

Physics 350 - Statistical Physics

Fall 2018

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Lectures: MWF 11:00 am - 11:50 am (Y01-1320)
Office Hours: MW 1:30-3pm

Textbooks:

Statistical Physics of Particles, by M. Kardar
Introduction to Statistical Physics, by K. Huang
Statistical Mechanics, by R. K. Pathria
Thermal and Statistical Physics, by Gould and Tobochnik (online notes):
<http://stp.clarku.edu/notes/>

Grading Scheme: homework (20%), midterm 1 (25%), midterm 2 (25%), final exam or presentation plus report (to be decided, 30%)

Topics:

(starred items will be covered depending on time, will be possible topics for final presentations)

1 - Review of Thermodynamics (Kardar Chapter 1)

Notions of thermodynamic heat, work, entropy
0th law of thermodynamics, equilibrium, and temperature
1st and 2nd laws of thermodynamics
Carnot heat engine
Free energy and heat capacities

2 - Review of Probability Theory (Kardar Chapter 2)

Definitions and axioms
Random variables
Probability distributions, characteristic functions
Central limit theorem, large deviations
Information and entropy*
Random walk, Brownian motion*

3 - Foundations of Statistical Mechanics (Kardar Chapter 3, Pathria Chapters 1 and 2)

Phase space, density of states

Liouville's theorem

Microstates and macrostates

Statistical Ensembles

Fundamental postulate of statistical mechanics

Microcanonical ensemble

From statistical mechanics to thermodynamics

Classical ideal gas

Gibbs paradox

The H-theorem, irreversibility, and the approach to equilibrium*

4 - Classical Statistical Mechanics (Huang Chapter 8, Kardar Chapter 4, Pathria Chapters 1 and 2)

Two-level systems

Canonical ensemble

Equivalence of ensembles

Equipartition theorem

Grand canonical ensemble

Chemical reactions*

5 - Quantum Statistical Mechanics (Kardar Chapter 6, Pathria Chapter 5)

Failures of classical statistical mechanics

Review of quantum mechanics

Quantum microstates and macrostates

Phase transitions*

From quantum mechanics to the equal a priori probabilities postulate*

6 - Ideal gases (Kardar Chapter 7, Pathria Chapter 6)

Maxwell-Boltzmann statistics

Fermi-Dirac statistics

Bose-Einstein statistics

Black body radiation*

Bose-Einstein condensation*