



## COURSE OUTLINE

### 1. **Course:** PHYS 611, Statistical Physics - Fall 2022

Lecture 01 : MWF 10:00 - 10:50 in ST 125

Instructor	Email	Phone	Office	Hours
Dr. Claudia Gomes da Rocha	claudia.gomesdarocho@ucalgary.ca	403 220-7023	SB 537	Tuesdays, 8:30 am - 9:30 am

To account for any necessary transition to remote learning for the current semester, courses with in-person lectures, labs, or tutorials may be shifted to remote delivery for a certain period of time. In addition, adjustments may be made to the modality and format of assessments and deadlines, as well as to other course components and/or requirements, so that all coursework tasks are in line with the necessary and evolving health precautions for all involved (students and staff).

#### **In Person Delivery Details:**

The lectures of this course are being offered in-person at scheduled times and location.

Lectures: MWF 10:00-10:50 am (Calgary local time).

Office hours will be offered via Zoom: T 8:30-9:30 am (Calgary local time). Zoom link for the office hours will be provided in the course D2L folder.

Students are encouraged to visit the [online learning webpage](#) at the Student Success Centre to manage and plan their course activities.

#### **Re-Entry Protocol for Labs and Classrooms:**

To limit the spread of COVID-19 on campus, the University of Calgary has implemented safety measures to ensure the campus is a safe and welcoming space for students, faculty and staff. The most current safety information for campus can be found [here](#).

#### **Course Site:**

D2L: PHYS 611 L01-(Fall 2022)-Statistical Physics

**Note:** Students must use their U of C account for all course correspondence.

#### **Equity Diversity & Inclusion:**

The University of Calgary is committed to creating an equitable, diverse and inclusive campus, and condemns harm and discrimination of any form. We value all persons regardless of their race, gender, ethnicity, age, LGBTQIA2S+ identity and expression, disability, religion, spirituality, and socioeconomic status. The Faculty of Science strives to extend these values in every aspect of our courses, research, and teachings to better promote academic excellence and foster belonging for all.

The Physics and Astronomy EDI Committee acknowledges there are persistent barriers that prevent such accessibility and hinder our progress towards EDI. Our representatives (faculty, postdocs, graduate and undergraduate students) are committed to addressing any concerns and work towards proactive solutions that enact necessary change within the department. To submit anonymous questions, comments or concerns regarding EDI related issues, please reach out to our Associate Head EDI, Claudia Gomes da Rocha ([claudia.gomesdarocho@ucalgary.ca](mailto:claudia.gomesdarocho@ucalgary.ca))

### 2. **Requisites:**

See section [3.5.C](#) in the Faculty of Science section of the online Calendar.

### 3. **Grading:**

The University policy on grading and related matters is described in [F.1](#) and [F.2](#) of the online University Calendar.

In determining the overall grade in the course the following weights will be used:

Course Component	Weight	Due Date (duration for exams)	Modality for exams	Location for exams
Take-home assignments <sup>1</sup>	20%	Ongoing		
Midterm exam <sup>2</sup>	35%	Nov 02 2022 at 10:00 am (50 Minutes)	in-person	In class
Registrar Scheduled Final Exam <sup>3</sup>	45%	Will be available when the final exam schedule is released by the Registrar	in person	Will be available when the final exam schedule is released by the Registrar

<sup>1</sup> This course has planned 6 take-home assignments in total. Each assignment will be posted on the course D2L folder one or two weeks before its due date. Once completed, students will bring their written homework assignments to class or place them in the instructor's office mailbox. Further details about these assignments will be posted in D2L.

<sup>2</sup> 50-minute, in-person, closed-book exam. Further details about the midterm will be posted in D2L.

<sup>3</sup> 2-hour, in-person, closed-book exam. Further details about the final will be posted in D2L.

Each piece of work (reports, assignments, quizzes, midterm exam(s) or final examination) submitted by the student will be assigned a grade. The student's grade for each component listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade.

The conversion between a percentage grade and letter grade is as follows.

	A+	A	A-	B+	B	B-	C+	C	C-	D+	D
<b>Minimum % Required</b>	95 %	90 %	85 %	80%	75%	70 %	65 %	60%	55%	50 %	45 %

This course will have a Registrar Scheduled Final exam that will be delivered in-person and on campus. [The Final Examination Schedule](#) will be published by the Registrar's Office approximately one month after the start of the term. The final exam for this course will be designed to be completed within 2 hours.

