Phy401: Thermodynamics (3 hr) Spring 2016

Department of Physics and Engineering

Instructor: Dr. Paul D. Schmelzenbach	Meeting: 11:00-11:55 MWF (RS 219)
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Materials – *An Introduction to Thermal Physics* by Daniel Schroeder (2000). Access to MATLAB or similar program.

Description – The goal of this course is to understand thermodynamics and statistical mechanics at an intermediate level. You will learn how to describe aspects of the behavior of large collections of particles and how this macroscopic behavior is connected to the laws governing the individual particles. These ideas, and associated problem solving techniques, are important in many engineering applications, material science, physics, and to understanding a wide variety of phenomena in the physical sciences.

Learning Outcomes – This course supports the overall learning objectives of the physics and engineering programs to: develop an understanding of the fundamental principles of physics and apply physical principles, mathematical reasoning, and computational techniques to solve real-world problems

Within these broader outcomes, in this course you will

1. Understand and quantify the energy exchange in thermal physics
2. Explain the concept of entropy and its application to many-particle systems
3. Demonstrate familiarity with a variety of practical thermodynamic systems and processes.
4. Apply the laws of thermodynamics to solve problems
5. Apply the methods of statistical mechanics (in particular the Boltzmann factor and the summation over probabilities with a partition function) to solve for equilibrium properties of simple systems.
6. Justify and explain your thinking and approach to a problem or physical situation in written or oral form
7. When appropriate for a given problem you should be able to predict your expectations of a problem (such as behavior at high or low temperature) as well as evaluate the reasonableness of your answer (such as its dependence on various quantities, units, etc.)
8. Apply computational techniques to help solve thermal physics and statistical mechanics problems.

Homework – Homework is exceedingly important for developing an understanding of the course material, not to mention building skills in complex physical and mathematical problem solving. Remember that it is not just a "correct solution" that is the goal, it is the process to the solution that will develop your skill as a physicist or engineer. I encourage you to work together on the homework sets, but you must participate in the process of obtaining the solution to each problem. The guideline is that you should have no trouble explaining or repeating work that you turn in.

Homework Grading: I will be using the following grading rubric for your homework (and similar scale for exams):

0: Work shows little knowledge of physics relevant to the problem.

1: There is clear evidence in the work that a reasonable approach to the problem was attempted, but there are errors in units, formulae, or fundamental physics.

2: Either a reasonable, but incorrect, approach was attempted with few other errors; or a correct approach was presented with errors in units or math.

3: A correct approach was presented with few errors.

4: A correct approach was presented with no more than one minor error. Words were used at times to clearly indicate how and why the derivation was performed.

Preclass questions Each class day there will be three preclass questions to answer electronically. These will be due by midnight the evening before class. Your responses to Preclass questions are graded on the following scale: 2=demonstrates reading/thinking; 1=room for improvement or late but before class, 0=unsatisfactory or submitted after class. For credit preclass questions must be submitted prior to class.

Exams – Three examinations will be given during the semester on February 10, March 18 and April 25. The final examination is scheduled for Monday, May 2 at 10:30 am.

Quick Quizzes – Through the semester there will be several "quick quizzes" that will be announced at a minimum of the previous class period.

Final Grades – The grade you earn in this course is based on the scale shown to the right. The points you receive during the course are weighted accordingly:

- Homework: 25%
- Preclass: 5%
- Tests (3): 35%
- Quick Quizzes: 10%
- Final Exam: 25%

A	100 - 91.0
A-	91.0 - 89.5
B+	89.5 - 87.0
B	87.0 - 81.0
B-	81.0 - 79.5
C+	79.5 - 77.0
C	77.0 - 71.0
C-	71.0 - 69.5
D+	69.5 - 67.0
D	67.0 - 61.0
D-	61.0 - 55.0

Course Calendar			
	Topics	Reading	Homework
1/12	Intro and Temperature	1.1	
1/13	Ideal Gas	1.2	
1/15	Ideal Gas II; Equipartition of Energy	1.2-1.3	
1/18	No class meeting		
1/20	Heat and Work	1.4, 1.5	
1/22	Heat Capcity	1.6	Hmk 1
1/25	Enthalpy; Heat capacity	1.6	
1/27	Microstates and Multiplicities	2.1-2.2	
1/29	The Second Law	2.3	Hmk 2
2/1	Large Systems	2.4	
2/3	Ideal Gas	2.5	
2/5	Entropy	2.6	
2/8	Wrap-up and Review	2.6	Hmk 3
2/10	Exam #1 (Chapters 1-2)		
2/12	Temperature	3.1	
2/15	Entropy and Heat	3.2	
2/17	Paramagnetism	3.3	
2/19	Pressure	3.4	Hmk 4
2/22	Chemical Potential	3.5-3.6	
2/24	Heat Engines	4.1	
2/26	Refrigerators	4.2; browse 4.3-4.4	
2/29	Free Energy	5.1	Hmk 5
3/2	Free Energy II	5.2	
3/4	Phase Transitions	5.3	
3/7	Spring Break		
3/9	Spring Break		
3/11	Spring Break		
3/14	Clausius-Clapeyron Relation	5.3	
3/16	Wrap-up and Review		Hmk 6
3/18	Exam #2 (Chapters 3-5)		
3/21	The Boltzmann Factor	6.1	
3/23	Average Values	6.2	
3/25	Easter Break		
3/28	Easter Break		
3/30	The Equipartition Theorem	6.3	
4/1	The Maxwell Speed Distribution	6.4	Hmk 7
4/4	More Partition Functions	6.5,6.6	
4/6	Ideal Gas Revisited	6.7	
4/8	The Gibbs Factor	7.1	
4/11	Bosons and Fermions	7.2	Hmk 8
4/13	Degenerate Fermi Gases	7.3 (up to p.277)	
4/15	Photon Gas	7.4	
4/18	Blackbody Radiation	7.4	
4/20	Debye Thoery of Solids	7.5	
4/22	Wrap-up and Review		Hmk 9
4/25	Exam #3 (Chapters 6-7)		
4/27	Additional Topics		
4/29	Additional Topics		Hmk 10
5/2	Final Exam Monday 10:30-1:00		

As with all courses at PLNU, this course supports the cause to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service becomes an expression of faith. Being of Wesleyan heritage, we aspire to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Academic Integrity – Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

Academic Accommodations – If you have a diagnosed disability, please contact PLNU's Disability Resource Center (DRC) within the first two weeks of class to demonstrate need and to register for accommodation by phone at 619-849-2486 or by e-mail at DRC@pointloma.edu. See Disability Resource Center for additional information.

Attendance – Regular and punctual attendance at all classes is considered essential to optimum academic achievement. If the student is absent from more than 10 percent of class meetings, the faculty member can file a written report which may result in de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university drop date or, after that date, receive the appropriate grade for their work and participation. See Academic Policies in the Undergraduate Academic Catalog.

Final Exam – Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the Class Schedules site.

FERPA Policy As a student at Point Loma, you have a legal right to privacy as outlined in the federal FERPA (Family Educational Rights and Privacy Act) legislation. See Policy Statements for full text.