

PHYS4409 Thermodynamics and statistical physics

Instructor: Dag Gillberg Pron: [Dawg] (he/him)
dag.gillberg@carleton.ca

Office location: Room 2404 HP
[Click here for visual directions.](#)

TAs: Jerome Claude, jerome.claude@carleton.ca

Class times: Monday 16:05-17:25

Carlos Henrique de Lima, CarlosHenriquedelima@carleton.ca

Location: First three weeks, fully online
then HyFlex in NI 4030 (Nicole building)

Student hour: Wednesday 4 pm or by appointment

Prerequisites: PHYS 3701 (Modern Physics),
MATH 2004 & 3705 or permission from departm.

Website: <https://carleton.brightspace.com>

- What are 'student hours'?**
- Student hours are office hours renamed: dedicated times for the TA and course instructor to meet with you. During the Wednesday student hour, you are free to ask questions related to the course or specifically about the assignment.
 - If you would like to meet separately, feel free to email me or the TA to set up a time to meet.

Welcome to Phys 4409!

This course is meant to develop an integrated understanding of thermal physics both at the macroscopic (thermodynamics) and at the microscopic (statistical mechanics) levels. The first part of the course focuses on fundamental principles of thermal physics, including the first and second laws of thermodynamics, entropy and free energy. This is followed by statistical mechanics, including Maxwell-Boltzmann and quantum statistics.

Course delivery: The course includes both synchronous and asynchronous activities. Lectures will be pre-recorded, and a problem based lecture will be given on Monday's using the Hybrid-flexible (HyFlex) model to provide flexibility in these uncertain times due to the pandemic. With [HyFlex](#), students can choose to attend each class in person on campus or online via Zoom.

- Asynchronous activities:** Material (e.g. access to pre-recorded lectures+slides) will be posted to Brightspace. You are expected to review and study this material, including the corresponding sections and example problems in the textbook. This is intended to provide flexibility to students.
- Synchronous classes:** These will be held on Mondays using the assigned class times initially only via BigBlueButton, but starting in February via HyFlex, meaning you can come to class (NI 4030) or attend virtually (BigBlueButton).
- Synchronous student hour:** These will be held on Wednesdays starting 16:05 via BigBlueButton. The Midterm exam will also take place during these times.

Note: Some classes may be only online. It is possible all classes will be switched to online part way through the semester if lecture attendance is very poor. Any such change will be announced via email.

Inclusive teaching statement

Science is for everyone. I am committed to fostering an environment for learning that is inclusive for everyone. All students in the class, the instructor, and any guests should be treated with respect during all interactions. I would appreciate any feedback related to class throughout the course.

The Faculty of Science EDI statement: <https://science.carleton.ca/about/edi/>

Land acknowledgement: Here at Carleton University, it is important that we acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

Learning materials:

Required reading

D. Schroeder: An Introduction to Thermal Physics,

This book was first published by Addison-Wesley, 2000. Since 2021 by Oxford University press

Note: **these books have the same content.** Using the older one is fine.

Supplementary material:

Concepts in Thermal Physics, Second Edition, Blundell & Blundell, ISBN: 9780199562107

Sears, Salinger: *Thermodynamics, Kinetic Theory, and Statistical Thermodynamics*

Thermal Physics. Baierlein: *Thermal Physics*

Technology checklist

- An internet-enabled computer (laptop/desktop), with a webcam and microphone. (note: for midterm and final, you will need a camera; this could be a smartphone)
- Access to reliable internet

Note: *If there are issues with equipment, please email me as soon as possible. Options for purchase include inexpensive options for technology (Best Buy refurbished products, Kijiji); single workspaces for student use on campus (pending pandemic restrictions).*

Course assessment

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage with the material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you all can meet those standards.

Grade breakdown

COMPONENT	GRADE VALUE
QUIZZES	5%
ASSIGNMENTS	40%
MIDTERM	15%
ORAL INTERVIEW	15%
FINAL EXAM	25%

We make an effort to reduce unintentional bias in grading. For example, we grade assignments one question at a time (all of question 1 before question 2), grading anonymously, and using rubrics.

Quizzes

Several quizzes will be released throughout the course. Typically they will have about 5 questions and be due before the Monday lecture (i.e. 16:05 on Monday). They will be timed at 20 min (or similar). Most questions will be multiple choice, but they might also be “choose one or more options” or simple calculations. Don’t forget units!

Assignments

An assignment will be due each Friday, for a total of ten assignments. The assignments are posted on the course's Brightspace page with the associated deadline. Late assignments are penalized, unless there is a valid reason. The penalty is approximately -10% per day initially, topping out at 50%. The worst assignment will be ignored in the grade calculation.

