



**PHYS 310: Thermodynamics and Kinetic Theory**  
**LEC-A01**  
**Fall Term, 2025**

**Instructor:** Prof. Bruce Sutherland

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**Course website:** <https://sites.ualberta.ca/~bsuther/courses/phys310.html>

**Office Hours:** By appointment

**Lecture Room & Time:** SAB 4-36 TR 9:30 - 10:50

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**TERRITORIAL ACKNOWLEDGEMENT**

The University of Alberta respectfully acknowledges that we are situated on Treaty 6 territory, traditional lands of First Nations and Métis people.

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**COURSE CONTENT**

**Course Description:**

Temperature: heat, work, and the first law of thermodynamics; entropy and the second law, enthalpy, Helmholtz and Gibbs free energy; thermodynamic equilibrium criteria; Maxwell's relations, phase transitions; elementary kinetic theory of gases.

**Course Prerequisites:**

one of PHYS 124, PHYS 144, or EN PH 131, and one of PHYS 126, PHYS 146, PHYS 181, or PHYS 130. Corequisite: MATH 209 or 215 or 315 or 317 or MA PH 351 or equivalent.

**Course Objectives and Expected Learning Outcomes:**

Students will develop a proficiency in understanding quantities characterizing heat, work, internal energy and free energies, the three laws of thermodynamics, applications to mechanical and natural phenomena, and microscopic/statistical interpretations that connect thermodynamics to molecular descriptions of gases and magnetism in solids.

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## LEARNING RESOURCES

**Required Textbook and/or Other Major Course Materials:** There is no required textbook. Lecture notes are posted on the course website (see above).

**Recommended or Optional Learning Resources:**

- "Thermodynamics, Statistical Thermodynamics and Kinetics", T. Engel and P. Reid, Pearson
- "An Introduction to Thermal Physics", Daniel V. Schroeder, Addison-Wesley Longman

Additional material (assignments, assignment solutions, practice exams and their solutions, formula sheets, etc) will be posted on the course website (see above).

**Course Schedule:**

Week	Dates	Topic
1	Sept 2,4	Introduction, definitions, equations of state
2	Sept 9,11	Work, heat and definition of the First Law of Thermodynamics
3	Sept 16,18	General Applications: heat capacity, enthalpy, adiabatic processes
	Weds Sept 17	<a href="#">Assignment 1 Due</a>
4	Sept 23,25	Specific applications: sound, diffusion, the atmosphere
5	Sept 30, Oct 2	Specific applications: Carnot Cycle, heat engines and refrigerators
	Weds Oct 1	<a href="#">Assignment 2 Due</a>
6	Oct 7,9	Entropy, the Second Law of Thermodynamics, free energies
7	Oct 14,16	Applications of the Second Law, irreversible processes
	Weds Oct 15	<a href="#">Assignment 3 Due</a>
8	Oct 21, 23	Applications of Gibbs free energy: phase transformations
9	Tues Oct 28	<a href="#">Midterm (in class)</a>
	Oct 30	Applications to the atmosphere: humidity, dew point, rain
10	Nov 4, 6	The kinetic theory of gases, Maxwell-Boltzmann distribution
11	Nov 10 - 14	<i>READING WEEK - no classes</i>
12	Nov 18, 20	mean free path and collision frequency
	Weds Nov 19	<a href="#">Assignment 4 Due</a>
13	Nov 25, 27	Introduction to statistical thermodynamics: entropy redefined
14	Dec 2, 4	Applications of statistical thermodynamics; course review
	Weds Dec 3	<a href="#">Assignment 5 Due</a>

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## GRADE EVALUATION

Assessment	Weight	Date
<a href="#">Assignment 1</a>	6%	4pm Sept 17
<a href="#">Assignment 2</a>	6%	4pm Oct 1
<a href="#">Assignment 3</a>	6%	4pm Oct 15
<a href="#">Assignment 4</a>	6%	4pm Nov 19
<a href="#">Assignment 5</a>	6%	4pm Dec 3
<a href="#">Midterm</a>	35%	9:30-10:50am, Tuesday Oct 28
<a href="#">Final Exam</a>	35%	1:00-4:00pm, Tuesday Dec 16

Assignments can be downloaded from the course website. Completed assignments must be submitted to box marked PHYS310 near CCIS L2-041 . Solutions will be posted on the course website shortly after the assignment is due. For this reason, late assignments will not be accepted.

