**Western University**
***Department of Mechanical & Materials Engineering***

# MME 3334B – Thermodynamics II

## COURSE OUTLINE – 2025-2026

***CALENDAR DESCRIPTION:*** This course emphasizes the application of thermodynamic principles to engineering systems and problem solving. Topics covered include: sonic velocity and compressible flow through nozzles, reciprocating and rotary compressors, availability and irreversibility in systems and processes, cycles, psychrometry of air conditioning, thermodynamic relations and the generalized compressibility charts, chemical reactions and equilibrium.

***COURSE INFORMATION:***

Instructor: Professor C. Zhang

Email: czhang@eng.uwo.ca

Lectures/tutorials/labs: See Draft My Schedule

***CONSULTATION HOURS:*** By appointment.

***PREREQUISITES:*** MME 2204a/b

***ANTIREQUISITES:*** None.

***ACCREDITATION UNITS:*** Engineering Science = 100%

***TOPICS:***

1. Review of first and second laws of thermodynamics
2. Second-law analysis of engineering systems and exergy
3. Power cycles
4. Refrigeration cycles
5. One-dimensional compressible flow
6. Mixtures, psychrometrics and introduction to air conditioning

***LEARNING OUTCOMES:*** The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

Upon successful completion of this course, students will be able to:

1. Determine exergy, irreversibility and second law efficiency (KB2, KB3, PA1, PA2)
2. Conduct second-law analysis of closed systems (KB3, PA1, PA2)
3. Conduct second-law analysis of steady-flow systems and unsteady-flow systems (KB3, PA1, PA2)
4. Conduct thermodynamic analysis of gas and vapor power cycles and

modify the cycles to increase thermal efficiency, thereby reducing $CO_2$ emissions and minimizing environmental impact (KB3, KB4, PA1, PA2, IESE3)
5. Conduct second-law analysis for gas and vapor power cycles (KB3, KB4, PA1, PA2)
6. Conduct thermodynamic analysis for vapor-compression refrigeration cycles, heat pump systems and gas refrigeration cycles (KB3, KB4, PA1, PA2)
7. Perform analysis for isentropic flows with simple area change with or without a normal shock wave (KB3, KB4, PA1, PA2)
8. Determine composition of a gas mixture (KB2, KB3, PA1, PA2)
9. Predict the P-v-T behavior of gas mixture (KB2, KB3, PA1, PA2)
10. Determine properties of gas mixtures (KB2, KB3, PA1, PA2)
11. Calculate the specific and relative humidity of air, and dew-point temperature (KB2, KB3, PA1, PA2)
12. Conduct analysis for adiabatic saturation processes (KB3, KB4, PA1, PA2)
13. Use a psychrometric chart (KB3, KB4, PA1, PA2)
14. Perform analysis for basic air conditioning processes (KB3, KB4, PA1, PA2)
15. Report experimental observations (I2, I3)
16. Interpret experimental outcomes in terms of the relevant theory (I2, I3)

***CONTACT HOURS:*** 3 lecture hours, 2 tutorial hours, 0.17 laboratory hours/week (2 lab activities, 1 hour each), half course

***TEXTBOOK:*** Yunus A. Cengel and Michael A. Boles, "Thermodynamics, An Engineering Approach", 10th Edition, McGraw-Hill.

The textbook is required, and the cost of the textbook is listed as $99.00 for an Ebook and $112.15 for a hard copy one from the UWO Bookstore. https://bookstore.uwo.ca/textbook-search?campus=UWO&term=W2024B&courses%5B0%5D=001_UW/MME3334B

Students are welcome to purchase second-hand or earlier editions (6th - 9th editions) of this textbook.

***UNITS:*** SI.

***EVALUATION:*** The course grade will be determined approximately as follows:

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|---|---|
| Quiz #1 | 6% |
| Quiz #2 | 4% |
| Laboratories: | 10% (5% for each lab) |
| Mid-term Test: | 25% |
| Final Examination: | 55% |

Quizzes - 3:30-4:30 p.m. on Monday, Feb. 2 and Mar. 23, 2026
Mid-term test - 2:30 - 4:30 p.m. on Monday, Mar. 2, 2026

***COMPUTING:*** Some problems may require computing.

***ASSIGNMENTS:*** Each week starting from the 2nd week till the 12th week there will be an assignment (4-6 problems), which will normally be assigned at the Monday class. These problems will indicate the level of student achievement expected. The students are not required to hand in the assigned problems for grading.

***TUTORIALS:*** During the tutorial periods, the teaching assistants will be available to help students with solving the assignment problems, to answer questions and to provide additional explanation of the lecture material if needed. There will be 2 quizzes held during the tutorial period. The questions in the quizzes will be from the assignments.

***LABORATORIES:*** Each student will conduct two experiments (1) **The Performance of a Small-scale Refrigeration Unit** and (2) **Air Compressor**. The experiments will be conducted in groups of 3 – 4 students (detailed schedule to be determined). Lab reports will be submitted as group reports and are due **one week** after the laboratory experiment is conducted.

