ME346A Introduction to Statistical Mechanics – Wei Cai – Stanford University – Win 2011

Handout 1. Introduction

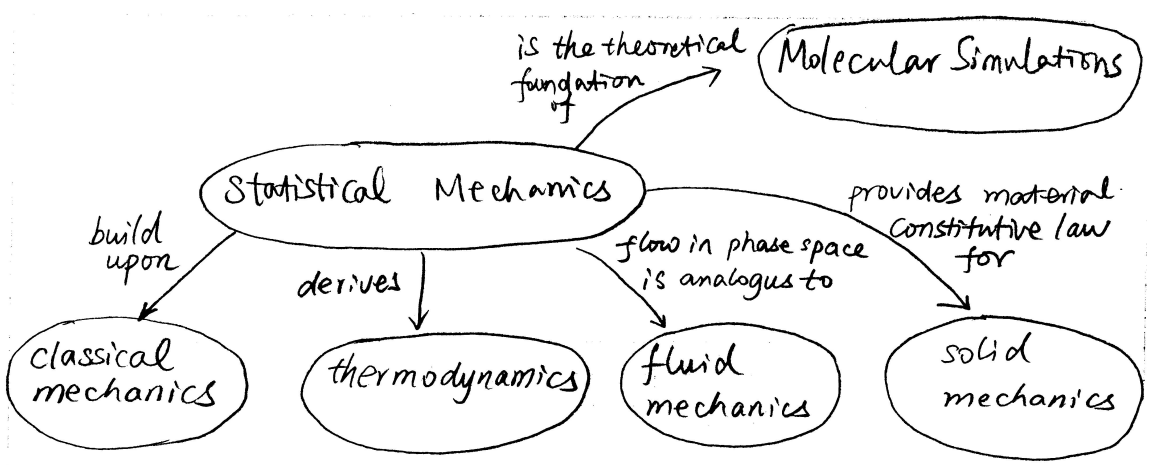
January 7, 2011

Statistical Mechanics

- is the theory with which we analyze the behavior of natural or spontaneous fluctuations — Chandler "Introduction to Modern Statistical Mechanics" (1987)
- provides a set of tools for understanding simple behavior that emerges from underlying complexity — Sethna "Statistical Mechanics" (2007)
- provides the basic tools for analyzing the behavior of complex systems in thermal equilibrium — Sachs, Sen and Sexten "Elements of Statistical Mechanics" (2006)
- involves systems with a larger number of degrees of freedom than we can conveniently follow explicitly in experiment, theory or simulation — Halley "Statistical Mechanics" (2007).

The **main purpose** of this course is to provide enough statistical mechanics background to the Molecular Simulation courses (ME 346 B and C), including fundamental concepts such as ensemble, entropy, free energy, etc.

We also try to identify the connection between statistical mechanics and all major branches of "Mechanics" taught in the Mechanical Engineering department.



Textbook

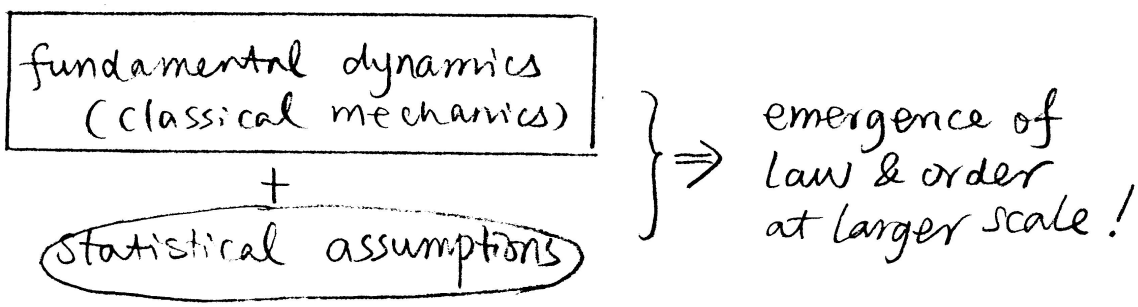
- Frederick Reif, "Fundamentals of Statistical and Thermal Physics", (McGraw-Hill, 1965). (required) $67.30 on Amazon, paperback. Available at bookstore. Several copies on reserve in Physics library.
- James P. Sethna, "Statistical Mechanics: Entropy, Order Parameters, and Complexity", (Claredon Press, Oxford). Suggested reading. PDF file available from Web (free!) `http://pages.physics.cornell.edu/sethna/StatMech/`.

First Reading Assignment

- Reif § 1.1-1.9 (by next class, Monday Jan 10).
- Sethna Chap. 1 and Chap. 2

What will be covered in this class: (Sethna Chapters 1 to 6)

- classical, equilibrium, statistical mechanics



- some numerical exercises (computer simulations)

What will be touched upon in this class:

- non-equilibrium statistical mechanics (phase transition, nucleation)

What will NOT be covered in this class:

- quantum statistical mechanics

Acknowledgement
I would like to thank Seunghwa Ryu for helping convert the earlier hand-written version of these notes to electronic (Latex) form.