Instructor

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Wright 208
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Office Hours: posted on-line at http://www.oberlin.edu/physics/Scofield/hours.htm

Note: Future course materials (with the possible exception of exams and quizzes) will generally not be made available on paper but, instead, will be distributed via the web..

Course Description

"Ludwig Boltzmann, who spent much of his life studying statistical mechanics, died in 1906, by his own hand. Paul Ehrenfest, carrying on the work, died similarly in 1933. Now it is our turn to study statistical mechanics." -- David L. Goodstein.

Most of the physics you have learned thus far (Classical and Quantum Mechanics, Electricity and Magnetism) is readily applied to very small systems – say, a single particle or rigid body. Most real-world problems, however, involve macroscopic systems consisting of “billions and billions” (more precisely, ~10^{24}) particles. Thermodynamics, which you studied briefly in P111, provides useful tools for understanding large systems, but, at least at first glance, appears to be poorly connected with the other physics you have learned.

Statistical Mechanics combines *Classical* and *Quantum Mechanics* with statistical properties of large systems to derive the behavior of macroscopic systems. This approach allows the Laws of Thermodynamics to be derived from basic laws of mechanics, combined with some plausible statistical assumptions regarding the behavior of large systems. Statistical Mechanics draws from fields of Classical Mechanics, Quantum Mechanics, and, for many practical problems, the laws of Electricity and Magnetism.

Textbook

The main textbook for this course is Daniel V. Schroeder, An Introduction to Thermal Physics (Addison-Wesley, New York, 2000). Additional reading and supplemental materials will be placed on reserve in the Science Library.

Lectures

Regular classes meet from 9:00-9:50 a. m. each *Monday*, *Wednesday* and *Friday* in the Wright first floor classroom. Regular class periods will normally be used for lectures; quizzes and two midterm exams will also be administered during the regular class sessions. You are required to attend all regular classes -- unexcused absences will negatively impact your course grade. Please be prompt. In turn, I will strive to end lectures at 9:50 sharp!

Homework

Weekly reading and homework assignments will be distributed, usually through the course web site. The assignments will normally be distributed at the beginning of each Friday lecture and your solutions will be due one week later. Homework must be turned in directly to me, not to the grader. Homework will not be accepted after the solutions have been made available. Your lowest HW grade will be thrown out in calculating your final course grade.

Honor Code

Working with other classmates on homework is not only allowed, it is strongly encouraged! However, any work you turn in must be written up by you, in your own words, and must reflect your own understanding of the material. In contrast, collaboration on exams is not permitted. And, under no circumstances is it acceptable to represent someone else's work as your own.

Under no circumstances are you allowed to make use of homework or exam solutions distributed in previous years nor are you to make available solutions distributed this year to anyone outside of this class. And, of course, it is not acceptable to make use of solutions you might find through some alternate means – for instance, posted on the web for a course at another institution.

Solutions to homework assignments will be made available to you after the due date for your personal use only. Homework problems and exam questions may be recycled year to year. You are not allowed to consult or otherwise make use of exams administered in previous offerings of this course, except as explicitly made available this semester to the entire class by the instructor – doing so is a violation of the honor code. And it should be obvious that you are not allowed to consult my solutions before you have turned your own work in.

Remember that you must write the honor pledge, "I have adhered to the honor code on this assignment" on all of your written work – including homework assignments. You will receive no credit for work turned in without this declaration.

Problem Session

We will arrange for one additional class period that will be devoted to questions about the homework. While this session is considered optional, I strongly advise you all to participate regularly. It is amazing how much additional learning and teaching takes place in this homework session. This *problem session* will be arranged based on the information I receive from you regarding your individual schedules.

Exams

There will be two midterm and a final exam administered in this course. The first exam will be given the week of October 10-14 and the second will be the week of Nov. 21-25. I expect that both of these exams will be of the take-home variety. The final exam will be due at the time set by the Registrar for this class. It is also likely to be a take-home exam.

If you are not able to take the exams at the scheduled times you must discuss this with the instructor during the first week of class. This applies to anyone requiring extra time on exams (e.g., due to a learning disability) or a conflict due to a prior commitment. Any emergency conflict should be brought immediately to the instructor's attention (death in the family, etc.).

Grades

Roughly speaking, your course grade will be determined as follows: homework (25%), first exam (20%), second exam (20%), and final exam (25%). The final 10% will be associated with "class participation" – not precisely defined, but category that is connected with your attendance, alertness in class, and the degree to which you help make this a better class for all.

Topics

In this course we will begin by reviewing classical thermodynamics. Next we will develop the basic framework for statistical mechanics. After laying the foundations we will address specific topics such as classical and quantal statistical mechanics, entropy, temperature, chemical potential, and ensembles. Applications to be discussed include magnetism, heat capacities of gases and solids, engines, thermal radiation, fuel cells, and ideal fermion and boson gases. Time permitting, we will also discuss kinetic theory.