The University of Calgary offers a [flexible grade option](#), Credit Granted (CG) to support student's breadth of learning and student wellness. Faculty units may have additional requirements or restrictions for the use of the CG grade at the faculty, degree or program level. To see the full list of Faculty of Science courses where CG is not eligible, please visit the following website: <https://science.ucalgary.ca/current-students/undergraduate/program-advising/flexible-grading-option-cg-grade>

#### 4. Missed Components Of Term Work:

The university has suspended the requirement for students to provide evidence for absences. Please do not attend medical clinics for medical notes or Commissioners for Oaths for statutory declarations.

In the event that a student legitimately fails to submit any online assessment on time (e.g. due to illness etc...), please contact the course coordinator, or the course instructor if this course does not have a coordinator to arrange for a re-adjustment of a submission date. Absences not reported within 48 hours will not be accommodated. If an excused absence is approved, one possible arrangement is that the percentage weight of the legitimately missed assignment could also be pro-rated among the components of the course. This option is at the discretion of the coordinator and may not be a viable option based on the design of this course.

#### 5. Scheduled Out-of-Class Activities:

There are no scheduled out of class activities for this course.

## 6. Course Materials:

Required Textbook(s):

Mehran Kardar, *Statistical Physics of Particles*: Cambridge University Press..

In addition to our textbook, the following are useful reference books:

- (a) Callen, H. B. *Thermodynamics and an Introduction to Thermostatistics*, 2d ed., Wiley (2001). ISBN-10:0471862568.
- (b) Toda, M., Kubo, R., Saitō, N. *Statistical physics*, Springer, 1991. ISBN: 3540536620, 9783540536628.
- (c) Landau, L. D., and E. M. Lifshitz. *Statistical Physics. Part 1*. 3rd ed. New York, NY: Pergamon, 1980. ISBN:0080230385.
- (d) Reif, F., ed. *Fundamentals of Statistical and Thermal Physics*. New York, NY: McGraw-Hill, 1965.
- (e) Stanley, H. Eugene. *Introduction to Phase Transitions and Critical Phenomena*. New York, NY: Oxford University Press, 1971. ISBN: 0195014588.
- (f) Reichl, Linda E. *A Modern Course in Statistical Physics*. 2d ed., Wiley (1998). ISBN-10: 0471595209.
- (g) Plischke, M., Bergersen, B. *Equilibrium Statistical Physics*, World Scientific, 2005. ISBN: 9812560483, 9789812560483.
- (h) Christensen, K., Moloney, N. R. *Complexity and Criticality*, World Scientific Publishing; 1 edition (Oct. 4 2005).

Further references and course related material will be given in class or posted on D2L.

In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology:

- A computer with a supported operating system, as well as the latest security, and malware updates;
- A current and updated web browser;
- Webcam/Camera (built-in or external);
- Microphone and speaker (built-in or external), or headset with microphone;
- Current antivirus and/or firewall software enabled;
- Stable internet connection.

For more information please refer to the UofC [ELearning](#) online website.

## 7. Examination Policy:

There will be several take-home assignments over the term, which will be posted on D2L together with their respective due dates. Students must write up their graded works in their own words, and with their own understanding. Failure to write assignments and exams in own-words and to add proper citations can lead to severe academic penalties. All assignments and exams are to be delivered to the instructor. Late assignment submissions will result in deduction of points from the total grade.

**All assignments are open-book and collaborative work is allowed, but midterm and final exams are individual works. Interacting with other students during midterm and final exam is not allowed.**

Students should also read the Calendar, [Section G](#), on Examinations.

## 8. Approved Mandatory And Optional Course Supplemental Fees:

There are no mandatory or optional course supplemental fees for this course.

## 9. Writing Across The Curriculum Statement:

For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of the work. See also Section [E.2](#) of the University Calendar.

## 10. Human Studies Statement:

Students will not participate as subjects or researchers in human studies.

See also [Section E.5](#) of the University Calendar.

## 11. Reappraisal Of Grades:

A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request

a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See [Section I.3](#) of the University Calendar.

- a. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **ten business days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall submit the Reappraisal of Graded Term work [form](#) to the department in which the course is offered within 2 business days of receiving the decision from the instructor. The Department will arrange for a reappraisal of the work within the next ten business days. The reappraisal will only be considered if the student provides a detailed rationale that outlines where and for what reason an error is suspected. See sections [I.1](#) and [I.2](#) of the University Calendar
- b. **Final Exam:** The student shall submit the request to Enrolment Services. See [Section I.3](#) of the University Calendar.

