

Physics 4125 Spring 2020
Thermodynamics and Statistical Mechanics

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Office Hours: MW 1pm-2pm
or by appointment

Lecture time: MWF 10:30 AM – 11:20 PM 118 Nicholson Hall

Text: *An Introduction to Thermal Physics* by Daniel Schroeder

Course website: <http://www.phys.lsu.edu/faculty/vekhter/Teaching.html> for Homework Assignments and Solutions. Website will be operational by the end of the first full week of classes.

Purpose: To introduce the concepts and methods of thermodynamics and statistical mechanics at the level of a senior undergraduate physics majors. To build problem solving skills and to effectively use mathematical tools to describe nature.

Lectures: There will be 1-academic hour (50 minute) lectures given each Monday, Wednesday, and Friday at 10:30 AM.

This course covers most of your textbook. A few sections will be omitted as noted on the course schedule and as announced in class.

You are *required* to read the assigned relevant material in the textbook prior to attending the lectures. The approximate lecture and reading schedule is attached below, and modifications will be announced in class and on the course website. You are expected to be able to discuss the relevant material from the reading assignment during the class. The instructor reserves the right to introduce *reading quizzes* if it is found that students are not properly preparing themselves before lectures. Such quizzes, if given, will account for a significant fraction of the final grade at the discretion of the instructor. I do hope that such measures will not be needed. I recommended that you attempt the homework problems only after reading each section of the text.

Homework: Assuming we have a grader, homework will be assigned (almost) each week. It will be due on Wednesdays at the beginning of class. Please remember that homework solutions are a communication between the student and grader that should include appropriate text and equations in enough detail so that the logic behind the solutions is clear. If the grader does not understand the solution, points will be taken off. I will post my solutions to the homework problems on the class web site after the due date and time. You should compare your solutions to mine, making sure that you understand my logic. I encourage you to make copies or to digitize your homework solutions so that you have these available for comparison purposes and for use as a study guide for exams: graders occasionally take longer than you think to finish grading.

20% of your course grade will be based on Homework. You are encouraged to solve additional problems in the text as the exam problems may be similar to the problems in the book (or not). Past experience shows a strong correlation between *quality* of homework and the exam grades. Homework problems are your way of assessing your mastery of the material AND your problem solving ability. Homework grades of less than 90% are an indication that students have not mastered the material and that more effort on the part of the student may be required. Solutions manuals are *not* to be used as an aid to performing homework problems; use of solution manual constitutes a violation of the LSU Academic code. Students are encouraged to work together to discuss and to assist each other in solving the assigned problems.

Participation in a pilot study: I was recently contacted by the Physics Education Team at UC Boulder, who are doing a pilot study of the online assessment tool for the upper level thermal physics courses. Therefore, probably towards the end of semester, you will be asked to complete the online assessment. To make it worth your time I will count completion of the assessment (not correctness of your responses, I am only getting statistical data, not individual scores) as a 100% score on an additional homework.

Office hours: If you do not understand part of the material or have trouble in working the problems assigned *seek help!!!!* I will be available during office hours or by appointment for any help you may need with the course material, problem solving, or other matters. Note that during the office hours I will only answer questions, but not give answers to homework problems, and help will only be offered on problems that have been attempted prior to the meeting.

Exams: There will be three midterm exams given during the semester. Two of those (#1 and #3) will be in-class: one closed book, when you will be supplied with a formula sheet for use during the exam, the other open book. You will need a scientific calculator.

Midterm #2 will be a 24hr take-home exam. For that exam you are allowed to use any books and reference materials. You are required to work on the exam on your own, without anyone's help or participation. Soliciting or receiving such help is contrary to the LSU academic code.

Since partial credit will be given for the problems, it is essential that you show all work and give explanations and intermediate steps. An answer without showing the appropriate steps through a calculation will not be accepted. Units are to be carried through as a part of the solution. Each midterm will be worth 15% of the final grade.

There will be no make-up exams.

Final exam: University has scheduled the final exam for Saturday, May 9, 7:30-9:30am. I will consider replacing it with a take-home exam, but that decision will be made in early April. The final exam will be open book and comprehensive in nature. It will be worth 35% of the final grade.

Preliminary Reading Assignment and lecture schedule

Note that the chapter and sections refer to Schroeder.

Date	Chapter – sections	Topic	
Week 1			
1/13	1	1-2	Equilibrium and the Ideal Gas
1/15	1	3-4	Ideal gas cont. and Equipartition
1/17	1	4-5	Heat and Work
Week 2			
1/20			No class MLK Birthday observance
1/22	1	6	Heat Capacity HW#1 Due <i>Final day for dropping without receiving a “W”</i>
1/23			<i>Final Day for Adding Course</i>
1/24	1	7	Rates of Processes
Week 3			
1/27	2	1-2	Probability review, two-state systems
1/29	2	2-3	Einstein solids; interacting systems HW#2 Due
1/31	2	3	Interacting Systems
Week 4			
2/3	2	4	Large Systems
2/5	2	5	The Ideal Gas HW#3 Due
2/7	2	6	Entropy
Week 5			
2/10	2	6	Entropy cont.
2/12	3	1	Temperature HW#4 Due
2/14	3	2	Entropy and Heat
Week 6			
2/17	3	3	Paramagnetism
2/19	3	4	Mechanical Equilibrium & Pressure HW#5 Due
2/21			EXAM I (Ch. 1-2, 3.1-3)
Week 7			
2/24			Mardi Gras Holiday
2/26			Mardi Gras Holiday
2/28	3	5	Diffusive Equilibrium and Chemical Potential
Week 8 (APS March Meeting, I am away M-Th)			
3/2	4	1-2	Carnot Engines and Refrigerators
3/4	4	3	Real Engines HW#6 Due
3/6	4	4	Real Refrigerators

Week 9

3/9	5	1	Free Energy as Available Work	
3/11	5	2	Free Energy as a force toward equilib.	HW#7 Due
3/13	5	3	Phase Transformations	

Week 10

3/16	6	1	The Boltzmann Factor	
3/18	6	2-3	Average Values and Equipartition	HW#8 Due
3/20			Catch-up and review	EXAM II (Ch. 3-6.4)

Week 11: Spring Break 3/23-3/29**Week 12**

3/30	6	4	Maxwell Speed Distribution	
4/1	6	5-6	Partition function	HW#9 Due
4/3	6	7	Ideal Gas Revisited 3/22	

Week 13

4/6	7	1-2	The Gibbs Factor	
<i>Final Day for dropping Course and for requesting rescheduling final examination when 3 exams are scheduled within 24 hours.</i>				
4/8	7	2-3	Bosons and Fermions	HW#10 Due
4/10			Good Friday Holiday	

Week 14

4/13	7	3	Degenerate Fermi gas	
4/15	7	3	Degenerate Fermi gas	HW#11 Due
4/17	7	4	Blackbody Radiation	

Week 15

4/20	7	5	Debye Theory of Solids	
4/22	7	6	Bose-Einstein Condensation	HW#12 Due
4/24			EXAM III (Ch. 6.5-7)	

Week 17

4/27	8	2	Ising model: mean field	
4/29			Catch up and review	HW#13 Due
5/1			Catch-up and review	

5/9 **Final Exam!!!!**