Students must verify the date on BearTracks when the Final Exam Schedule is posted. Grades are unofficial until approved by the Department and/or Faculty offering the course.

**Re-examination:** There is no possibility of a re-examination in this course.

### University of Alberta Grading Policy

Grades reflect judgements of student achievement made by instructors and must correspond to the associated descriptor. These judgements are based on a combination of absolute achievement and relative performance in a class. Faculties may define acceptable grading practices in their disciplines. Such grading practices must align with the [University of Alberta Assessment and Grading Policy](#) and its procedures.

**Access to Past or Representative Evaluative Material:** Sample midterm and final exams will be posted on the course website at least a week before the examination.

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## POLICIES FOR LATE AND MISSED WORK

### Late Policies:

Late assignments will not be graded and marks for that assignment will be given a zero grade.

### Missed Term Work or Final Exam Due to Non-medical Protected Grounds (e.g., religious beliefs):

When a term assessment or final exam presents a conflict based on [non-medical protected grounds](#), students must apply to the Academic Success Centre for accommodations via their [Register for Accommodations website](#). Students can review their eligibility and choose the application process specific for *Accommodations Based on Non-medical Protected Grounds*.

It is imperative that students review the dates of all course assessments upon receipt of the course syllabus, and apply **AS SOON AS POSSIBLE** to ensure the timely application of the accommodation. Students who apply later in the term may experience unavoidable delays in the processing of the application, which can affect the accommodation.

### Missed Term Work:

A student who cannot complete an assignment due to incapacitating illness, severe domestic affliction or other compelling reasons must contact the instructor within two working days of missing the assessment, or as soon as possible, to request an excused absence. If an excused absence is granted, then the grade of marked assignments will be cumulatively worth 30% of the final grade. An excused absence is a privilege and not a right. There is no guarantee that an absence will be excused. Misrepresentation of facts to gain an excused absence is a serious breach of the Student Academic Integrity Policy. In all cases, instructors may request adequate documentation to substantiate the reason for the absence at their discretion.

### Deferred Final Examination: 1pm, Tuesday, January 7, 2025

A student who cannot write the final examination due to incapacitating illness, severe domestic affliction or other compelling reasons can apply for a deferred final examination. Such an application must be made to the student's Faculty office within two working days of the missed examination and must be supported by appropriate documentation or a Statutory Declaration (see calendar on [Attendance](#)). Deferred examinations are a privilege and not a right; there is no guarantee that a deferred examination will be granted. The Faculty may deny deferral requests in cases where less than 50% of term work has been completed. Misrepresentation of facts to gain a deferred examination is a serious breach of the Student Academic Integrity Policy.

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## STUDENT RESPONSIBILITIES

### **Academic Integrity and Student Conduct:**

The University of Alberta is committed to the highest standards of academic integrity and honesty, as well as maintaining a learning environment that fosters the safety, security, and the inherent dignity of each member of the community, ensuring students conduct themselves accordingly. Students are expected to be familiar with the standards of academic honesty and appropriate student conduct, and to uphold the policies of the University in this respect.

Students are particularly urged to familiarize themselves with the provisions of the [Student Academic Integrity Policy](#) and the [Student Conduct Policy](#), and avoid any behaviour that could potentially result in suspicions of academic misconduct (e.g., cheating, plagiarism, misrepresentation of facts, participation in an offence) and non-academic misconduct (e.g., discrimination, harassment, physical assault). Academic and non-academic misconduct are taken very seriously and can result in suspension or expulsion from the University.

All students are expected to consult the [Academic Integrity website](#) for clarification on the various academic offences. All forms of academic dishonesty are unacceptable at the University. Unfamiliarity of the rules, procrastination or personal pressures are not acceptable excuses for committing an offence. Listen to your instructor, be a good person, ask for help when you need it, and do your own work -- this will lead you toward a path to success. Any academic integrity concern in this course will be reported to the College of Natural and Applied Sciences. Suspected cases of non-academic misconduct will be reported to the Dean of Students. The College, the Faculty, and the Dean of Students are committed to student rights and responsibilities, and adhere to due process and administrative fairness, as outlined in the [Student Academic Integrity Policy](#) and the [Student Conduct Policy](#). Please refer to the policy websites for details on inappropriate behaviours and possible sanctions.

