Thermal Physics

PHY B52 - Winter 2018

Lecture	Tuesday	1:00 pm - 3:00 pm	SW 143
Tutorial	Wed. / Thu.	3:00 pm - 5:00 pm	IC 204 / AA 206

"A theory is the more impressive the greater the simplicity of its premises, the more different kinds of things it relates, and the more extended its area of applicability. Therefore the deep impression that classical **thermodynamics** made upon me. It is the only physical theory of universal content which I am convinced will never be overthrown, within the framework of applicability of its basic concepts."

– Albert Einstein

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Course Website: portal.utoronto.ca

Office Hours

Tuesday	3:30 pm - 4:30 pm
Wednesday	12:30 pm - 2:30 pm
Thursday	11:30 am - 2:30 pm

Course Description and Requirements

The course will start with the idea of thermal equilibrium; an extension to the concepts of energy, heat, and work; and the definitions of temperature and entropy. We will continue with a study of mechanical and chemical equilibrium; the laws of thermodynamics; and examples and applications to heat engines, refrigerators, free energy, and chemical thermodynamics. We will conclude the course with an introduction to the statistical concepts which underlie macroscopic thermodynamics and provide the bridge between the microscopic and macroscopic pictures, using quantum ideal gases as our example.

By the end of the course you will be able to:

- Identify and define the basic vocabulary used in Thermodynamics and Statistical Mechanics.
- Recognize the connection between the microscopic quantum mechanical description and the macroscopic thermodynamical view of systems composed of large numbers of particles.
- Apply fundamental principles of thermal physics to solve problems and conceptual questions involving both ideal as well as real thermodynamical phenomena.
- Develop individual and group problem solving strategies, and implement these strategies to examples and questions involving themodynamical systems.
- Continue building a mathematical toolbox connected to quantitative and analytical skills useful to the scientist in general, and to the physicist in particular.

Course Prerequisites: Intro. to Physics IIA (PHYA21); Calculus of Several Variables I (MATB41)

Course Corequisite: Calculus of Several Variables II (MATB42)

Required Materials

- **Textbook:** ***An Introduction to Thermal Physics*** by Daniel V. Schroeder (Pearson 2000)

The schedule provided at the end of this document indicates the chapters and sections you must read **before** each lecture. The textbook also provides the conceptual questions and detailed problems that will be the subject of the weekly problem sets, reading quizzes, and tutorial quizzes.

- **Calculator:** A scientific non-programmable calculator is required.

Grading Scheme - Preliminary

Component	Points	Due Date
Reading Quizzes	5	Ongoing (Pre-Lecture)
Concept Maps	5	Ongoing (Post-Lecture)
Outcome Reflections	5	Ongoing (Post-Tutorial)
Tutorial Work	15	Ongoing (Weekly Tutorials)
Test #1	15	Week 5 (Tentative)
Test #2	20	Week 9 (Tentative)
Final Examination	35	Exam Period (April 11 - 26)

Grade Components

Reading Quizzes (5%)
Each week on the course website you will be asked a set of questions from the assigned readings for the upcoming week. You will have until **11:55 pm** on Monday to submit your answers. Each quiz is worth **5 points**, and your final grade is the total sum of all quizzes up to a maximum of **50 points**. Use the **Class Schedule** found at the end of this document to prepare for the lectures and reading quizzes.

Concept Maps (5%)
At the **start** of each Tuesday lecture discussion and based on the **previous week** of lecture discussions you will submit a concept map. Each map is worth **2 points**, and your final grade is the total sum of all maps up to a maximum of **20 points**. There is an **extra 2% bonus** for each student that submits, no later than the last tutorial session, a **Full-Course Map** that includes all the course material from **Chapters 1 - 6.** All maps must be well designed in a useful, readable, and well presented manner.

Outcome Reflections (5%)
After each tutorial session and on the course website a space will be made available for you to submit a reflection on the achievement of the course learning outcomes. You will have until **11:55 pm** on Friday to submit your reflection. Each reflection is worth **2 points**, and your final grade is the total sum of all reflections up to a maximum of **20 points**.

