Syllabus for Classical Thermodynamics, PHYS 451
Spring 2024

CRN: 33412, F01

TR 4:45-5:45 PM, REIC 207 (Lecture)

Instructor: Ataur R. Chowdhury

Office: REIC 118

Office Hours: MW 3:30-5:00 PM

Contact: Phone (907) 474-6109
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Prerequisites: PHYS 342, PHYS 351, PHYS 421; or permission of instructor**.**

Text: **Required:** *An Introduction to Thermal Physics* by D. Schroeder, Addison Wesley.

Reference Texts:
1. *Equilibrium Thermodynamics,* C.J. Adkins, 3rd Edition, Cambridge.
2. *Classical and Statistical Thermodynamics*, A. Carter, Prentice Hall.
3. *Fundamentals of Statistical and Thermal Physics*, F. Reif, Waveland Press.

Course Outline: The canonical ensemble; maximizing entropy, the partition function and Helmholtz free energy, the harmonic oscillator, Einstein and Debye solids, classical system and ideal gas, diatomic molecules, equipartition theorem, the photon gas and blackbody spectrum, the grand canonical ensemble, quantum statistics, Fermion and Boson systems.

Course Objectives: To acquire a basic understanding of the principles of statistical mechanics.

Student Learning Outcomes:

1. Students should be able to understand the fundamentals of statistical mechanics from a classical viewpoint.
2. Students should be able to gain clear understanding of founding laws of statistical mechanics and should be able to explain statistical processes based on these laws.
3. Students should have clear understanding of equation of large systems based on statistical interpretations.
4. Students should understand the fundamentals of interacting systems based on classical and quantum statistical principles.

Instructional methods: Interactive lecture-based instruction

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Mode of Instruction: Face-to face live lectures in class

Credits: 2 credits: 2 hr. of lecture.

Help Session: Help with homework and lab is available through the teaching assistants (TAs) during the hours posted on the door of REIC 122.

MTWR: TBA (REIC 122)

Additional help with homework is available through the instructor during his designated office hours.

Course Requirement and Policies:

Class Attednence/Participation:
For a better understanding of the course material attendance and participation in classroom activities are very important. This particular course is generally regarded as one of the founding courses that deal with the fundamentals of classical thermodynamics, and it is highly expected that the students will commit themselves to attend the class regularly. There will be supplemental materials for this course and the students will be held responsible for all the materials that will be brought in from outside the text. The students will be expected to participate in class activities and take part in meaningful discussion and ask questions to better comprehend the subject material. Participation will account for 5% of your total grade.

It is highly expected that the students will cause least disruption of class activities by showing up before the class starts, not leaving the class before it stops, keeping cell phones in silent mode, and refraining from talking during the class.

Homework:
On the average, 6-8 problems/exercises/questions will be assigned each week on Wednesdays, and these will be posted on the blackboard. The homework will be due back by 5:00 PM on Wednesdays the following week. NO LATE HOMEWORK WILL BE ACCEPTED. NO EXCEPTIONS (barring emergencies and extreme situations). Group work is highly encouraged for solving problems, and for additional help with the homework the students are most welcome to consult the instructor during the office hour or any other time by prior appointment. Any homework you submit should reflect you own best effort. Copying of homework is absolutely not acceptable and will result in a grade of zero for the assignment. All assignments on homework will be posted on the Black Board, and solutions must be submitted in a designated drop box inside the physics office, REIC 102.

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Quiz: During the lecture, the students will be expected to take part in meaningful discussion and ask questions to better comprehend the subject material. To engage students in active participation, there may be, from time to time, some pop quizzes and clicker questions. These quizzes will be administered at the beginning of the lecture, and are designed to test students understanding of the subject material covered during the preceding week. The quiz may include problems like those in the homework, those worked out in class, and may also include 'intuitive' question pertaining to the subject material covered during the previous week. **All quizzes (open-note, open-text), without a worsening COVID-19, will take place in class and will have to be submitted on paper. No digital devices, like laptops, cell phones, are allowed during the quizzes. Make-up quizzes, if you miss class for valid reasons, may be arranged with approval from the instructor.**

Examinations:
There will be two midterm examinations (March 7, Thursday, 4:45-5:45 PM, and April 4, Thursday, TBA) and a final comprehensive examination (May 2, Thursday, 4:45-5:45) for this course. Examinations will consist of, in most part, problems similar to those in the homework and those worked out in class. Midterm will cover the material covered in class and homework prior to the date of test, and the final will be comprehensive and will include material covered during the entire semester**. All exams, without a worsening COVID-19, will take place in class and will have to be submitted on paper. All exams are open-text, and no digital devices of any kind, like laptops, cell phones, are allowed during the exams. Make-up exams, for valid reasons, may be arranged in consultation with the instructor.**

Course Evaluation:

Final grade for this course will based on student's performance on homework, classroom participation, midterm, and final with respective weights as follows.

