Phys 463/663 (3 credits) **Spring 2013**

Statistical Mechanics

Instructor: Dr. Alan R. Denton, South Engineering 214B
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Classes: Tues. & Thurs., 2:00-3:15 p.m., SE 221

Makeup classes: MWF, 8:00-8:50 a.m., TBA

Office Hours: Drop in any time or make an appointment.

Bulletin Description:
The Maxwell-Boltzmann distribution function and its applications to thermodynamic problems. Introduction to kinetic theory and to Bose-Einstein and Fermi-Dirac statistics.

Prerequisite: Phys 462 Heat & Thermodynamics

Goals: Master the foundations of statistical mechanics, including fundamental concepts, theoretical and computational methods, and practical applications to a variety of systems.

Approach: $\boxed{\text{concepts}} \rightarrow \boxed{\text{models}} \rightarrow \boxed{\text{methods: theory/simulation}} \rightarrow \boxed{\text{properties}}$

Student Responsibilities: Attend all classes. Read assigned material in advance. Come prepared for discussion. Be curious and ask questions!

Textbook: David Chandler, Introduction to Modern Statistical Mechanics (Oxford, 1987). See also the list of Additional References.

Evaluation: quizzes and participation (10%); exams (15%, 20%, 30%); homework (25%). Phys 663 students will complete an additional project worth 20% of the homework grade. No makeup exams, quizzes or homework will be scheduled.

Homework: Assignments will be posted on Blackboard (`https://bb.ndsu.nodak.edu`). Group discussion of homework is encouraged, but written solutions must be your own. Identical or near-identical solutions will receive no points. Since solutions will be discussed on the due date, late assignments cannot be accepted. However, partial credit may be given for incomplete work, so submit whatever you can by the deadline. As part of each assignment, you may be asked to present your work in class.

Note: Three missed homework assignments or not completing the project (663 students) will result in automatic failure of the course.

Project (663 students only): Outlines are due **Thursday, March 28**.

Reports are due **Friday, April 26**.

Grading: A: 90-100%, B: 80-89.9%, C: 70-79.9%, D: 60-69.9%, F: $< 60\%$

Topics and Timetable

Dates	Topics	Reading
1/7-11	Microstates, macrostates, probability, fundamental postulates	Notes
1/14-18	Statistical foundation of thermodynamics, fluctuations	Chap 3
1/21-25	Ensembles, partition functions, thermodynamic potentials	Chap 3
1/28-2/1	Quantum statistics: bosons and fermions	Chap 4
2/4-8	Noninteracting systems: photons, phonons, electrons, ideal gas	Chap 4
2/7	**Midterm Exam**	**Chaps 1-4**
2/11-15	Phase transitions: Ising model, lattice gas model	Chaps 2, 5
2/18-22	Phase transitions: mean-field theory, critical exponents	Chaps 2, 5
2/25-3/1	Computer simulations: Monte Carlo	Chap 6
3/4-8	Computer simulations: molecular dynamics	Notes
3/11-15	**Spring Break (no classes)**	
3/19	**Midterm Exam**	**Chaps 1-6**
3/25-29	Interacting classical fluids: distribution functions	Chap 7
3/28	**Project outlines due**	
4/1-5	Interacting classical fluids: thermodynamic properties	Chap 7
4/8-12	Density-functional and integral-equation methods	Notes
4/15-19	Nonequilibrium systems: Brownian motion, Langevin equation	Chap 8
4/22-26	Nonequilibrium systems: Fluctuation-dissipation theorem	Chap 8
4/26	**Project reports due**	
4/29-5/3	Statistical mechanics of soft matter systems	Notes
5/8	**Final Exam (8-10 a.m.)**	**Chaps 1-8**

Rules of the Road

- *All work done in this course must be completed in a manner consistent with NDSU Senate Policy, section 355: Code of Academic Responsibility and Conduct*
  `http://www.ndsu.nodak.edu/policy/355.htm`
- *Plagiarism or inappropriate use of computers will result in failure of the course.*
- *Any students with disabilities who need accommodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.*
- *All access to NDSU computers must respect NDSU Senate Policy, section 158: Acceptable use of Electronic Communication Devices*
  `http://www.ndsu.nodak.edu/policy/158.htm`