Tutorial Work (15%)
During the tutorials we will discuss the most important points in the problem sets as well as difficult points you may have encountered in your readings. Please note that the problem sets will not be collected or graded and it is your responsibility to make sure you understand the discussions presented in these problems. The assessment of your work will be a combination of tutorial quizzes, group work, blackboard problems, electronic homework, and take-home questions.

Test #1 (15%)
This **90-minute** long test will be scheduled *tentatively* during **Week 5**. Content includes all lecture discussions, textbook readings, and problem sets up to and including the material discussed in **Week 4**.

Test #2 (20%)
This **2-hour** long test will be scheduled *tentatively* during **Week 9**. Content includes all lecture discussions, textbook readings, and problem sets up to and including the material discussed in **Week 8**.

Both tests will include conceptual questions in multiple-choice or short-answer format, and detailed problems. The only aids allowed are your non-programmable scientific calculator, and a hand-written, double-sided, and letter-sized aid sheet. Note that photocopies or computer printouts are not allowed.

Final Examination (35%)
The final examination will be scheduled during the exam period of **April 11 - 26**. Content for the final examination includes all the topics discussed in the assigned textbook readings, lecture presentations, problem sets, and tutorial quizzes. The final examination will be **3 hours** long and the format includes conceptual multiple-choice and short answer questions as well as detailed problems. The only aids allowed are your non-programmable scientific calculator, and **one** hand-written, double-sided, and letter-sized aid sheet. Please note that photocopies or computer printouts are not allowed.

Class Policies

Absences
In order to ensure fairness in the assessment of all students, there will be no makeup options for tutorial work or the tests. In the case of a **valid** and **documented** problem that supports an absence to a tutorial, the grade will be calculated on the basis of all other work. In the case of a **valid** and **documented** problem that supports an absence to the first test, the second test will have its weight increased accordingly. In the case of a **valid** and **documented** problem that supports an absence to the second test, the final examination will have its weight increased accordingly. If the problem is health-related use the official form: http://www.utsc.utoronto.ca/∼registrar/resources/pdf_general/UTSCmedicalcertificate.pdf

Name and Student Number
Any work you hand in must clearly indicate your name and student number, this includes tutorial quizzes, materials for the reading project, tests, and the final exam. Any work you submit that fails to meet this requirement will be penalized with a 10% deduction, provided we are able to identify the work as yours. If we are unable to identify the work as yours, a grade of zero will be awarded.

e-mail
If you want to ask a question via e-mail, please first check the electronic forums in the **Discussion Board** of the course website. Quite likely, you are not the only person with that same question, and if that question has already been asked, you will find the answer there. If the question has not been asked, go ahead and post it yourself instead of sending it by e-mail. This way you will also help other students facing the same issue. The forums in the discussion board are monitored regularly by the course instructor and your peers, making it the best way of communicating for various queries of a diverse nature.

However, if the electronic forums are not the best place for your query, make sure you send your e-mail from an official **utoronto.ca** address (e.g., your UTmail+ account), as all other addresses will be filtered out automatically. For a quicker response time include the code **PHYB52** in the subject line of your message. I reply to e-mails within a period of 24 hours and I rarely reply to e-mails during weekends.

In-class Conduct

- Lectures start at 1:10 pm and end at 3:00 pm. Tutorials start at 3:10 pm and end at 5:00 pm. Late arrival or early departure from class is inappropriate and disruptive so please be considerate.
- Regarding anything that you want to use in the classroom: if you are not using it to perform a task specifically related to what we are doing in class at that very moment, you must put it away. This includes but is not limited to cell phones, laptop computers, tablets, and other electronic devices.
- Do not bring or consume food in the classroom as this creates unwanted distractions that will negatively affect the learning environment.