The College of Natural and Applied Sciences (CNAS) has created an [Academic Integrity for CNAS Students](#) eClass site. Students can self enroll and review the various resources provided, including the importance of academic integrity, examples of academic misconduct & possible sanctions, and the academic misconduct & appeal process. They can also complete assessments to test their knowledge and earn a completion certificate.

*"Integrity is doing the right thing, even when no one is watching." -- C.S. Lewis*

### **Contract Cheating and Misuse of University Academic Materials or Other Assets:**

Contract cheating describes the form of academic dishonesty where students get academic work completed on their behalf, which they submit for academic credit as if they had created it themselves. Contract cheating may or may not involve the payment of a fee to a third party, who then creates the work for the student.

Examples include:

1. Getting someone to write an essay or research paper for you.
2. Getting someone to complete your assignment or exam for you.
3. Posting an essay, assignment, or exam question to a tutorial or study website; the question is answered by a "content expert", then you copy it and submit it as your own answer.
4. Posting your solutions to a tutorial/study website, public server, or group chat and/or copying solutions that were posted to a tutorial/study website, public server, or group chat.
5. Sharing your login credentials to the course management system (e.g., Canvas) and allowing someone else to complete your assignment or exam remotely.
6. Using an artificial intelligence bot or text generator tool to complete your essay, research paper, assignment, or exam solutions for you (without the instructor's permission).
7. Using an online grammar checker to "fix" your essay, research paper, assignment, or exam solutions for you (without the instructor's permission).

Contract cheating companies thrive on making students believe that they cannot succeed without their help; they attempt to convince students that cheating is the only way to succeed.

Uploading the instructor's teaching materials (e.g., course outlines, lecture slides, assignment, or exam questions, etc.) to tutorial, study, or note-sharing websites or public servers is a copyright infringement and constitutes the misuse of University academic materials or other assets. Receiving assignment solutions or answers to exam questions from an unauthorized source puts you at risk of receiving inaccurate information.

### **Appropriate Collaboration:**

Students need to be able to recognize when they've crossed the line between appropriate collaboration and inappropriate collaboration. If students are unsure, they need to ask the instructors to clarify what's allowed and what's not allowed.

Here are some tips to avoid copying on assessments:

1. Do not write down something that you cannot explain to your instructor.
2. When you are helping other students, avoid showing them your work directly. Instead, explain your solution verbally. Allowing your work to be copied is also considered inappropriate collaboration.
3. It is possible that verbally discussing the solution in too much detail may result in written responses that are too similar. Try to keep discussions at a general or high level.
4. If you find yourself reading another student's solution, do not write anything down. Once you understand how to solve the problem, remove the other person's work from your sight and then write up the solution to the question yourself. Looking back and forth between someone else's paper and your own paper is almost certainly copying and considered inappropriate collaboration.
5. If the instructor or TA writes down part of a solution in order to help explain it to you or the class, you cannot copy it and hand it in for credit. Treat it the same way you would treat another student's work with respect to copying, that is, remove the explanation from your sight and then write up the solution yourself.

6. There is often more than one way to solve a problem. Choose the method that makes the most sense to you rather than the method that other students happen to use. If none of the ideas in your solution are your own, there is a good chance it will be flagged as copying.

**Exam Conduct:**

Please refer to the [Examinations](#) section of the Academic Calendar for more details on Conduct

Some key points to be aware of:

- Your student photo I.D. is required at exams to verify your identity.
- Students must arrive at the specified time to take the exam. Once the exam has started, students must remain in the physical in-person or remote environment for at least 30 minutes. Students who arrive more than 30 minutes late for an in-person exam will not be permitted to take the exam. Students who arrive more than 30 minutes late for an online exam may have their exam attempt removed or disqualified by the instructor. In both cases students may apply for a deferred examination.
- All cell phones must be turned off and stored in your bags.