The assignments are a critical part of the course and working through the problems yourself is essential to learn the material. Students are permitted to discuss concepts and strategies related to solving the assignments; **however, the work you turn in must be your own.** Feel free to consult me or the TA if you have problems. Note that the TA (Jerome) constructs the assignments and will hence be very familiar with the problems. The assignments are a critical part of the course and working through the problems yourself is essential to learn the material. Your homework solutions should be thorough, self-contained and logical with all steps explained.

Assignments will be submitted electronically on Brightspace. Hand-written solutions may be scanned or photographed for upload. The complete assignment must be uploaded as a single PDF file.

Midterm and final examination

The midterm exam will (most likely) be the last lecture before the reading week during the normal lecture slot (80 min). Note that this is planned to be done using the e-proctoring system, i.e. you need to have your video camera (e.g. using cell phone) showing a side-view of yourself while writing the exam. You will need to produce a pdf and upload it to the CU-learn page, in the same way the assignments are submitted.

The final exam will likely have two parts: a Brightspace-based quiz + a written part. It will take place during the regular examination period at the end of the term. The exact format of the exams will be discussed in advance during the lectures. Again, you will need to broadcast while writing with a video camera. Statement from the university:

Use of e-Proctoring system: This course has timed written assessments, which may consist of tests, midterms and/or final examinations. The Carleton University e-Proctoring system may be used in your assessments, and requires the use of webcams, microphones, and smartphones.

Oral interview

Each student will have an oral exam for about 15 minutes during the last week of classes. This will cover mostly conceptual questions, i.e. ask to explain and reason around the concepts of the course (the 'list of concepts' pdf on Brightspace is very useful to prepare for this). Also, you might be asked on quizzes and/or assignment questions you did poorly on.

Plagiarism and other forms of cheating

Working through problems is essential in developing understanding of thermal physics. Students are permitted to discuss concepts and strategies related to solving the assignments. All work handed in, however, **must be their own.**

Viewing or searching for solutions in any form before your assignment is submitted is forbidden and is considered an academic offence. This includes online resources like Chegg, solutions manuals, examples posted at Carleton or elsewhere, or from any other type of unauthorized source. Using any such resource for an examination of any kind (laboratory report, assignment, midterm, etc) is considered **plagiarism**, even if only part of the solution is used.

For more information see [Reg. 19 of the Grad calendar](#)

Community guidelines

The following values are fundamental to academic integrity and are adapted from the International Center for Academic Integrity². In our course, we will seek to behave with these values in mind:

	As students, we will...	As a teaching team, we will...
Honesty	<ul style="list-style-type: none"> Honestly demonstrate our knowledge and abilities on assignments and exams Communicate openly without using deception, including citing appropriate sources 	<ul style="list-style-type: none"> Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams Communicate openly and honestly about the expectations and standards of the course through the syllabus, and with respect to assignments and exams
Responsibility	<ul style="list-style-type: none"> Complete assignments on time and in full preparation for class Show up to class on time, and be mentally/physically present Participate fully and contribute to team learning and activities 	<ul style="list-style-type: none"> Give you timely feedback on your assignments and exams Show up to class on time, and be mentally & physically present Create relevant assessments and class activities
Respect	<ul style="list-style-type: none"> Speak openly with one another, while respecting diverse viewpoints and perspectives Provide sufficient space for others to voice their ideas 	<ul style="list-style-type: none"> Respect your perspectives even while we challenge you to think more deeply and critically Help facilitate respectful exchange of ideas
Fairness	<ul style="list-style-type: none"> Contribute fully and equally to collaborative work, so that we are not freeloading off others Not seek unfair advantage over fellow students in the course 	<ul style="list-style-type: none"> Create fair assignments and exams, and grade them in a fair, and timely manner Treat all students equitably
Trust	<ul style="list-style-type: none"> Not engage in personal affairs while on class time Be open and transparent about what we are doing in class Not distribute course materials to others without authorization 	<ul style="list-style-type: none"> Be available to all students when we say we will be Follow through on our promises Not modify the expectations or standards without communicating with everyone in the course
Courage	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept a lower or failing grade or other consequences of upholding and protecting the above values 	<ul style="list-style-type: none"> Say or do something when we see actions that undermine any of the above values Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

² This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Special information regarding COVID-19

All members of the Carleton community are required to follow COVID-19 prevention measures and all mandatory public health requirements (e.g., wearing a mask, physical distancing, hand hygiene, respiratory and cough etiquette) and [mandatory self-screening](#) prior to coming to campus daily.

