse that homework for you. Should this happen, it is still your responsibility to work through the homework on your own time to ensure you understand the material.
- **Collaboration:** Homework is exceedingly important for developing an understanding of the course material, not to mention building skills in complex physical and mathematical problem solving. They will require considerable time and personal effort this term! **We strongly encourage collaboration, an essential skill in science and engineering** (and highly valued by employers!). Social interactions are critical to scientists' success - most good ideas grow out of discussions with colleagues, and essentially all physicists work as part of a group. Find partners and work on homework together via whatever online platform you choose. However, it is also important that you OWN the material. We strongly suggest you start homework by yourself (and that means really making an extended effort on *every* problem). *Then* work with a group, and finally, finish up on your own - write up your own work, in your own way. There will also be time for peer discussion during classes - as you work together, try to help your partners get over confusions, listen to them, ask each other questions, critique, *teach each other*. You will learn a lot this way!
  - While collaboration is the rule in technical work, evaluations of individuals also play an important role. The majority of the exams will be done without help from others. For all assignments, the work you turn in must, in the end, be your own: in your own words, reflecting your own understanding. For each homework assignment you will be asked to report your collaborators – this is good scientific practice and something that is worth practicing!
  - (If, at any time, for any reason, you feel disadvantaged or isolated, contact me and I can discretely try to help arrange study groups.)

**Homework Sessions:** (*times listed at the top of the syllabus*) Help sessions/office hours are to facilitate your learning and will be held via an online platform called [Gather.Town](#) (password to access the room is 112358). This platform can only be accessed via a computer (no phones or ipads) and runs best on the chrome or firefox browsers. If you have difficulty accessing Gather.Town, let Dr. Wilcox know and she will arrange a Zoom alternative.

We encourage attendance - plan on working in small groups, our role will be as learning coaches. Help sessions will be fairly homework-centric, but we will *not* be explicitly telling anyone how to do the homework (how would *that* help you learn?) I strongly encourage you to *start all problems on your own*. If you come to help sessions "cold", the value of homework to you will be greatly reduced.

**Lecture Notes and Solutions:** Lecture notes and solutions of the in-class concept tests, written homework, exams, and solutions will generally be posted on Canvas for your reference.

**Clickers:** These questions are designed to help you learn by giving you an opportunity to engage with challenging material during class. Each student is expected to use their own iClicker account only. Deliberately using another student's iClicker account and registering answers for that person in their absence is a violation of the honor code. If you are found registering answers with an iClicker other than your own, then you and the individuals assigned to all iClickers involved will forfeit any available credit associated with clicker participation. Note, as discussed in the classroom etiquette section above, an asynchronous option is provided to get clicker points even if you miss the live class. All students will get 3 free dropped clicker days.

**Exams:** There are no makeups. *You may not miss any exam* except for reasons beyond your control, approved by Prof. Wilcox (usually a confirmed medical problem with written documentation). In the unusual case of an (at most, single) excused absence from midterms, I'll use your score on the final to replace the missing exam. *If you miss the final, you cannot pass the course.* Exact procedures for the exam (e.g., what you can use and what you can bring) will be announced on Canvas.

**Grading:** Your course grade is largely determined by a combination of your performance on exams and homework. There will be some credit for in-class participation primarily from clicker questions. In the era of remote work, my stance it is all the more important to provide incentives to help students engage with the material as much as possible, and the best way to convey the importance of this is to give credit for it. Thus, clickers are not extra credit (as would normally be the case for an in-person semester), and they represent a non-negligible portion of the overall grade.

	<b>Date, Time</b>	<b>Location</b>	<b>% of course grade</b>
Exam 1	Due 2/23 at 9:30pm MT	Take home	20%
Exam 2	Due 4/6 at 9:30pm MT	Take home	20%
Final Exam	Due TBD	Take home	20%
Homework	Every Thursday at 11:59pm MT (except exam weeks)	Canvas	33%
Clickers	Zoom or on Canvas	I-clicker Reef or Canvas	5%
Preflights	Due Mondays 10am	Online	2%

Occasional extra credit opportunities may be provided for up to 1% of the total course grade.

