Point Loma Nazarene University
Department of Physics and Engineering
EGR 4013/PHY 4013 Thermodynmaics (3)

Fall Semester, 2023
Class meetings MWF: 12:15-1:10; Rohr Science Hall 365 (RS 365)
Final Exam: Monday, Dec. 11 10:30 am-1 pm

Instructor: Dr. Paul D. Schmelzenbach
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Office hours (RS 258): Tues & Thurs: 9-10am, 12:30-2pm. Other times available by appointment.

PLNU Mission: To Teach ~ To Shape ~ To Send
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission
The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment, and pursue integration of modern scientific knowledge and Christian faith.

Course Description
Fundamental concepts of thermodynamics and statistical mechanics; applications to both classical and quantum systems.

Course Learning Outcomes
After completing this course, students can

1. Understand and quantify the energy exchange in thermal physics.
2. Explain the concept of entropy and its application to multi-particle systems.
3. Demonstrate familiarity with a range of practical thermodynamic systems and processes.
4. Apply the laws of thermodynamics to solve problems.

5. Use methods of statistical mechanics, especially the Boltzmann factor and summation over probabilities with a partition function, to determine equilibrium properties of simple systems.

6. Justify and articulate your reasoning and approach to a problem or physical scenario, either in writing or verbally.

7. For relevant problems, predict expected outcomes (e.g., behavior at high or low temperatures) and assess the plausibility of your solution, considering aspects like dependence on specific quantities and units.

Required Texts and Materials
"An Introduction to Thermal Physics" by Daniel Schroeder (2000). Access to MATLAB or similar program.

Course Credit Hour Information
In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for a 3-unit class delivered over 15 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

Assessment and Grading: The grade you earn in this course is based on the scale below. The points you receive during the course are weighted accordingly:

A	**B**	**C**	**D**	**F**
A 92-100	B+ 87-89	C+ 77-79	D+ 67-69	F Less than 59
A- 90-91	B 83-86	C 73-76	D 63-66	
	B- 80-82	C- 70-72	D- 60-62	

(2%) Preclass: In preparation for each class meeting, a reading assignment or activity will be given. Since class meetings do not follow a standard lecture format, these assignments are crucial. To complete the reading assignment, answer three questions and submit them electronically by 11:59 pm the evening before a class meeting. Late submissions will not earn points.

(23%) Homework: Practicing and completing homework assignments is vital for understanding the course material and building skills in physical and engineering problem solving. The objective is not merely arriving at the "correct solution"; rather, it is the practice of the process leading to that solution that will develop your skillset as an engineer or physicist. Collaboration on homework sets is encouraged, but you should actively participate in the solution-finding process. A good rule of thumb is being able to explain or replicate any work you submit.

(35%) Exams (3): Three exams will be administered throughout the semester. They will comprise multiple-choice and short answer conceptual questions, as well as problems to solve. Exams are closed book, though a formula sheet will be provided.

(15%) Quizzes: Students will be given approximately weekly quizzes to demonstrate their understanding of the material. Quizzes cannot be made up; however, the lowest two quiz scores will be excluded from the overall quiz grade calculation.

(25%) Final exam: The final examination will be comprehensive. You are allowed a handwritten page of notes, and a sheet of formulas will be provided.

Exams: Examinations, including the final examination, will cover topics explored in the text, lecture and through homework. The specific learning outcomes distributed for each section will serve as a valuable study guide.

Late Assignments and Exam Policy: Preclass assignments, homework will not earn points if submitted late. The lowest homework score will be dropped in the calculation of your final grade.

No examination may be missed without prior consent or a well-documented emergency beyond your control. A score of zero will be assigned for any examination missed without prior consent or a documented emergency. If such an event arises, please ensure that you communicate with the professor as soon as possible so other arrangements can be made.

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. If you find yourself scheduled for three (3) or more final examinations on the same day, you are authorized to contact each professor to arrange a different time for one of those exams. However, unless you have three (3) or more exams on the same day, no requests for alternative final examinations will be granted.

