2W04
Engineering Thermodynamics
Undergraduate Studies
Fall/Winter 2025/26
Course Outline

CALENDAR/COURSE DESCRIPTION

Introduction to the principles of thermodynamics, and applications in engineering. Basic concepts include energy systems, properties of pure substances, entropy, and the laws of thermodynamics. Power and refrigeration cycles are introduced. Three lectures and one tutorial per week.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): As per the Undergraduate Calendar.
Antirequisite(s): As per the Undergraduate Calendar.

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Dr. Jim Cotton
JHE 212a
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TEACHING ASSISTANT CONTACT INFORMATION

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COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Avenue to Learn: http://avenue.mcmaster.ca/

Avenue to Learn is the primary channel for formal course communication.
Students are expected to stay abreast of announcements and schedule changes discussed in lectures and posted on Avenue to Learn.

COURSE INTENDED LEARNING OUTCOMES

By the end of this course, students should be able to:

- Identify the unique vocabulary associated with thermodynamics and explain the basic concepts of thermodynamics.
- Determine thermodynamic properties of pure substances, apply ideal gas relations, and use equations of state as appropriate.
- Solve first-law of thermodynamics problems involving energy transfer to and from a system for common closed and control-volume systems.
- Apply the conservation of mass principle to steady-flow and unsteady-flow control volumes.
- Apply the second law and Carnot principles, compute thermal efficiencies and coefficients of performance for ideal cycles, and compute isentropic efficiencies for selected devices.
- Analyze vapor power cycles in which the working fluid is alternately vaporized and condensed.

MATERIALS

Required Texts:
Thermodynamics: An Engineering Approach, Yunus A. Cengel and Michael A. Boles, 8th, 9th, or 10th edition, McGraw Hill (Chapters 1-7 and 10).

Calculator:
Only the McMaster Standard Calculator (Casio fx-991) may be used during term tests and the final examination. This is available at the Campus Store.

COURSE FORMAT AND EXPECTATIONS

The course is organized as follows:

- 3 classroom-based live lectures per week
- 1 tutorial (2 hours per week)
- 8 assignments (weekly problem sets)
- 2 midterm tests (2 hours each)
- 1 final exam (2.5 hours)

COURSE SCHEDULE

Date/Week	Topic	Readings
Week 1	Introduction, definitions, systems, properties, forms of energy, temperature and pressure, problem solving methodology	Text chapters as assigned
Week 2	Properties of pure substances, phase change processes, property diagrams and tables	Text chapters as assigned
Week 3	Ideal gas equation of state, specific heats	Text chapters as assigned
Week 4	Energy transfer, heat and work, conservation of mass, flow work and energy	Text chapters as assigned

Week 5	First law of thermodynamics, energy balance for closed systems	Text chapters as assigned
Week 6	Energy balances for steady-flow systems, steady-flow devices (nozzles, turbines, compressors, pumps, heat exchangers)	Text chapters as assigned
Week 7	Energy balances for unsteady-flow systems	Text chapters as assigned
Week 8	Second law of thermodynamics, thermal energy reservoirs, heat engines, reversible and irreversible processes	Text chapters as assigned
Week 9	Heat pumps, refrigerators, power cycles, Carnot cycles, Carnot principles	Text chapters as assigned
Week 10	Entropy, Clausius inequality, increase of entropy principle, entropy change of pure substances	Text chapters as assigned
Week 11	Isentropic processes, process diagrams involving entropy, entropy data and TdS equations, special cases	Text chapters as assigned
Week 12	Vapor power cycles, Carnot vapor cycle, Rankine cycle, efficiency improvements	Text chapters as assigned

The correlation between Lecture Schedule (Part 1 to 7) and Textbook Chapters is present on Avenue in Administration Tab

TUTORIALS

T04 Group A- Tuesday	2:30 - 4:20pm	@ T13 105	TA: Mostafa & TBD
T01 Group B- Thursday	8:30 - 10:20am	@ T13 105	TA: Mostafa & TBD
T03 Group C- Thursday	2:30 - 4:20pm	@ ITB 139	TA: Ethan & TBD
T02 Group D- Friday*	2:30 - 4:20pm	@ T13 105	TA: Ethan & TBD

* Friday April 3 is a holiday so rescheduled to Tuesday April 7th (or attend any tutorial on week of March 30th)

Assessment: TOTAL 10% of Grade

Participation and Completion of Assigned Tutorial Problems: 1 Marks/Tutorial

There are a total of 11 tutorials, participation marks are based on attending 10 of 11 tutorials
Missed tutorials will have a grade of zero entered without legitimate and documented reason.

ASSESSMENT

The following distribution of marks will be used unless there is a valid and compelling reason to use an alternative weighting.

Component	Due Date	Weight
Tutorial participation	Weekly (seep Avenue)	10%
Assignments (problem sets)	Weekly (see below)	10%

Midterm tests (2)	As scheduled below	30%
Final Exam	Exam period	50%
Total		100%

MID-TERM
Mid-term examinations: There will be two tests of 2 hour duration.
Midterm #1: Wednesday February 11, 2026 – 6:30pm – 8:30pm
Location: PGCLL 127

Midterm #2: Wednesday March 18, 2026 – 6:30pm – 8:30pm
Location: PGCLL 127

Final examination: 2.5 hours in duration.
The final exam will cover all lecture material.

Calculators: Only McMaster Standard Calculator (Casio fx-991) may be used during term tests and the final examination.