After computing the final course score (from 0-100), we will use a standard scale to determine letter grades (the course will not be curved):

- 90-100 = A's (including A-'s)
- 79-90 = B's (including B-'s and B+'s)
- 68-79 = C's (including C-'s and C+'s)
- 55-68 = D's (including D-'s and D+'s)
- < 55 = F

Exact +/- cutoffs will not be set until all grades are collected.

That means even if everyone in the class gets 91% overall, we will happily give everyone A's. (Well, in that particular case, A-, but you get the point!) If the class average comes out lower than we expect (due to say, accidentally overly tough exams), we will consider 'stretching' the scale down a bit. But, no matter what, we will not get tougher than the above. The scale can shift in your favor but will never change against you. This is done to encourage collaborative work and a supportive atmosphere - it's not a competition with other students, helping someone else in the class will not harm your grade in any way!

**Disabilities:** Students with disabilities, including non-visible disabilities, please let Prof. Wilcox, know early in the semester (*first two weeks*) so that your academic needs may be appropriately met. You will need to provide documentation from the Disability Services Office. Students with religious obligations that conflict with the exam dates should contact us early in the semester so that accommodations can be made.

**Using Canvas:** Most of the activities in this course take place within the university's Canvas learning management system. Use your personal Identikey and password to access your Canvas Home site by visiting [canvas.colorado.edu](https://canvas.colorado.edu). From there, select our course name to access our course Canvas site.

## Comment on preparation

Physics 4230 at a high level of conceptual and mathematical sophistication. Therefore, you should expect:

- a large amount of material covered quickly.
- no recitations, and few examples covered in lecture. Most homework problems are not similar to examples from class.
- long, hard homework problems that usually cannot be completed by one individual alone.
- challenging exams.

Physics 4230 is a challenging, upper-division physics course. Unlike more introductory courses, you are fully responsible for your own learning. In particular, you control the pace of the course by asking questions in class. We tend to speak quickly, and questions are important to slow down the lecture. This means that if you don't understand something, it is your responsibility to ask questions. Attending class and the homework help sessions gives you an opportunity to ask questions. We are here to help you as much as possible, but we need your questions to know what you don't understand.

Here is what we have experienced, and heard from other faculty teaching upper division physics in the past:

- most students reported spending a minimum of 10 hours per week on the homework (!!)
- students who didn't attend the homework help sessions often did poorly in the class.
- students reported learning a tremendous amount in this class.

Don't be surprised if you have to think hard and work hard to master the material. **My standards for this course are high because I know you are all capable of meeting those expectations if you work hard and ask for help when necessary.**

## CLASSROOM BEHAVIOR

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

## REQUIREMENTS FOR COVID-19

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements, and public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,
- clean local work area,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert [CU Boulder Medical Services](#).

Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](#). For more information, see the policies on [COVID-19 Health and Safety](#) and [classroom](#)

[behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the “Accommodation for Disabilities” statement on this syllabus.

All students who are new to campus must complete the [COVID-19 Student Health and Expectations Course](#). Before coming to campus each day, all students are required to complete the [Buff Pass](#).

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home. In this class, if you are sick or quarantined let me know that you will be unable to attend in-person so I may offer your classroom slot to other students. If you are sick and cannot participate in the course remotely, let me know as soon as reasonably possible and we will work out a plan to get you caught up on the material you missed.

### **ACCOMMODATION FOR DISABILITIES**

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition or injury, see [Temporary Medical Conditions](#) under the Students tab on the Disability Services website.

### **PREFERRED STUDENT NAMES AND PRONOUNS**

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

### **HONOR CODE**

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

### **SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION**

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (including sexual assault, exploitation, harassment, dating or domestic violence, and stalking), discrimination, and harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

### **RELIGIOUS HOLIDAYS**

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this applies to you, please speak directly to me within the first two weeks of the term, or ASAP. The sooner I know, the more options we will have to work with.

See the campus [policy regarding religious observances](#) for full details.