

# Thermal and Statistical Physics

## Physics UA 140 Spring 2018

Professor: Paul Chaikin chaikin@nyu.edu 212 998-7694

Office: 877, Physics Dept. 726 Broadway

Lectures TR/ 11:00 -12:15 Meyer 264

TA: Dan Older do756@nyu.edu

Recitation section 002 60 Fifth Ave, rm 250 M/2:00-3:15

Recitation section 003 Meyer 264 T/5:00-6:15

Texts: C. Kittel, H. Kroemer, THERMAL PHYSICS, (Freeman), *main text*

F. Reif, FUNDAMENTALS OF STATISTICAL AND THERMAL PHYSICS, (McGraw-Hill)

Grading:

Homework 40%

Midterm 20%

Final Exam 40%

References:

- Thermodynamics

- H. B. Callen, THERMODYNAMICS, (Wiley), *develops thermo as the result of a couple of basic (unjustified) postulates*
- E. Fermi, THERMODYNAMICS, (Dover), *classic thermo book*
- A. B. Pippard, CLASSICAL THERMODYNAMICS, (Cambridge), *ditto*

- Statistical Mechanics

- C. Kittel, ELEMENTARY STATISTICAL PHYSICS, (Wiley), *nice little summary of the ideas and equations of stat mech*
- H. Huang, STATISTICAL MECHANICS, (Wiley), *more advanced*
- R. Kubo, STATISTICAL MECHANICS, (North Holland), *even more*
- L. Landau and E. M. Lifshitz, STATISTICAL PHYSICS, (Pergamon), *as for the whole L&L series, if you know this - you know physics*
- L. E. Reichl, A MODERN COURSE IN STATISTICAL PHYSICS, (U. Texas), *like the title says, advanced text and more modern ideas*
- R. C. Tolman, THE PRINCIPLES OF STATISTICAL MECHANICS, (Dover), *classic tomb*
- P. M. Chaikin and T. C. Lubensky PRINCIPLES OF CONDENSED MATTER PHYSICS, (Cambridge), *mostly phase transitions*

## Stat Mech and Thermo Course Outline

- (1/23-25)
  - Probability and Statistics, Averages, Random Walks, Gaussian Distributions
  - K&K ch.1, Reif ch.1
- (1/30-2/1)
  - Density of States, Phase Space – Definition of the problem for classical and quantum systems
  - K&K ch.2, Reif ch.2
- (2/6-8)
  - Entropy, temperature, equilibrium – thermodynamics as a consequence of statistics
  - K&K ch.3, Reif ch.3
- (2/13, 15)
  - Ensembles, Partition functions, - the meat of Stat Mech
  - K&K ch.4, Reif ch.6,7
- (2/20, 22)
  - Ideal Gases, Equipartition
  - K&K ch.3,5,6, Reif ch.6,7
- (2/26, 3/1)
  - Fermions and Bosons, Quantum Statistics
  - K&K ch.7, Reif ch.9
- (3/8)
  - **Midterm Exam**
- (3/13-15 )
  - **Spring Break**
- (3/20, 3/22, 27, 29)
  - Heat engines, Carnot cycles, Maxwell Relations – The classic thermodynamic thing
  - K&K ch.8, Reif ch.4,5
- (4/3)
  - Chemistry
  - K&K ch.9, Reif ch.8
- (4/5-4/10)
  - Phase Transitions, Magnetism
  - K&K ch.10, Reif ch.8,10
- (4/12-4/19)
  - Ising Model, Monte Carlo Simulations, Landau Mean Field Theory
  - K&K ch.10, Reif ch.10
- (4/24-26)
  - Scaling and Renormalization ideas for phase transitions.
- (5/1-3)
  - Shannon Entropy, Information, Kolmogorov Complexity, Data Compression
- (5/9-15)
  - **Final Exams**