Missed assignments and tests will have a grade of zero entered without legitimate and documented reason. **The course of action for missed mid-terms with Associate Dean's (MSAF) approval is the weight of the mid-term or assignment will be re-distributed to the Final Exam.**

ASSIGNMENTS COLLECTION AND EVALUATION
Assessment: TOTAL 10% of Grade
Assignments will be evaluated out of 10 marks.
Missed assignments will have a grade of zero entered without legitimate and documented reason.

Home Work No.	Due Date	Day	Marking TA In-Charge*
1	January 22	Thursday	TBD
2	January 29	Thursday	Akira
3	February 5	Thursday	TBD
4	February 26	Thursday	TBD
5	March 5	Thursday	TBD
6	March 12	Thursday	TBD
7	March 26	Thursday	TBD
8	April 2	Thursday	Akira

*MARKING TA SUBJECT TO CHANGE, CHANGES WILL BE POSTED IN AVENUE.

ASSIGNMENT SOLUTIONS FORMAT AND EVALUATION

Format: All homework submissions should adhere to the following format. Adherence to format will help us grade faster and more efficiently. So, help us give you a better grade.

- Use a clean 8-1/2" x 11" (letter size) or digital paper.
- Follow the approach to problem solving described below:
    - Problem Statement

  - Schematic and Given Data
  - Assumptions
  - Physical Laws
  - Know Data & Properties
  - Analysis/Calc's – with Units
- Numerical substitutions should be made after an algebraic solution has been formulated. You may get a good grade even if your numerical answer is wrong but your algebraic approach is reasonable. Try restraining yourself from numerical substitutions as long as you can.
- **Highlight** your final answer and be sure to not forget the **UNITS.**

If a computer program is used to attain a solution, attach a copy of the program and the data sheet.

ASSIGNMENT SUBMISSIONS
All homework should be submitted to Avenue to Learn\Assessments\Assignment\ by 11:59pm on the due date.
NO late submissions will be accepted without permission from the Associate Dean's Office (MSAF).
Grade allocation of an MSAF Assignments will be redistributed to the Final Exam

Procedure for Remarking Term Test Answer Books:
In the event that a student has an issue with the way in which a term test has been evaluated, he/she may lodge their objections within a week of returning the marked papers.

Please follow the steps below while submitting material for remarking:
Compare your solutions to that posted on the course website. Write your concern in a separate piece of paper or email memo indicating: (i) Problem number(s) you have concerns about, (ii) Detailed nature of the discrepancy, and (iii) The marks you think you should have received, in reference to the solution/marking scheme posted on the course website. Please submit this along with your answer book personally to the instructor or TA.

The student will receive a written response from the TA that marked the paper; if the student does not agree with the response, the student may submit the whole documentation to the instructor for arbitration/remarking.

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's grade in the course.

Outcomes	Indicators
Knowledge base for Engineering	Indicator 1.03 (measured in Course Intended Learning Outcomes 1-6)
Problem Analysis	Indicator 2.02 (measured in Course Intended Learning Outcomes 3-6)

For more information on Accreditation, please visit: https://www.engineerscanada.ca

EQUITY, DIVERSITY, AND INCLUSION

Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

McMaster University is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Chair (Undergraduate), Academic Advisor or the Equity and Inclusion Office.

MENTAL HEALTH & WELLNESS

For a list of McMaster University's resources, please refer to the Student Wellness Centre.
Talkspot is a non-crisis mental health resource specifically for students in the Faculty of Engineering.

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy*, located at https://secretariat.mcmaster.ca/university-policies-procedures- guidelines/

The following illustrates only three forms of academic dishonesty:

1. plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. improper collaboration in group work.
3. copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal**

verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

McMaster is committed to sustaining an inclusive and respectful community. These principles and expectations extend to online activities including electronic chat groups, video calls and other learning platforms.

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

COURSE POLICY ON MISSED WORK, EXTENSIONS, AND LATE PENALTIES

1. It is the students' responsibility to regularly check the course webpage (ex. Avenue to Learn) for updates and announcements.
2. Assignments must be submitted through Avenue to Learn by 11:59 pm on the due date. Late submissions are not accepted unless relief is approved by the Associate Dean's Office (MSAF) or prior permission is granted by the instructor.
   Missed assignments and tests receive a grade of zero unless supported by legitimate documentation

and approved relief. When relief is granted for a midterm test or assignment, the associated weight is normally redistributed to the final exam. When relief is granted for a missed tutorial, the tutorial weighting is redistributed to the remaining tutorials.
Requests to review or re-grade term test answer books must be submitted within one week of the return of the marked test, following the procedures posted on Avenue to Learn.

SUBMISSION OF REQUEST FOR RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

1. **Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:**

   - Use the McMaster Student Absence Form (MSAF) on-line self-reporting tool. No further documentation is required.
   - Students may submit requests for relief using the MSAF once per term.
   - An automated email will be sent to the course instructor, who will determine the appropriate relief. Students must immediately follow up with their instructors. Failure to do so may negate the opportunity for relief.
   - The MSAF cannot be used to meet a religious obligation or to celebrate an important religious holiday.
   - The MSAF cannot be used for academic work that has already been completed attempted.
   - An MSAF applies only to work that is due within the period for which the MSAF applies, i.e. the 3-day period that is specified in the MSAF; however, all work due in that period can be covered by one MSAF.
   - The MSAF cannot be used to apply for relief for any final examination or its equivalent. See *Petitions for Special Consideration* above.

2. **For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has been used previously in that term:**

   - Students must report to their Faculty Office to discuss their situation and will be required to provide appropriate **supporting documentation**.
   - If warranted, the Faculty Office will approve the absence, and the instructor will determine appropriate relief.

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

EXTREME CIRCUMSTANCES

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.