

Western University
Department of Mechanical & Materials Engineering

MME 3334B – Thermodynamics II

COURSE OUTLINE – 2022-2023

**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 – c Zhang@eng.uwo.ca

Office Hour: Friday 2:30 p.m. – 3:30 p.m. (Zoom)

Lectures: Tu 12:30 - 1:30 p.m. (SEB 2100), W 3:30 - 4:30 p.m. (SEB 2100), F 1:30 - 2:30 p.m. (SEB 2100)

Tutorials: M 2:30 - 4:30 p.m. (SEB 2200)

Laboratory: M (003) 8:30 - 11:30 a.m. SEB 1078
Tu (004) 8:30 - 11:30 a.m. SEB 1078
F (005) 3:30 - 6:30 p.m. SEB 1078
W (006) 9:30 a.m. - 12:30 p.m. SEB 1078
Th (007) 8:30 - 11:30 a.m. SEB 1078
W (008) 12:30 - 3:30 p.m. SEB 1078

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
- TEXT:** “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 - 3:30-4:30 p.m. on Monday, Feb. 6 and Mar. 27, 2023
 Mid-term test - 2:30 - 4:30 p.m. on Monday, Mar. 6, 2023
- 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 with the exception of 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.

Course delivery with respect to the COVID-19 pandemic

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at: <https://remoteproctoring.uwo.ca>.