Homework	30%
Quizzes	15%
Midterm I	15%
Midterm II	15%
Final	25%
Total	100%

The final grade for this course will be based on a curve. For a given score, your letter grade will not be lower than what it would be expected based on standard grading scale (90-100 = A, 80-90 = B, etc.). No plus-minus letter grades will be given for this course.

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Syllabus Addendum (Revised 8/22/2022)

COVID-19 statement: Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:
https://sites.google.com/alaska.edu/coronavirus/uaf?authuser=0
Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

Student protections statement: UAF embraces and grows a culture of respect, diversity, inclusion, and caring. Students at this university are protected against sexual harassment and discrimination (Title IX). Faculty members are designated as responsible employees which means they are required to report sexual misconduct. Graduate teaching assistants do not share the same reporting obligations. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/.

Disability services statement: I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

ASUAF advocacy statement: The Associated Students of the University of Alaska Fairbanks, the student government of UAF, offers advocacy services to students who feel they are facing issues with staff, faculty, and/or other students specifically if these issues are hindering the ability of the student to succeed in their academics or go about their lives at the university. Students who wish to utilize these services can contact the Student Advocacy Director by visiting the ASUAF office or emailing asuaf.office@alaska.edu.

Student Academic Support:

- Speaking Center (907-474-5470, uaf-speakingcenter@alaska.edu, Gruening 507)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Gruening 8th floor)
- UAF Math Services, uaf-traccloud@alaska.edu, Chapman Building (for math fee paying students only)
- Developmental Math Lab, Gruening 406
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 120, https://www.ctc.uaf.edu/student-services/student-success-center/)
- For more information and resources, please see the Academic Advising Resource List (https://www.uaf.edu/advising/lr/SKM_364e19011717281.pdf)

Student Resources:

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- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, Whitaker 208)
- Student Health & Counseling **[6 free counseling sessions]** (907-474-7043, https://www.uaf.edu/chc/appointments.php, Gruening 215)
- Center for Student Rights and Responsibilities (907-474-7317, uaf-studentrights@alaska.edu, Eielson 110)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement: The University of Alaska is an affirmative action/equal opportunity employer and educational institution. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination. For more information, contact:
UAF Department of Equity and Compliance
1692 Tok Lane, 3rd floor, Constitution Hall, Fairbanks, AK 99775
907-474-7300
uaf-deo@alaska.edu

Additional syllabi statement for courses including off-campus programs and research activities:

University Sponsored Off-Campus Programs and Research Activities

We want you to know that:

1. UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.
2. Incidents can be reported to your university's Equity and Compliance office (listed below) or online reporting portal. University of Alaska takes immediate, effective, and appropriate action to respond to reported acts of discrimination and harassment.
3. There are supportive measures available to individuals that may have experienced discrimination.
4. University of Alaska's Board of Regents' Policy & University Regulations (UA BoR P&R) 01.02.020 Nondiscrimination and 01.04 Sex and Gender-Based Discrimination Under Title IX, go to: http://alaska.edu/bor/policy-regulations/.

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5. UA BoR P&R apply at all university owned or operated sites, university sanctioned events, clinical sites and during all academic or research related travel that are university sponsored.

For further information on your rights and resources click here.

Course Calendar:

Tentative Schedule

Lecture, Reading, and Exam

Date	Topics	Reading Assignment
Jan 16	syllabus, introduction	
18	Boltzman factor	6.1
23	partition function	6.2
25	statistical average	6.2
30	equipartition theorem	6.3
Feb. 1	Maxwell speed distribution	6.4
6	free energy	6.5
8	composite systems	6.6
13	statistical interpretation of ideal gas	6.7
15	quantum statistics, Gibbs factor	7.1
20	Bosons and Fermions	7.2
22	degenerate Fermi gases	7.3
27	Blackbody radiation	7.4
29	Blackbody radiation Cont'd	7.4
Mar.5	Debye theory of solids	7.5
7	**Midterm I**	
11-15	**Spring Break (no classes)**	

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18	Debye theory of solids	7.5
20	Bose-Einstein Condensation	7.6
26	Bose-Einstein Condensation	7.6
28	weakly interacting gases	8.1
Apr. 2	partition function	8.1
4	**Midterm II**	
9	cluster expansion	8.1
11	Virial coefficient	8.1
16	Ising model of ferromagnets	8.2
18	mean field approximation	8.2
23	phase transformations	8.2
25	Monte Carlo Simulation	8.2
29	review/overview	
May 2	**Final Examination** 4:30-6:30, Thursday, REIC 207	