## 12. Other Important Information For Students:

- a. **Mental Health** The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness and academic success, and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [Mental Health Services Website](#)) and the Campus Mental Health Strategy website ([Mental Health](#)).
- b. **SU Wellness Services:** For more information, see their [website](#) or call [403-210-9355](#).
- c. **Sexual Violence:** The Sexual Violence Support Advocate, Carla Bertsch, can provide confidential support and information regarding sexual violence to all members of the university community. Carla can be reached by email ([syva@ucalgary.ca](mailto:syva@ucalgary.ca)) or phone at [403-220-2208](#). The complete University of Calgary policy on sexual violence can be viewed [here](#).
- d. **Misconduct:** Academic integrity is the foundation of the development and acquisition of knowledge and is based on values of honesty, trust, responsibility, and respect. We expect members of our community to act with integrity. Research integrity, ethics, and principles of conduct are key to academic integrity. Members of our campus community are required to abide by our institutional [Code of Conduct](#) and promote academic integrity in upholding the University of Calgary's reputation of excellence. Some examples of academic misconduct include but are not limited to: posting course material to online platforms or file sharing without the course instructor's consent; submitting or presenting work as if it were the student's own work; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; borrowing experimental values from others without the instructor's approval; falsification/fabrication of experimental values in a report. Please read the following to inform yourself more on academic integrity:

[Student Handbook on Academic Integrity](#)  
[Student Academic Misconduct Policy and Procedure](#)  
[Faculty of Science Academic Misconduct Process](#)  
[Research Integrity Policy](#)

Additional information is available on the [Student Success Centre Academic Integrity page](#)

### e. **Academic Accommodation Policy:**

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Student-Accommodation-Policy.pdf>

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>.

Students needing an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, by filling out the [Request for Academic Accommodation Form](#) and sending it to Dr. David Feder by email [phas.ahugrd@ucalgary.ca](mailto:phas.ahugrd@ucalgary.ca) preferably 10 business days before the due date of an assessment or scheduled absence.

- f. **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPPA). Students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information, see [Legal Services](#) website.
- g. **Student Union Information:** [SU contact](#), Email SU Science Rep: [sciencerep1@su.ucalgary.ca](mailto:sciencerep1@su.ucalgary.ca), [Student Ombudsman](#)
- h. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction ([USRI](#)) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.
- i. **Copyright of Course Materials:** All course materials (including those posted on the course D2L site, a course website, or used in any teaching activity such as (but not limited to) examinations, quizzes, assignments, laboratory manuals, lecture slides or lecture materials and other course notes) are protected by law. These materials are for the sole use of students registered in this course and must not be redistributed. Sharing these materials with anyone else would be a breach of the terms and conditions governing student access to D2L, as well as a violation of the copyright in these materials, and may be pursued as a case of student academic or [non-academic misconduct](#), in addition to any other remedies available at law.

## DETAILED COURSE SYLLABUS

Catalog description: classical and quantum ensemble theory applied to interacting systems: real gases, spin systems, phase transitions. Kinetic theory: Boltzmann equation, transport processes, irreversible processes and fluctuations. Specifically, we will cover:

1. Thermodynamics: the zeroth law, the first law, the second law, Carnot engines, entropy, thermodynamic potentials;
2. Probability theory: random variables, probability distributions, central limit theorem, rules for large numbers, information and entropy;
3. Kinetic theory: Liouville's theorem, BBGKY hierarchy, Boltzmann equation, H-theorem, conservation laws;
4. Classical statistical mechanics: microcanonical ensemble, two-level systems, ideal gas, mixing entropy and Gibbs paradox, canonical ensemble, grand canonical ensemble;
5. Interacting systems: cumulant expansion, cluster expansion, van der Waals equation;
6. Quantum statistical mechanics: dilute polyatomic gas, vibrations of a solid, black body radiation, quantum microstates, quantum macrostates;
7. Ideal quantum gas: identical particles, canonical formulation, grand canonical formulation, non-relativistic gas, degenerate Fermi gas, degenerate Bose gas, Bose-Einstein condensation;
8. Introduction to phase transitions and critical phenomena (time permitting): Ising model, transfer matrix method, mean-field theory, Landau theory.

The take-home assignments will enable you to build up and apply your understanding of the various concepts and techniques. Please, keep in mind that your two main goals in writing up your homework are: (i) to be clear so that I can understand what you have written, (ii) to demonstrate insight. **Writing clearly means using readable handwriting.** If one cannot read and understand your assignments easily, you will get little or no credit. **You are allowed to collaborate on the homework assignments only** (this is realistic, scientists collaborate all the time in research) but as much as possible you should attempt the assignments on your own since you will learn the most that way. You must write up your homework on your own, in your own words, and with your own understanding. Failure to write assignments in own-words and proper citations can lead to severe academic penalties.

If you use Mathematica or any other software package in an assignment, include your source code or script that generated the data or performed the calculation in your assignment. Add comment lines and explanations that clarify what your code does and how you reached your answers.

Electronically Approved - Aug 30 2022 21:07

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**Department Approval**