PHYSICS 4230 SYLLABUS, FALL 2019

Lectures: MWF 11 AM-11:50 (G125)
Instructor: Prof. Bethany Wilcox
Email: Bethany.Wilcox@colorado.edu
Phone: (303) 492-8759
Office: Duane F-1017 (physics tower)

Office hours (tentative):
After class (up front) for quick questions
Help Sessions (G2B70):
  Mon. 4-5pm
  Tues. 4-6pm
  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 form, 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.) There will be a copy of Griffiths on reserve in the Math/Physics library, along with several other good texts including the "Feynman Lectures in Physics" (Vol II is all about E&M, and is wonderful reading), and Pollack and Stump, "Electromagnetism." This is at Griffith's level, but a little more mathematical/formal.
2) "iClicker", available at the bookstore. We will use concept tests (clicker questions) during lectures (for extra credit), to help you learn the material. You need to purchase an "iClicker" from the bookstore. Note: All users must re-register their clicker once the year, even if you have used clickers in the past. To register your iClicker, go to the usual MyCU portal, click on the Student tab and there should be a prominent link to register your clicker.

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).

Classroom Etiquette: Please turn off or silence all cell phones when entering any classroom. Please do not throw vegetables at the instructor. Private chatter during lecture is very distracting except when doing group work, but it is perfectly OK to interrupt the lecture by yelling “Question!” Questions in lecture are always good and are strongly encouraged!

Homework: There will be a homework due every Wednesday (except exam weeks when they will be due Friday) at the start of class. No late homework will be accepted - but your lowest score will be dropped. After grading the homework will be handed back during the classes. If you feel that your homework was unfairly or incorrectly graded, please write short note about it, fix it to your homework and return your homework to Dr. Wilcox to request a regrading within two weeks after return of the 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.

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. 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. (If, at any time, for any reason, you feel disadvantaged or isolated, contact us and we 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. 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?)* We 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.

**Grading and exams:** 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.

<table>
<thead>
<tr>
<th>Date, Time</th>
<th>Location</th>
<th>% of course grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>Tues 10/1, 7:30-9:15 PM</td>
<td>Duane G130</td>
</tr>
<tr>
<td>Exam 2</td>
<td>Tues 11/12, 7:30-9:15 PM</td>
<td>Duane G130</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Sun. 12/15, 1:30-4 PM</td>
<td>TBA</td>
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<tr>
<td>Homework</td>
<td>Due every Wednesday (except exam weeks)</td>
<td>In-class</td>
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<td>Clickers</td>
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<td>In-class</td>
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<tr>
<td>Preflights</td>
<td>Due Mondays 9am</td>
<td>Online</td>
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Extra credit can only help, and never hurt you. As you accumulate extra credit, it reduces the weighting of your midterm exams below 40%, and replaces those percentage points with perfect score. If you got 100% on your exams, there is no change; anything less and you benefit. Based on past experience, for most people, clicker bonus extra credit will add in the region of 1% to 3% to the course score.

Explicitly, your total course points *(100 maximum)* are computed as follows:

\[
[40 - (\text{extra}\_\text{credit}\times4)] \times (\text{weighted midterm ave exam score}) + (\text{extra}\_\text{credit}\times4 + 28\times(\text{final exam percentage}) + 30\times(\text{homework}) + 2\times(\text{participation})
\]

where the various definitions are:

- weighted midterm Ave exam score = \((20\times\text{exam1} + 20\times\text{exam2})/40\)
- homework score = \((\text{your total hw points}) / (\text{maximum total possible})\) after dropping the lowest homework set
- participation = computed from completion of weekly preflight questions *(any answer counts equally)* as a proportion of the maximum available.
- extra\_credit = computed from responding to clicker questions in class as a proportion of the maximum available.

After computing the final course score *(from 0-100)*, we will use a standard scale to determine letter grades:

- 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!

**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 his or her own iClicker only. Deliberately using another student's iClicker 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 extra credit associated with clicker participation.

**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, we'll use an average of your other exams. *If you miss the final, you cannot pass the course.* You may bring one side of a single sheet of 8.5 in. x 11 in. paper for each exam, with your own *handwritten* notes. Calculators with scientific notation are allowed and but should not be needed. More details will be announced at the time of the exams in class and on the website.

**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. 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.

The course topics that we will cover in Physics 4230 are among the greatest intellectual achievements of humans. 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.

**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 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.

**CLASSROOM BEHAVIOR**
Students and faculty each have responsibility for maintaining an appropriate learning environment. 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. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

**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; 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. 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.