**Accommodations for Students:**

In accordance with the University of Alberta's [Discrimination, Harassment, and Duty to Accommodate policy](#), accommodation support is available to eligible students who encounter limitations or restrictions to their ability to perform the daily activities necessary to pursue studies at a post-secondary level due to medical conditions and/or non-medical protected grounds. Accommodations are coordinated through the [Academic Success Centre](#), and students can learn more about eligibility on the [Register for Accommodations website](#).

It is recommended that students apply **AS SOON AS POSSIBLE** in order to ensure sufficient time to complete accommodation registration and coordination. Students are advised to review and adhere to published deadlines for accommodation approval and for specific accommodation requests (e.g., exam registration submission deadlines). Students who request accommodations less than a month in advance of the academic term for which they require accommodations may experience unavoidable delays or consequences in their academic programs, and may need to consider alternative academic schedules.

**Recording and/or Distribution of Course Materials:**

Audio or video recording, digital or otherwise, of lectures, labs, seminars or any other teaching environment by students is allowed only with the prior written consent of the instructor or as a part of an approved accommodation plan. Student or instructor content, digital or otherwise, created and/or used within the context of the course is to be used solely for personal study, and is not to be used or distributed for any other purpose without prior written consent from the content author(s).

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## STUDENT SUPPORTS

### Academic Success Centre:

The [Academic Success Centre](#) provides professional academic support to help students strengthen their academic skills and achieve their academic goals. Individual advising, appointments, and group workshops are available year round in the areas of Accessibility, Communication, Learning, and Writing Resources. Modest fees apply for some services.

### Faculty of Science Student Services:

The [Faculty of Science Student Services](#) office is located on the main floor of the [Centennial Centre for Interdisciplinary Sciences](#) (CCIS). This office can assist with the planning of [Your Academics](#), and provide information related to [Student Life & Engagement](#), [Internship & Careers](#), and [Study Abroad](#) opportunities. Please visit [Advising](#) for more information about what Faculty Academic Advisors in the Student Services Office can assist you with.

### Feeling Stressed, Anxious, or Upset?

It's normal for us to have different mental health experiences throughout the year. Know that there are people who want to help. You can reach out to your friends and access a variety of supports available on and off campus at the [Need Help Now](#) webpage or by calling the 24-hour Distress Line: 780-482-4357 (HELP).

### Student Self-Care Guide:

This [Self-Care Guide](#), originally designed by the Faculty of Native Studies, has broader application for use during students' learning. It provides some ideas and strategies to consider that can help navigate emotionally challenging or triggering material.

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### Learning and Working Environment:

The Faculty of Science is committed to ensuring that all students, faculty and staff are able to work and study in an environment that is safe and free from discrimination, harassment, and violence of any kind. It does not tolerate behaviour that undermines that environment.

If you are experiencing harassment, discrimination, fraud, theft or any other issue and would like to get confidential advice, please contact any of these campus services:

- [Office of Safe Disclosure & Human Rights](#): *A safe, neutral and confidential space to disclose concerns about how the University of Alberta policies, procedures or ethical standards are being applied. They provide strategic advice and referral on matters such as discrimination, harassment, duty to accommodate and wrong-doings. Disclosures can be made in person or online using the [Online Reporting Tool](#).*
- [University of Alberta Protective Services](#): *Peace officers dedicated to ensuring the safety and security of U of A campuses and community. Staff or students can contact UAPS to*



*make a report if they feel unsafe, threatened, or targeted on campus or by another member of the university community.*

- [Office of the Student Ombuds](#): *A confidential and free service that strives to ensure that university processes related to students operate as fairly as possible. They offer information, advice, and support to students, faculty, and staff as they deal with academic, discipline, interpersonal, and financial issues related to student programs.*
- [Office of the Dean of Students](#): *They can assist students in navigating services to ensure they receive appropriate and timely resources. For students who are unsure of the support they may need, are concerned about how to access services on campus, or feel like they may need interim support while you wait to access a service, the Dean of Students office is here to help.*

**Course Outlines:**

Policy about course outlines can be found in [Course Requirements, Evaluations Procedures and Grading](#) of the University Calendar.

**Disclaimer:**

Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported in this syllabus.

**Copyright:**

Dr. Bruce R Sutherland, Departments of Physics and Earth & Atmospheric Sciences, Faculty of Science, University of Alberta (2025).