Physics 775 (Graduate Statistical Physics)

Syllabus, Fall 2016

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Office hours:	Tuesdays, 1215-1400

Content:

This one-semester course is an introduction to statistical physics at the graduate level. The subject is vast, and I warn the intrepid student that we will hardly do it justice. This course will entirely focus on *equilbrium statistical mechanics*. There is of course the entire field of *non-equilibrium* statistical mechanics which we will neglect. In order to best prepare students, students will not only learn material during biweekly lectures, but will teach themselves supplementary material through weekly problem sets. My tentative plan for the semester is:

- A lightning review of classical and quantum mechanics (2 lectures).
- Equilibrium thermodynamics (4 lectures).
- Random processes, Brownian motion, and basic statistics (2 lectures).
- The microcanonical ensemble, Boltzmann weight, and partition function. (2 lectures).
- Ideal and near-ideal gases. Crystals. Applications of the canonical ensemble (6 lectures).
- Quantum ideal gases (including the Bose-Einstein and Fermi-Dirac distributions) (4 lectures).
- Density matrices (2 lectures).
- Towards statistical field theory: spin systems (2 lectures).
- Criticality and the renormalization group in the Ising model (3 lectures).
- Black hole thermodynamics (2 lectures).

The goal is for students to be proficient in statistical mechanics at a level where they could, in principle, pass a Ph.D. qualifying exam section in Statistical Physics.

Textbook and supplementary material:

1. R. Kubo, *Statistical Mechanics* (North-Holland Personal Library).

For further reading, see

1. R. P. Feynman, *Statistical Mechanics: A Set of Lectures*.
2. L. D. Landau and E. M. Lifshitz, *Statistical Physics, Part 1*, 3rd Edition (Pergamon Press).
3. M. Plischke and B. Bergersen, *Equilbrium Statistical Physics*, 3rd Edition (World Scientific).
4. C. Itzykson and J. M. Drouffe, *Statistical field theory, Volume 1* (Cambridge Monographs on Mathematical Physics).
5. See the lecture notes from the MIT Statistical Mechanics I Course (`http://ocw.mit.edu/index.htm`).

Prerequisites:

1. Physics 370.
2. Physics 385.
3. Math 376.

Course format:

Lectures:	Tuesday/Thursday 1100-1215, in Thornton 425.
Problem Sets:	Due weekly at the beginning of the Thursday lecture.
Midterm:	In-class on October 13.
Final exam:	There will be a take-home exam on Thursday, December 15.

Grades:

1. Final: 50%
2. Midterm: 30%
3. Problem sets: 20%

General comments:

1. Problem sets will be assigned weekly on Thursday, to be due the following Thursday.
2. The problem sets are *essential*. Physics is learned by doing, and the problem sets will give you ample opportunity to do statistical mechanics firsthand. Do not expect to succeed on the exams without putting in an enormous effort on the weekly assignments. Collaboration with fellow students is great and even encouraged. However, you should independently write up your assignments, both because you owe it to yourself to properly learn the material and in the interest of academic integrity.
3. I will ask you to write up a number of problems every week. Not all of them will be marked. Each week, I will mark $\sim 30\%$ of problems at random.
4. Please take advantage of my office hours.

Unpleasantries:

1. There are not many students enrolled in this class, and so it will be easy to detect when one student plagiarizes another's solution. Plagiarism of another student's solutions, or the copying of a solution off the internet, will result in an automatic zero score on the assignment for everyone involved as well as trigger an investigation with the Office of Student Conduct. See `http://conduct.sfsu.edu/plagiarism` and `http://www.physics.sfsu.edu/policy/plagiarism.pdf` for further detail.

2. Barring medical or family emergency, assignments are due promptly at the beginning of the Thursday lecture. Late assignments will be accepted until 1700 Monday of the week after the assignment was due. However, there will be a lateness penalty. It is:

Thursday, after 1100:	10%
Friday:	20%
Until 1700 Monday:	40%
After 1700 Monday:	100%

Disability statement:

Students with disabilities who need reasonable accommodations are encouraged to contact me. The Disability Programs and Resource Center (DPRC) is available to facilitate the reasonable accommodations process. The DPRC is located in the Student Service Building and can be reached by telephone (voice/TTY 415-338-2472) or by email (dprc@sfsu.edu).

Withdrawal policy:

Please consult `http://www.physics.sfsu.edu/policy/withdrawal.pdf`.

Student disclosures of sexual violence:

SF State fosters a campus free of sexual violence including sexual harassment, domestic violence, dating violence, stalking, and/or any form of sex or gender discrimination. If you disclose a personal experience as an SF State student, the course instructor is required to notify the Dean of Students. To disclose any such violence confidentially, contact:

- The SAFE Place - (415) 338-2208; `http://www.sfsu.edu/~safe_plc/`
- Counseling and Psychological Services Center - (415) 338-2208; `http://psyservs.sfsu.edu/`

For more information on your rights and available resources: `http://titleix.sfsu.edu`.