Phys 112
Fall 2006
Goals

Deeper understanding of concepts: less mysterious
- Entropy
- Free energy
- Chemical potential
- Statistical mechanics
- Fluctuations
- Kinetic theory background <= use of simulations

Recognition of physics in a “context rich” situation, i.e. real life

Acquire computational tools
- Quantitative
- Problem solving skills

Linkages to
- Everyday life
  - Bridge between microscopic and macroscopic
  - Irreversibility
  - Engineering
- Modern physics
  - Frontier
  - Applications: e.g. astronomy, cosmology
    - Condensed matter physics, low temperature
- History
Thermal Physics and Modern

- Quantum Mechanics
- Statistical Mechanics
- Thermodynamics
- General Concepts
- N Body
- Critical Phenomena
- Kinetic Theory
- Reversible
- Irreversible
- Far for equilibrium
- Radiative Processes
- Applications
- Chaos
- Applications
Participation

**Focus: Conceptual Understanding**
Construction /reconstruction of your mental models
Both intensely personal and social component (learn through others)
≠ focus on grades, formulae, short cuts

**Before lecture**
Read book and notes
Play with applet simulations => intuition
You can suggest others you can find (or if you know Java, write your own!)

**In class**
Beginning of class: typically a conceptual question /applet
Discussion with the whole class or in small groups
Active participation during lecture: questions, answers to my questions
Non graded quizzes

**Out of class**
Homework
Working groups on problems if you like (but you write your own solution)
Discussion sections (but try homework first)
Office hours (come with questions)
Prerequisites

Some exposure to thermodynamics

Quantum Mechanics not essential

- Notion of discrete state
- We will be able to cope with recipe on the number of states \(1/h^3\)

Maths: we will practice

- Calculus: differentiation, Taylor series
- Partial derivatives
- Integration by part
- First order differential equation
- Complex numbers
- Fourier transform not essential
Logistics

Lectures + Kittel and Kromer
MWF 8:00-9:00 160 Dwinelle

Lecture notes
Skeleton slides + your own notes (you can download skeleton slides before class)
Lecture notes on line (can also be downloaded before class)
Web site: http://cosmology.berkeley.edu/Classes/F2006/Phys112/
or on physics web page

Office Hours
Bernard SADOULET 439 LeConte
Monday 2:30-3:30 + appointments
Wednesday 9:00 to 10:00
Friday 9:00 to 9:30
sadoulet@cosmology.berkeley.edu (please use Phys112 in title)
642 5719 - Cell in case of emergency: 703 3840

Homework!!! Due Friday 5:00 pm
Homework for following week posted in principle Friday night
+ Ungraded quizzes in class

Discussion sections: No discussion section first week
Compulsory for undergraduates
Monday 10-11 am 75 Evans
Wednesdays 4:00-5:00pm 136 Barrows

Graduate Student Instructor
Stephen Glassman <glassman@berkeley.edu>
Office hours Th 12:30-1:30 Fr 2:00-3:00 254 LeConte
Work Load & Grading

4 Units => ≈ 10 hours - 4 ≈ 6 hours/week
- 1h30 reviewing notes and reading text books
- 2h30 homework
- 2h (in average, i.e. ≈ 7h for each): preparing midterms and final paper
Note: you will be allowed notes at midterms and final (1, 2, 3 and 4 pages respectively)

3 Midterms during class

Grading
- 10% participation (good incentive to come to class in spite of the early hour + office hours and discussion sections)
  in spite of personal reservation, will use attendance sheet
- 30% Homework
- 3x 10% each midterm
- 30% Final exam
Outline

1 First elements of kinetic theory, Probability
   Moments, central limit theorem

2 States of a system KK chap. 1
   Entropy, counting states, $1/h^3$ rule

3 Equilibrium between 2 isolated systems KK chap. 2, 9
   Temperature, pressure, chemical potential, undistinguishability, difference of concentration, law of mass action

4 Classical thermodynamics KK chap. 8
   Thermodynamics, reversibility, adiabatic expansion, Carnot cycle

5 System in contact with thermal bath KK chap. 3, 5
   Boltzman factor, partition function, chemical potential, fluctuations

6 Black Body Radiation KK chap. 4
   The genius of Planck, Stephan-Boltzmann, Detailed balance

7 Quantum gases KK chap. 6, 7, 13
   Bose Einstein, Fermi-Dirac, gas, metals, semi-conductors, liquid helium

8 Phase transformation KK chap. 10
   Beyond the ideal gas approximation

------------------- Optional: we will choose between
9 Diffusion/transport

10 Noise and Quantum Mechanics

11 Cosmology
Texts on reserve

Physics-Astronomy Library, Hearst Field Annex:

F. Reif: "Fundamentals of Statistical and Thermal Physics"

Bowley & Sanchez: "Introductory Statistical Mechanics"

John R. Taylor, "An introduction to error analysis : the study of uncertainties in physical measurements"

Daniel V. Schroeder, "An Introduction to Thermal Physics"
Information Card

Name
Email
Telephone

Department, Major, Year
Courses currently taken
Involvement in research?

Physics courses taken
Astronomy courses taken
Maths courses taken

Goals

Hobby activities and interests (optional)