PHY 300 Statistical Physics & Thermodynamics

STAFF INFO

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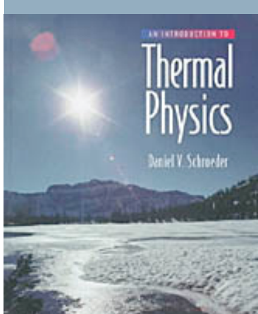

Text: An Introduction to Thermal Physics, Addison-Wesley, 2000, webpage
other texts: Kittel and Kroemer: *Thermal Physics*, Freeman and Co., 2th edition,
F. Reif: *Fundamentals of statistical and thermal physics,* McGraw Hill
F. Reif: *Statistical Physics*, Berkley Physics Course-Volume 5
Webpage: PHY300 on Blackboard

Welcome to PHY300 !

The course is designed for physics majors and minors as well as upper-level chemistry majors. Prerequisites are Calculus I and II, General Physics I and II and Modern Physics. Statistical Physics (together with the Quantum Physics) is one of the fundamental disciplines on which modern physics research (in condensed matter physics, atomic and molecular physics, nuclear physics, astrophysics, biophysics, physical chemistry, etc.) relies on. This course is devoted to discussions of some of basic physical concepts and methods appropriate for a description of systems involving very many particles (gases, liquids, crystals). It is intended, in particular, to present thermodynamics and statistical physics from unified and modern point of view.

Why study Thermal and Stat-Mech?

Statistical & Thermal Physics is actually a generic category that encompasses two different but very interrelated fields: classical thermodynamics and statistical mechanics. Common subjects to both fields are study of matter relating to heat, temperature and thermal energy. Classical thermodynamics treats these concepts as operationally defined macroscopic variables and deduces their behavior from a small number of empirical "laws". On the other hand statistical mechanics employs microscopic models of the constitution of matter and deduces the behavior of its thermal properties by calculating averages over the unknown behavior of the individual microscopic particles subject to the results of probability theory.

Grading policy

Physics 300 grade is based on the following

Homework	30 %
Homework presentation	10 %
Exams	40 %
Final Presentations	15 %
Class participation	5 %
Total	**100 %**

Lectures

You are expected to attend all lectures and actively participate in discussions and problem solving sessions. Students will be asked to present on various topics during a course of the semester. Some problems will involve computer simulations will be used to aid in understanding of concepts. Homework assignments, answers to problems and other relevant material will be posted on Blackboard^{tm}.

Homeworks

there will be ~10 homework assignments throughout the semester. The problems are assigned from the text. Working assiduously on the homework is crucial for learning the material and performing well on the exams. The problems will be discussed in class. For some of the problems we will use symbolic manipulation software (Maple, Mathematica, Matlab, Mathcad). You will have a week to complete each homework, but plan to start working on problems early. I will not discuss homework problems on the dates the homework is due. Late assignments will not be accepted. I encourage you to discuss problems but not blindly copy someone else's work.

Homework Presentations

Twice during the semester you should prepare a problem form the homework set and present it to the rest of the class.

Exams

There will be two exams spread through the semester. Exam times are listed in the schedule. One exam will be an in-class. Exams are open book.

Presentation Project

Instead of a final exam, you will give a presentation on a topic of your interest. The project presentation (in PowerPoint, Keynote, 15-20 minutes +5 for questions) may include further theoretical ideas and/or experimental applications not discussed in class. Some of the possible topic with references are:

Entropy and Time (i.e The Direction of Time),American Journal of Physics, December 1999
Stars and Statistical Physics, American Journal of Physics, December 1999
Brownian Motion and Applications, American Journal of Physics, December 1999, Physics Today, February 1996
Experimental Studies of Bose-Einstein Condensation, Physics Today, December 1999, Serway, Modern Physics, Chapter 9
Real Heat Engines and Real Refrigerators, Textbook, Chapter 4
Financial Market and Statistical Physics, Bouchand, Theory of Financial Risk and Derivative Pricing: From Statistical Physics to Risk Management, Cambridge Press, 2003
Degenerate Fermi Systems. Applications in astrophysics.

You mast get my approval for a topic of you own interest. You should make an effort to try to link the concepts learned in class and the topic you are presenting. Talks will be scheduled during the finals week, so plan ahead what you would like to present.

Schedule

Note: Class schedule is tentative and subject to a change.

Week	Topics	Readings
1	Intro, overview; Temperature; thermal equilibrium	1.1, 1.2,
2	Ideal gas, equipartition of energy;heat and work;	1.3, 1.4, 1.5
3	Heat capacities, 2nd law; Einstein model	1.6, 2.1, 2.2
4	Interacting systems; more on ideal gas; entropy;	2.3, 2.4, 2.5
5	Entropy; temperature revisited; entropy and heat	2.6, 3.1, 3.2
6	Paramagnetism, mechanical equilibrium; Exam	3.3, 3.4, 3.5
7	Heat engines, refrigerators; cooling	4.1, 4.2, 4.3, 4.4
8	Free energy; Phase transformations	5.1, 5.2, 5.3
9	Chemical equilibrium; Boltzmann, equipart. theorem	5.6, 6.1, 6.2
10	Exam; Maxwell speed distribution; Partition function	6.3, 6.4, 6.5
11	Quantum statistics; Gibbs factor; Bosons & Fermions	6.6, 6.7, 7.1
12	Exam; Degenerate Fermi gas; Blackbody radiation	7.2, 7.3, 7.4,
13	Bose-Einstein condensation; Weakly interacting gases	7.6; 8.1
Finals	Presentations	