If you feel ill or exhibit COVID-19 symptoms while on campus or in class, please leave campus immediately, self-isolate, and complete the mandatory [symptom reporting tool](#). For purposes of contact tracing, attendance will be taken in all classes and labs. Participants can check in using posted QR codes through the cuScreen platform where provided. Students who do not have a smartphone will be required to complete a paper process as indicated on the [COVID-19 website](#).

All members of the Carleton community are required to follow guidelines regarding safe movement and seating on campus (e.g., directional arrows, designated entrances and exits, designated seats that maintain physical distancing). In order to avoid congestion, allow all previous occupants to fully vacate a classroom before entering. No food or drinks are permitted in any classrooms or labs.

For the most recent information about Carleton's COVID-19 response and required measures, please see the [University's COVID-19 webpage](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

Please note that failure to comply with University policies and mandatory public health requirements, and endangering the safety of others are considered misconduct under the [Student Rights and Responsibilities Policy](#). Failure to comply with Carleton's COVID-19 procedures may lead to supplementary action involving Campus Safety and/or Student Affairs.

Note about COVID-19 & Mental Health: The global pandemic has led to extra stress and uncertainty for everyone, and while we may all be experiencing the same storm, this does not mean that we are all in the same boat! If you are struggling, please do not hesitate to reach out. I can direct you to resources that might help. Remember that Carleton also offers an array of mental health and well-being resources, which can be found [here](#).

Children & zoom class sessions: You are welcome to have children with you during video sessions as I fully understand that childcare situations may be complicated for many of us at this time. Do your best to participate and engage, but also please get in touch with me if you have any questions or concerns.

University policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59	
A = 85-89	B = 73-76	C = 63-66	D = 53-56	
A- = 80-84	B- = 70-72	C = 60-62	D- = 50-52	F = <50

WDN = Withdrawn from the course

ABS = Student absent from final exam

DEF = Deferred

FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

Academic accommodations, regulations, plagiarism, etc.

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found at: <https://students.carleton.ca/course-outline/>

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

Academic accommodations for students with disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the [Paul Menton Centre website](#).

Addressing human rights concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Religious obligations

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Survivors of sexual violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the

services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

Accommodations for missed work

Carleton recognizes that these are unprecedented times during the COVID-19 pandemic, and that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at:

<https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf>

For pregnancy

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Accommodation for student activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).

Academic Integrity

Academic misconduct undermines the values of honesty, trust, respect, fairness, and responsibility that we expect in this class. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity.

(adapted from Carleton University's Academic Integrity Policy, 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Sanctions for not abiding by Carleton's academic integrity policy

A student who has not adhered to Carleton's Academic Integrity Policy may be subject to one of several sanctions:

1. If you take full responsibility for your actions, and it is the first time you have violated the policy, you will receive zero on the assessment. If you are found to have violated the policy but do not take responsibility, an additional grade deduction will be applied (e.g. an A- will become a B+)
2. Subsequent violations of the policy may result in more severe sanctions such as failing the course, suspension from all studies and/or expulsion.

Process of an academic misconduct investigation

Step 1: The instructor believes misconduct has occurred and submits documentation to the Dean of the Faculty of Science.

Step 2: The Dean reviews documentation and can proceed with or dismiss the allegation.

Step 3: If sufficient evidence, the student receives an allegation statement by email. Ombuds services is copied on the email.

Step 4: The student provides a written response to the evidence provided.

Step 5: Either party may request a meeting between student, dean, and the ombudsperson.

Step 6: Dean informs the student of the decision.

Appeal: Student has the right to appeal the decision.

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#). Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Plagiarism

Plagiarism is the passing off of someone else's work as your own and is a serious academic offence. For the details of what constitutes plagiarism, refer [the Faculty of Science Academic Integrity website](#). To further understand Academic Integrity, consider attending the [Learning and Support Academic Integrity Workshop](#).

What are the penalties for plagiarism?

A student found to have plagiarized an assignment may be subject to one of several penalties including: expulsion; suspension from all studies at Carleton; suspension from full-time studies; and/or a reprimand; a refusal of permission to continue or to register in a specific degree program; academic probation; award of an FNS, Fail, or an ABS.

What are the procedures?

1. All allegations of plagiarism are reported to the Dean of Faculty of Science. Documentation is prepared by instructors and/or departmental chairs.
2. The Dean writes to the student and the University Ombudsperson about the alleged plagiarism.
3. The Dean reviews the allegation. If it is not resolved at this level then it is referred to a tribunal appointed by the Senate.

Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Course copyright

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Assistance for students

Academic and Career Development Services: <http://carleton.ca/sacds/>

Writing Services: <http://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>

Important dates

<https://calendar.carleton.ca/academicyear/>

<https://carleton.ca/registrar/registration/dates/>