

Thermodynamics Syllabus

Department of Physics and Atmospheric Science
PHYC 3200 Fall 2023

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Prof. Thomas J. Duck	tduck@dal.ca	MWF @ 12:30 PM, Dunn 128
Cameron Nickerson (TA)	cameron.nickerson@dal.ca	Wed. 1-4 PM, Chemistry 322

Course Description

An introduction to the basic concepts and laws of thermodynamics. There will be a short survey of required Mathematics (partial derivatives). Topics include: thermometry, equations of state, energy and entropy, thermodynamic potentials, heat engines, thermodynamic efficiency and phase transitions.

Course Prerequisites

PHYC 2140.03 or PHYC 2060.03, MATH 2001.03/2002.03, or permission of the instructor.

Course Exclusions

None.

Student Resources

Prof. Duck is available after class, or by appointment. TA Cameron Nickerson is available Wednesdays 1-4 PM.

In general, questions about the course and lectures should be raised with Prof. Duck, while help with homework assignments should be asked of Cameron. Grading questions should be raised with Cameron before bringing them to Prof. Duck.

Course Structure

Course Delivery

The course will be delivered in person, and will not be recorded so as to protect privacy and encourage classroom participation. Video lectures may be provided in the event Prof. Duck must be away or if there are unforeseen circumstances.

Lectures

Monday, Wednesday, and Friday, from 11:35-12:25 in Dunn 302.

Laboratories

None.

Tutorials

None.

Course Materials

There is no required textbook. Material has been drawn from a wide range of sources, including scientific journals. The texts below may be helpful in furthering your understanding of Thermodynamics.

1. Callen, Herbert B.: Thermodynamics and an Introduction to Thermostatistics (John Wiley and Sons, 1985).
2. Fermi, E.: Thermodynamics (1936; Dover 1956).
3. Van Ness, H. C.: Understanding Thermodynamics (McGraw-Hill, 1969).

Weekly assignments will be delivered via Brightspace.

Assessment

Assignments

Assignments will be provided on a weekly basis. (15%)

Tests/quizzes

Midterm 1: Friday, October 13, in class. (20%)

Midterm 2: Friday, November 10, in class. (20%)

Final exam

Scheduled by Registrar, in person, 3 h duration, during exam period. (45%)

Other course requirements

None.

Conversion of numerical grades to final letter grades follows the [Dalhousie Grade Scale](#)

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A-(80-84)	B-(70-72)	C-(55-59)	

Course Policies on Missed or Late Academic Requirements

Assignment extensions may be granted at the discretion of Prof. Duck. Assignments not handed in at the time they are due will be assessed a penalty of 10%/day late, with a minimum penalty of 10%. Late assignments will not be accepted once graded assignments have been returned to the class.

Midterm exams that are missed will need to be documented using the Student Declaration of Absence form. A maximum of one declarations of absence will be accepted for this purpose. Students who miss writing both midterm exams at their regularly-scheduled time will receive a final grade of INC.

Students who miss a midterm or final exam will be required to write a makeup. Students who write a makeup exam will be required to sign a statement that they have not received any information about the exam from another student, either directly or indirectly.

As per University Regulations, a student requesting an alternative time for a final examination will be granted that request only in exceptional circumstances. Documentation of the reasons for absence will be required.

Course Policies related to Academic Integrity

Students are NOT allowed to work together on assignments. Students may discuss assignments outside of class, and may even exchange ideas on how to solve assignment problems. However, anything submitted for grading must represent a student's own work. Generative AI and large language models like ChatGPT should not be used in this course.

Learning Objectives

Students will learn about :

- i) The four laws of thermodynamics and their implications;
- ii) How to perform thermodynamic calculations;
- iii) Callen's axiomatic formulation of thermodynamics and its mathematical consequences; and
- iv) Applications of thermodynamics.

Course Content

I. THE FOUR LAWS (13 lectures): The four laws, kinetic theory of gases, simple systems, processes of transformation, heat capacity, adiabatic processes, thermodynamic cycles, and entropy.

II. CALLEN'S AXIOMATIC FORMULATION (7 lectures): The four postulates, intensive variables, equilibrium conditions, thermodynamic potentials, Maxwell relations, reduction of derivatives, and the Euler and Gibbs-Duhem equations.

III. APPLICATIONS (13 lectures): Sound waves, cryogenerators, van der Waals' equation, phase diagrams, vaporization, steam power plants, refrigerator and heat pumps, thermal radiation, climate, and climate change.

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Faculty of Science

Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol: https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in

the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803: <https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

South House Sexual and Gender Resource Centre: <https://southhousehalifax.ca/about/>

LGBTQ2SIA+ Collaborative: <https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Dalhousie Student Advocacy Services: <https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Safety

Biosafety: <http://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Laser Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>