***EXAMINATIONS AND QUIZZES:*** Quizzes – **Closed book**. Two summary pages (8.5"x11", both sides) and non-programmable calculator are allowed. Property tables will be provided.
Term test and final examination are **Limited Open Book –** textbooks, calculators and two summary pages (8.5"x11", both sides) will be allowed. You can use your laptop/iPad to access the textbook by the mouse or touchpad only. Property tables will be provided.

***COURSE POLICIES:*** The following course-specific policies will be strictly enforced throughout the course:

Due to the nature and structure of the evaluation in this course, it is exempt from the 15% policy. This means that you will not have received 15% of your grade prior to the course drop deadline.

**Laboratory sessions**

• Laboratory attendance is compulsory.

• Passing the laboratory component of the course (i.e., at least 50% mark in the laboratory component) is necessary to pass the course

• Students who arrive 30 min after the scheduled lab time or miss the lab without academic consideration will be given one time only chance to conduct the lab (at a rescheduled time) with 50% penalty.

• Students who miss a lab with academic consideration are required to reschedule the lab by contacting the course instructor. Failure to do so will result in a zero mark for that lab

• Missing both labs without academic consideration will result in the course failure

**Quizzes**

• No make-up quiz options will be offered regardless of the circumstances for which the quiz was missed

• Missing quizzes with academic consideration will shift the weight of the missed quizzes into the final exam

• Missing of a quiz without academic consideration will translate into a zero mark for that quiz

**Midterm exam (designated assessment)**

• No make-up midterm options will be offered regardless of the circumstances for which the midterm was missed

• Missing the midterm with academic consideration will shift the weight of the missed midterm exam into the final exam

• Missing the midterm exam without academic consideration will translate into a zero mark for the midterm

**Final exam**

• If a minimum of 50% is not obtained on the final examination, the student will be assigned a grade of no greater than 48% for the course.

***General Faculty / University Policies***

In the event of contradictions between course-specific policies above and general Faculty / University policies described below, please contact your course instructor for clarification.

**Missed/Late Accommodation Policy**

1. Students missing a test/assignment/lab or examination you will report the absence by submitting an Academic Consideration Request form through STUDENT ABSENCE PORTAL.
2. **Documentation must be provided as soon as possible.**

**Exam Accommodation**

1. If you are unable to write a final examination, report your absence using the Academic Consideration Request Form through STUDENT ABSENCE PORTAL.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (below for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department and the Associate Dean and in order to apply you must submit an Academic Consideration Request Form through STUDENT ABSENCE PORTAL.

   *PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.*

**Late Assignments**

1. Advise the instructor if you are having problems completing the assignment on time (prior to the due date of the assignment).
2. Be prepared to submit the Academic Consideration Request Form and provide documentation if requested by the instructor (see below for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4. Some courses may have built-in flexibility for assignment deadlines or the total number of assignments that will be graded. See course-specific policies for details.
5. Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.

   *Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).*

**Medical Accommodation**

1. The Academic Consideration Request Form is available through the STUDENT ABSENCE PORTAL.

2. Requests for academic consideration must include the following components:
    a. Indication of the course(s) and assessment(s) affected by the request
    b. Medical note, and
    c. Additional supporting documentation as relevant

3. Requests for academic consideration without a medical note or other supporting documentation may be accepted once per term, per course.

4. Undocumented absences cannot be used for examinations scheduled by the Office of the Registrar during official examination periods (including take-home final exams and December mid-year exams for full courses) and practical laboratory and performance tests typically scheduled in the last week of the term. Undocumented absences also cannot be used for the "designated assessment" in each course. When flexibility in assessment exists and is clearly stated on the course outline, both undocumented absences and academic consideration requests with documentation may be denied.

5. **Students must request academic consideration as soon as possible and no later than 48 hours after the missed assessment.**

6. Once the request and supporting documents have been received and reviewed, appropriate academic consideration, if granted, shall be determined by the instructor in consultation with the academic advisor, in a manner consistent with the course outline.

   Academic consideration may include extension of deadlines, waiver of attendance requirements for classes/labs/tutorials, or re-weighting of course requirements. Some forms of academic consideration, such as arranging Special Examinations, assigning a grade of Incomplete, or granting late withdrawals without academic penalty, may only be granted by the Academic Advising office of the Faculty of Registration.

7. An instructor may deny academic consideration for any assessment that is not required in the calculation of the final grade (e.g., "8 of 10 quizzes"). Assessment flexibility must be indicated on the course outline.

8. An instructor may deny academic consideration relating to the timeframe submission of work where there is already flexibility in the submission timeframe (e.g., 72-hour submission window). This assessment flexibility must be indicated on the course outline.

**Religious Accommodation**

When scheduling unavoidably conflicts with religious holidays, which (a) require an absence from the University or (b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate Department Chair and, if necessary, the student's Dean.

