

Western University
Department of Mechanical & Materials Engineering

MME 3334B – Thermodynamics II

COURSE OUTLINE – 2023-2024

**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
Office – Room SEB 2065
Telephone – 519-661-2111 Ext. 88345
E-mail – czhang@eng.uwo.ca
Office Hour: Friday 2:30 p.m. – 3:30 p.m.
Timetable information is available at <https://draftmyschedule.uwo.ca/>

PREREQUISITES:

MME 2204a/b

Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

**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:**

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

1. Determine exergy, irreversibility and second law efficiency.
Conduct second-law analysis of closed systems.
Conduct second-law analysis of steady-flow systems and unsteady-flow systems.
2. Conduct thermodynamic analysis for gas and vapor power cycles.
Conduct second-law analysis for gas and vapor power cycles.
3. Conduct thermodynamic analysis for vapor-compression refrigeration cycles, heat pump systems and gas refrigeration cycles.
4. Perform analysis for isentropic flows with simple area change with or without a normal shock wave.
5. Determine composition of a gas mixture.
Predict the P-v-T behavior of gas mixtures.
Determine properties of gas mixtures.
Calculate the specific and relative humidity of air, and dew-point temperature.
Conduct analysis for adiabatic saturation processes.
Use a psychrometric chart.
Perform analysis for basic air conditioning processes.

CONTACT HOURS:

3 lecture hours, 2 tutorial hours, 0.5 laboratory hour, half course

**RECOMMENDED
TEXTBOOKS:**

“Thermodynamics, An Engineering Approach”, 9th Edition, Yunus A. Cengel and Michael A. Boles, McGraw-Hill

https://bookstore.uwo.ca/textbook-search?campus=UWO&term=W2022B&courses%5B0%5D=001_UW/MME3334B

- 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 1 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.
Mid-term test and final exam – **Open book**. You can use your laptop/iPad to access the course materials by the mouse or touchpad only. Property tables will be provided.
- UNITS:** SI
- EVALUATION:** The course grade will be determined approximately as follows:
- | | |
|--------------------|-----------------------|
| Quiz #1 | 6% |
| Quiz #2 | 4% |
| Laboratories: | 10% (5% for each lab) |
| Mid-term Test: | 25% |
| Final Examination: | 55% |

Quizzes - 1:30-2:30 p.m. on Wednesday, Feb. 7 and Mar. 27, 2024

Mid-term test - 12:30 - 2:30 p.m. on Wednesday, Mar. 6, 2024

- COURSE POLICIES:** 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 one quiz with academic consideration will automatically shift the weight of the missed quiz into the other quiz
- Missing both quizzes with academic consideration will automatically 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

- 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.

ENGLISH:

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work except for final examinations 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.

ATTENDANCE:

Any student who, in the opinion of the instructor, is absent too frequently from class or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

SSD:

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

CHEATING:

University policy states that cheating, including plagiarism, is a scholastic offense. 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.

NOTE:

The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (i.e., <50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

STATEMENT ON GENDER-BASED AND SEXUAL VIOLENCE

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.

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

A. GENERAL REGULATIONS & PROCEDURES

1. All first-year students will report to the Undergraduate Services Office by submitting the [Academic Consideration Request Form](#), for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting [Academic Consideration Request Form](#). Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test and request relief through the [Academic Consideration Request Form](#). If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to report your absence using the [Academic Consideration Request Form](#) and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page 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 "[Application for a Special Exam](#)" form. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

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

D. 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 reverse side 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.
 - i) 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.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for directions.

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

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included in the course outlines. If not, ask your instructor(s).
2. You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

https://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_135

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6&SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

<http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5&command=showCategory&SelectedCalendar=Live&ArchiveID=>

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

<https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf>

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

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.

Add Deadlines:

First term half course (i.e. “A” or “F”)	September 15, 2023
Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 15, 2023
Second term half course (i.e. “B” or “G”)	January 16, 2024

Drop Deadlines:

First term half course without penalty (i.e. “A” or “F”)	November 13, 2023
Full courses and full-year half courses without penalty (i.e. “E”, “Y” or no suffix)	November 30, 2023
Second term half or second term full course without penalty (i.e. “B” or “G”)	March 7, 2024

Contact Information:

Undergraduate Services Office: SEB 2097	Phone: 519-661-2130	E-mail: engugrad@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
Mechanical Engineering: SEB 3002	Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca

December 7, 2023