Incomplete grade
Incompletes will only be assigned in extremely unusual circumstances. If you believe that your particular circumstances qualify be in clear communication with the professor as soon as you are able.

Course AI policy
Emerging technologies, such as large language models (e.g., ChatGPT), are intriguing and potentially beneficial. However, their pedagogical impact on physics learning outcomes remains somewhat untested. Any work that employs AI-based tools must be clearly identified, including the specific tool(s) used and relevant details. This policy will be further elucidated with examples during lectures. Please be aware that AI policies may differ among classes this semester.

State Authorization

State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

PLNU Copyright Policy

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU Academic Honesty Policy

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.

PLNU Academic Accommodations Policy

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

PLNU Attendance and Participation Policy

Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions,

the faculty member will issue a written warning of 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 an "F" grade.

Class Enrollment:
It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

Sexual Misconduct and Discrimination
In support of a safe learning environment, if you (or someone you know) have experienced any form of sexual discrimination or misconduct, including sexual assault, dating or domestic violence, or stalking, know that accommodations and resources are available through the Title IX Office at pointloma.edu/Title-IX. Please be aware that under Title IX of the Education Amendments of 1972, faculty and staff are required to disclose information about such misconduct to the Title IX Office.

If you wish to speak to a confidential employee who does not have this reporting responsibility, you can contact Counseling Services at counselingservices@pointloma.edu or find a list of campus pastors at pointloma.edu/title-ix.

Spiritual Care
Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith. If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development Links to an external site.

Topics and Assignments at a glance:

Date	Topic	Reading	Hmk
8/28	Introduction and Temperature	1.1	
8/30	Ideal Gas; Equipartition Theorem	1.2-1.3	
9/01	Heat and Work	1.4, 1.5	Hmk 1
9/06	Heat Capacity; Enthalpy	1.6	
9/08	Microstates and Multiplicities	2.1-2.2	Hmk 2
9/11	The Second Law	2.3	
9/13	Large Systems	2.4	
9/15	Ideal Gas	2.5	Hmk 3
9/18	Entropy	2.6	
9/20	Wrap-up and Review		

Date	Topic	Reading	Hmk
9/22	**Exam 1**		Hmk 4
9/25	Temperature	3.1	
9/27	Entropy and Heat	3.2	
9/29	Paramagnetism	3.3	Hmk 5
10/02	Pressure; Mechanical Equilibrium	3.4	
10/04	Chemical Potential	3.5-3.6	
10/06	Free Energy	5.1	Hmk 6
10/09	Free Energy 2	5.2	
10/11	Phase Transitions; Clausius-Clapeyron Relation	5.3	
10/13	Clausius-Clapeyron Relation	5.3	Hmk 7
10/16	Wrap-up and Review		
10/18	**Exam 2**		
10/23	The Boltzmann Factor	6.1	
10/25	Average Values	6.2	
10/27	The Equipartition Theorem	6.3	Hmk 8
10/30	The Maxwell Speed Distribution	6.4	
11/01	More Partition Functions	6.5,6.6	
11/03	Ideal Gas Revisited	6.7	Hmk 9
11/06	The Gibbs Factor	7.1	
11/08	Bosons and Fermions	7.2	
11/10	Degenerate Fermi Gases	7.3 (up to p.277)	Hmk 10
11/13	Photon Gas	7.4	
11/15	Blackbody Radiation	7.4	
11/17	Wrap-up and Review		Hmk 11
11/20	**Exam 3**		
11/27	Heat Engines	4.1	
11/29	Refrigerators	4.2; browse 4.3-4.4	
12/01	Heat Transfer I	Notes 1.1	Hmk 12
12/04	Heat Transfer II	Notes 1.2	
12/06	Heat Transfer III	Notes 1.3	
12/08	Heat Transfer IV		Hmk 13