Physics 4230: Thermodynamics and Statistical Mechanics (Fall 2008)

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Lectures: Monday, Wednesday, Friday, 9:00 – 9:50am, Duane G2B21

Textbook and other required materials: The text is An Introduction to Thermal Physics, by Daniel V. Schroeder. You will also need an “iClicker,” since answering clicker questions will be an important part of participation in lecture and will count for extra credit.

Webpage: http://www.colorado.edu/physics/phys4230

Updates to the syllabus may be made on the webpage (and will be announced in class), and will take precedence over the original paper version!

Office Hours: Wednesday 10am-11am, Thursday 2pm-4pm, and by appointment.

I enjoy discussing physics with students (that means you!), so please stop by.

Grader: Quan Zhang

Course description and outline: In this course, you will learn about the fundamentals of thermodynamics and statistical mechanics. These areas are the basic conceptual framework for understanding behavior of large (or, macroscopic) physical systems, made up of many constituents (say, atoms). There are a few reasons why these are important topics to study: While some macroscopic systems are familiar and well-understood, many more are among the most exciting and challenging research problems in physics. Even if you happen to be a bigger fan of very small systems – elementary particles, for example – all physicists need to know some thermodynamics and statistical mechanics. Finally, there are many applications of the ideas we will cover to the world around us.

Broadly speaking, the course will start with thermodynamics and will move toward statistical mechanics. Thermodynamics has to do with the basic concepts and quantities needed to understand the behavior of macroscopic systems. It tells us how quantities such as energy, entropy, temperature, etc. are related very generally, independent of which specific system we are studying. Statistical mechanics, on the other hand, gives us a means to calculate thermodynamic quantities for particular systems. We’ll start by developing the concepts of thermodynamics and how they fit together. To help us understand these concepts, we’ll introduce and study some simple macroscopic systems along the way (using some simple statistical mechanics), especially the ideal gas and the Einstein model of a solid. Next, we’ll learn more about thermodynamics by applying it to heat engines and refrigerators, and to phases of matter and phase transitions. In the last part of the course, we’ll turn our attention more fully to statistical mechanics, learn what a partition function is and what it’s good for, and learn about the quantum statistical mechanics of identical particles.
**Prerequisites:** The formal prerequisites for the course are Quantum Mechanics I (PHYS 3220) and Differential Equations and Linear Algebra (APPM 2360, or MATH 3130 and 4430). If you haven’t taken these courses, please come see me – you don’t necessarily need them for this course, but in that case I would like to know more about your preparation.

**Lectures:** I hope and expect you will interrupt me with questions during lecture. If there is something you don’t understand, chances are others don’t understand it either. Please ask questions!

**Reading:** Reading the textbook (Schroeder) will be an important part of the course. Each lecture I will assign reading that I will expect you to complete before the next lecture. The purpose of these assignments is to get you thinking about the material before lecture, so we can have a more useful discussion.

**Clicker questions:** I will ask clicker questions during lectures – these will count for your grade purely as extra credit. Half your clicker score will be for simply answering questions, the other half will be for answering correctly.

**Homework:** There will be weekly homework assignments due at the *beginning of class* each Friday. (However, there will be no homework during the two midterm weeks, and in the last week of class.) Because solutions will be posted online immediately after each assignment is due, late homework cannot be accepted – but, your lowest homework score will be dropped.

I encourage collaboration on homework, *but* the work you hand in should in the end be your own, reflecting your own understanding. You *must* write up your solutions on your own. I strongly suggest that you first get as far as you can on each assignment on your own. Then, work on the problems with your classmates, and, finally, write it up on your own.

**Exams:** There will be two midterm exams and one final exam. The midterms will be held during class periods. Here is the info:

- **Exam 1** Friday, October 3 G2B21 9:00am – 9:50am
- **Exam 2** Friday, November 7 G2B21 9:00am – 9:50am
- **Final Exam** Saturday, December 13 TBA 1:30pm – 4:00pm

**Grading:** The course grade will be determined by weekly homework assignments (30%), two midterm exams (15% each), and a final exam (40%). Clicker questions, as well as a couple of surveys, will count for extra credit. The effect of the extra credit will be to raise your total grade on the exams – see the webpage for the detailed formula. The grading scale will be: 89 – 100 (A, including A-); 78 – 89 (B, including +/-); 66 – 78 (C, including +/-); 55 – 66 (D, including +/-); and < 55 (F). Exact +/- cutoffs will be set later. I may adjust this scale (“grade on a curve”), but *only* in your favor. So, for example, a grade of 95 will be an A, no matter what happens with the curve.
Disabilities: If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and http://www.colorado.edu/disabilityservices

Religious observances: Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please let me know as soon as possible if you have a conflict with any part of the course. If you have a conflict with one of the exams, please inform me within the first two weeks of the course (by September 8, 2008), so that I have time to make an accomodation. For full details of the campus policy, see http://www.colorado.edu/policies/fac_relig.html.

Classroom Behavior Policy: 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 differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. 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. See policies at http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

Statement from the Office of Discrimination and Harassment: The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh.

Honor Code: All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at http://www.colorado.edu/policies/honor.html and at http://www.colorado.edu/academics/honorcode/