Academic Integrity and Respect for the Academic Endeavor

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's *Code of Behaviour on Academic Matters:*

http://www.governingcouncil.utoronto.ca/policies/behaveac.htm

outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

- In papers and assignments: Using someone else's ideas or words without appropriate acknowledgment; submitting your own work in more than one course without the permission of the instructor; making up sources or facts; obtaining or providing unauthorized assistance on any assignment.
- On tests and exams: Using or possessing unauthorized aids; looking at someone else's answers during an exam or test; misrepresenting your identity.
- In academic work: Falsifying institutional documents or grades; falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the *Code of Behaviour on Academic Matters*. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources resources such as: http://www.utsc.utoronto.ca/vpdean/academic-integrity

Course Support

Access*Ability*

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the Access*Ability* Services Office as soon as possible. I will work with you and Access*Ability* Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC Access*Ability* Services staff (located in SW302) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or ability@utsc.utoronto.ca

Discussion Board

The course website supports electronic forums useful for questions and discussions on course content, conceptual and detailed problems, textbook readings, as well as any issues relating to administrative details of the course such as deadlines, future topics, and scheduling. It is recommended that you check the forums on a regular basis to keep on top of current issues. You can subscribe to the various forums in order to receive email notifications when new posts are available, and there are also options for posting anonymously.

Class Schedule

This schedule is ***tentative*** and might change during the term in order to accommodate for variations in the lectures in response to performance and feedback from the students.

Some topics might be removed and others added to adjust for variations in the background of the class. Announcements will be made whenever needed.

Please note that it is your responsibility to read the assigned sections and chapters **before** each lecture.

During the lectures we will concentrate on the most important and difficult aspects of the theories and concepts from your textbook readings.

Failing to complete the textbook readings before each lecture will negatively affect your ability to understand and participate in the class discussions.

Dates	**Tuesday Lecture** 1pm - 3pm	**Wed. / Thu. Tutorial** 3pm - 5pm
Jan. 09	**Energy in Thermal Physics**	**Energy in Thermal Physics**
Jan. 10 / 11	Chapter 1: 1 - 2	Chapter 1: 3 - 4
Jan. 16	**Energy in Thermal Physics**	**Problem Set # 01**
Jan. 17 / 18	Chapter 1: 5 - 6	Tutorial #01
Jan. 23	**The Second Law**	**Problem Set # 02**
Jan. 24 / 25	Chapter 2: 1 - 2	Tutorial #02
Jan. 30	**The Second Law**	**Problem Set # 03**
Jan. 31 / Feb. 01	Chapter 2: 3 - 4	Tutorial #03
Feb. 06	**The Second Law**	**Problem Set # 04**
Feb. 07 / 08	Chapter 2: 5 - 6	Tutorial #04
Feb. 13	**Interactions and Implications**	**Problem Set # 05**
Feb. 14 / 15	Chapter 3: 1 - 3	Tutorial #05
Feb. 20	**Reading Week**	**Problem Set # 06**
Feb. 21 / 22	**Reading Week**	Electronic Homework #06
Feb. 27	**Interactions and Implications**	**Problem Set # 07**
Feb. 28 / Mar. 01	Chapter 3: 4 - 6	Tutorial #07
Mar. 06	**Engines and Refrigerators**	**Problem Set # 08**
Mar. 07 / 08	Chapter 4: 1 - 2	Tutorial #08
Mar. 13	**Free Energy**	**Problem Set # 09**
Mar. 14 / 15	Chapter 5: 1 - 2	Tutorial #09
Mar. 20	**Boltzmann Statistics**	**Problem Set # 10**
Mar. 21 / 22	Chapter 6: 1 - 3	Tutorial #10
Mar. 27	**Boltzmann Statistics**	**Problem Set # 11**
Mar. 28 / 29	Chapter 6: 4 - 7	Tutorial #11
Apr. 03	**Quantum Statistics**	**Problem Set # 12**
Apr. 04 / 05	Chapter 7: 1 - 3	Tutorial #12