It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action.

**Academic Integrity**

In the Faculty of Engineering, we encourage students to create a culture of honesty, trust, fairness, respect, responsibility, and courage, befitting the professional degree you are pursuing.

Please visit Academic Integrity Western Engineering for more information

**Academic Offences**

Plagiarism means using another's work without giving credit. The university has rules against plagiarism and other scholastic offences. Western Engineering has a zero-tolerance policy on plagiarism. The minimum penalty is zero on the course work and a repeat offence will earn you zero on the course. A third offence may lead to expulsion from the university. Scholastic Discipline for Undergraduate Students & Cheating, Plagiarism and Unauthorized Collaboration: What Students Need to Know

Students must write their reports, essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (http://www.turnitin.com). Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

**Faculty of Engineering AI Policy**

The use of generative Artificial intelligence (GenAI) tools won't be discouraged in the Faculty of Engineering. As we pride ourselves on building the future we can't hide from the use of GenAI tools to contribute to the understanding of the course materials. However, the use of GenAI tools in any assignment or contribution during the course will have to be disclosed, as a resource.

**GenAI tools use won't be permitted in any type of examination or other assessments where the faculty have prohibited their use.** If use of GenAI tools is detected by the instructor in these instances, academic offences penalties might be imposed against the student.

**Use of English Policy**

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work except for the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

**Accessibility**

Western is committed to achieving barrier free accessibility for persons with disabilities studying, visiting and working at Western. As part of this commitment, there are a variety of services, groups and committees on campus devoted to promoting accessibility and to ensuring that individuals have equitable access to services and facilities. To help provide the best experience to all members of the campus community, please visit the Accessibility Western University for information on accessibility-related resources available at Western.

Students with disabilities may arrange for academic accommodation at Western. For a more detailed explanation, please visit Academic Support & Engagement -Academic Accommodation.

**Inclusivity, Diversity, and Respect**

The Faculty of Engineering at Western University is committed to creating equitable and inclusive learning environments that value diverse perspectives and experiences. We recognize that university courses often marginalize students based on social identity characteristics such as, but not limited to, Indigeneity, race, ethnicity, nationality, ability, gender identity, gender expression, sexuality, age, language, religion, and socioeconomic status. Understanding this, we strive to facilitate equitable experiences and inclusion within the classroom by respecting and integrating multiple ways of knowing, being, and doing. Please visit the Office of Equity, Diversity and Inclusion.

**Health and Well-Being**

- Health & Wellness Services – Students - Offers appointment-based medical clinic for all registered part-time and full-time students.
- Mental Health Support - Provides professional and confidential services, free of charge, to students needing assistance to meet their personal, social and academic goals. Services include consultation, referral, groups and workshops, as well as brief, change-oriented psychotherapy.
- Crisis Support - For immediate assistant, please visit Thames Hall Room 2170 or call 519-661-3030. The crisis clinic operates between 11:00 am - 4:30 pm. For after-hours crisis support, click here.
- Gender-Based Violence and Survivor Support - Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE
Western is committed to working to end gender-based and sexual violence on campus and in our community and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here: https://www.uwo.ca/health/gbsv/support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

USE OF GENERATIVE ARTIFICIAL INTELLIGENCE (AI)
Instructors must indicate whether the use of generative artificial intelligence (AI) tools/software/apps is acceptable, permitted in specific situations, or unacceptable in their course. Instructors may refer to the Centre for Teaching and Learning for resources on the use of generative Artificial Intelligence.

***Important Links***

- **WESTERN ACADEMIC CALENDAR**
- **ACADEMIC RIGHTS AND RESPONSIBILITIES**
- **ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS**
- **UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES**
- **IMPORTANT DATES AND DEADLINES**
- **ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS**
- **ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS**
- **SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS**
- **STUDENT FORMS**
- **OFFICE OF THE REGISTRAR**
- **RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)**
- **ACADEMIC APPEALS**
- **STUDENT ABSENCE PORTAL**

***Note:*** These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

***Contact Information:***

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| Undergraduate Services Office: | SEB 2097 |
| Phone: 519-661-2130 | E-mail: engugrad@uwo.ca |
| Mechanical Engineering: | SEB 3002 |
| Phone: 519-661-4122 | E-mail: mmeundergraduate@uwo.ca |
| Chemical & Green Process Engineering: | TEB 477 |
| Phone: 519-661-2131 | E-mail: cbeugrad@uwo.ca |
| Civil Engineering: | SEB 3005 |
| Phone: 519-661-2139 | E-mail: civil@uwo.ca |
| Computer, Electrical, Mechatronic Systems & Software Engineering | TEB 279 |
| Phone: 519-661-3758 | E-mail: eceugrad@uwo.ca |
| Integrated Engineering | ACEB 2410 |
| Phone: 519-661-6725 | E-mail: engceli@uwo.ca |
| Office of the Registrar/Student Central | WSSB 1120 |
| Phone: 519-661-2100 | |