

PHY442 Statistical Mechanics

Spring 2016

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Time and Location: MWF 10:10-11:00 LL 514

Course website <http://athena.physics.lehigh.edu/>

Course Outline

- 1. Introduction to Statistical Mechanics.** Many-particle systems. Macroscopic variables. Kinetic definition of pressure. Temperature. Correlations. Time and phase-space averages. Computer simulation.
- 2. Entropy and Thermodynamics.** Definition of entropy. Thermodynamic variables. Legendre transforms and free energies.
- 3. Canonical Ensemble.** Partition function. Equipartition theorem. Applications to gas, solid and magnetic systems.
- 4. Grand Canonical Ensemble.** Grand canonical partition function. Applications to solutions, chemical reactions, and systems with adsorption.
- 5. Statistical Physics of Bosons and Fermions.** Quantum statistical mechanics. Black body radiation. Phonons. Bose-Einstein condensation. Systems of interacting and non-interacting electrons. Superconductivity.
- 6. Phase Transitions.** Phases and phase diagrams. Phase equilibrium. First and second order phase transitions.
- 7. Continuous Phase Transitions.** Mean field and Landau theory. Scaling, universality and renormalization. High temperature expansion. Percolation.

Textbooks

Required: Leonard M. Sander, "Equilibrium Statistical Physics: with Computer Simulations in Python", 2013

We will follow this book that integrates the teaching of graduate level statistical mechanics with computer simulations. Many other books are available and recommended for further reading, for example:

Pathria and Beale, Statistical Mechanics, 3rd ed, (Academic Press, 2011)

Huang, Statistical Mechanics, 2nd ed. (Wiley, 1987)
Kardar, Statistical Physics of Particles (Cambridge University Press, 2007)

An extensive list of books in statistical mechanics, including some that are available online for free, can be found at <http://stp.clarku.edu/books/>

Grading

Upon satisfactory attendance, the course grade will be based on:

1. **Weekly homework problems (25%).**
2. **Two one-hour exams (25%).**
3. **Final exam (50%).**

Office Hours

MW 3:00-4:00

Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center C212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.

The Principles of Our Equitable Community:

Lehigh University endorses The Principles of Our Equitable Community (http://www.lehigh.edu/inprv/initiatives/PrinciplesEquity_Sheet_v2.032212.pdf). We expect each member of this class to acknowledge and practice these Principles. Respect for each other and for differing viewpoints is a vital component of the learning environment inside and outside the classroom.