PHYS 408, Thermodynamics and Statistical Mechanics
Fall, 2017 Syllabus
Texas A&M University

This course will include a survey of thermodynamics and statistical mechanics, including quantum as well as classical gases, thermal properties from a statistical perspective including entropy and partition functions, crystals and other dense systems, phase transformations, heat engines and refrigerators, and thermal properties of interacting gases and systems.

Learning Goals: Students in this course will

1. Understand the thermodynamic potentials and the conditions under which they are used.
2. Become familiar with the most important ensembles used to treat thermodymic systems.
3. Learn to apply the fundamental variables in describing the mathematical properties of such systems.
4. Master the statistical approach to essential thermal problems from a microscopic viewpoint.
5. Gain an understanding of quantum gases and their behavior, and of how these properties contribute to the behavior of physical systems from nuclear matter to crystals and astronomical systems.
6. Become familiar with heat engines and other cycles, including the Carnot cycle and its relation to the second law of thermodynamics.
7. Understand some of the essential themal physics underlying phase transformations, and interacting particle systems.

Class Meetings: TR 9:35-10:50 and W 9:10-10:00, MPHY 107

Instructor: J. H. Ross, email: ross@physics.tamu.edu
Office: 448 MPHY. Research Lab: B03 ENPH/lab phone 979-845-7823
Office hours, in 448 MPHY unless otherwise pre-arranged: TR 11-12, W 10:30-12
(At other times than these I am often available to meet either in my lab or my office, although it is always a good idea to email first to make sure I am available.)

Course Website: http://rossgroup.tamu.edu/408page.html

Text: Course Text: D. V. Schroeder, An Introduction to Thermal Physics (Addison Wesley 2000). Some additional materials will be provided in class to supplement the text readings.

Prerequisites: PHYS 221, PHYS 412, MATH 311 or equivalent

Grading:		
	Homework / HW presentations	40%
	2 Hourly Exams	30%
	Final Exam	30%

HW presentations: As part of the homework grade, 5 out of the 40 points are reserved for in-class presentations of the homework solutions. These will be done on a rotating basis, more details in class.

Honors contract: To take this course under honors credit requires an extra research paper/presentation. This involves investigating a topic releated to this course beyond what is covered in the textbook and regular lectures, preparing a paper on this subject, and giving a short lecture to the class (about 20 minutes) on this topic. The paper and presentation should include a derivation of some of the relevant physics (or perhaps numerical simulations related to the topic), showing how the results connect to what

is covered in class. Also you should include at least some references to recent research papers showing one or more current research directions related to your topic. I will provide suggestions for topics as the course proceeds.

Tentative schedule of classes along with topics covered:

(Schedule follows roughly the Schroeder text with chapters in the text given below; specific chapter sections for reading will be given in class.)

week 1	8-28 to 9-1	Introduction; ideal gases; first law. (ch. 1)
week 2	9-4 to 9-8	Heat capacities, enthalpy; statistical processes. (ch. 1-2)
week 3	9-11 to 9-15	Entropy and second law (ch. 2).
week 4	9-18 to 9-22	Thermal processes; chemical potential. (ch. 3)
week 5	9-25 to 9-29	Entropy in magnetic systems; ch. 3 continued.
week 6	10-2 to 10-6	Heat engines; carnot cycle. (ch. 4)
		Exam 1: Oct. 5. (material from chapters 1-3)
week 7	10-9 to 10-13	Chapter 4 continuation and Free energies (ch.5).
week 8	10-16 to 10-20	More on free energies and applications to chemical equilibrium, phase transformations (ch. 5).
week 9	10-23 to 10-27	Boltzmann statistics; classical ideal gas and equipartition theorem (ch. 6).
week 10	10-30 to 11-3	Partition function and canonical ensemble (ch. 6).
week 11	11-6 to 11-10	Quantum gases; grand canonical ensemble and Fermi-Dirac distribution (ch. 7).
week 12	11-13 to 11-17	Fermi gas applications; blackbody radiative systems, phonons in solids (ch. 7).
week 13	11-20 to 11-21	**Exam 2 Nov 21:** covers ch. 4 through Fermi gases/phonons and photons (specific corresponding text sections to be announced)
week 14	11-27 to 12-1	Bose condensation, Curie systems (ch. 7-8)
week 15	12-4 to 12-6	Ch. 8 continuation and review (Tues-Weds class this week).
	12-8	**Final Exam;** 12:30-2:30 PM.

Further Information: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus, or call 979-845-1637. For additional information visit http://disability.tamu.edu.

You should also know and follow the Aggie Honor Code: "*An Aggie does not lie, cheat, or steal or tolerate those who do*." and consult the Honor Council Rules and Procedures on the web, http://www.tamu.edu/aggiehonor.