

**Western University
Faculty of Engineering
Mechatronic Systems Engineering Program**

MSE 2214 – Thermodynamics

Course Outline Fall/Winter 2025

COURSE DESCRIPTION: This course covers the fundamental laws of thermodynamics, evaluation of properties of pure substances (e.g. water, steam, ideal gases), and the application of these concepts to the study of thermodynamic systems such as pumps, turbines, compressors and their use in energy conversion systems.

ACADEMIC CALENDAR:

https://www.westerncalendar.uwo.ca/Courses.cfm?CourseAcadCalendarID=MAIN_027026_1&SelectedCalendar=Live&ArchiveID=

Properties of a pure substance, first law of thermodynamics, processes in open and closed systems, second law of thermodynamics; ideal gases, compressors and energy conversion systems.

PRE OR COREQUISITES:

NMM 1412A/B or the former Applied Mathematics 1412A/B.

Unless you have either the requisites 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.

ANTIREQUISITES:

CBE 2214A/B, MME 2204A/B.

CEAB ACADEMIC UNITS:

Engineering Science 60%, Science 40%

CONTACT HOURS:

Lectures occur weekly. Tutorials occur weekly.

LECTURE:	3 hours per week
LAB:	3 hours / 2 times during the term
TUTORIAL:	2 hours per week

RECOMMENDED/REQUIRED TEXT: "Thermodynamics, An Engineering Approach", 10th Edition. Yunus A. Cengel, Michael A. Boles, Mehmet Kanoglu; McGraw-Hill. (see course website for link to details)

RECOMMENDED/ REQUIRED SOFTWARE: None

RECOMMENDED RESOURCES/REFERENCES: "Fundamentals of Engineering Thermodynamics," 6th Edition, Copyright 2008; Michael J. Moran & Howard N. Shapiro, John Wiley & Sons Inc.

GENERAL LEARNING OBJECTIVES (CEAB GRADUATE ATTRIBUTES)

Knowledge Base	D	Engineering Tools		Impact on Society	I
Problem Analysis	D	Individual & Teamwork		Ethics and Equity	
Investigation	I	Communication		Economics and Project Mgmt.	
Design		Professionalism		Life-Long Learning	

Notation: x represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Rating: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e. g. no review).

COURSE MATERIALS: Weekly content will be provided in class. Guides for the laboratories will be available on the course OWL site.

UNITS: SI

COURSE TOPICS AND SPECIFIC LEARNING OUTCOMES:

The following table summarizes the course learning outcomes along with CEAB GAls where the GAls in bold indicate ones to be measured and reported annually.

Course Topics and Specific Learning Outcomes	CEAB Graduate Attribute Indicators
Introduction and definitions At the end of this section, students will be able to: a. Understand any apply the definitions of work, energy, and heat b. Understand the concept of a thermodynamic system, be able to classify a system as closed, isolated, or open, and identify transfers of energy via work and heat	PA1, PA2

Properties of a pure substance At the end of this section, students will be able to: a. Understand the concepts of thermodynamic state, equilibrium, simple compressible substances, and the state postulate b. Evaluate the thermodynamic properties of a pure substances in any phase, or combination of phases, using thermodynamic tables	PA1, PA2, KB2, KB3, KB4, I2, I3
First law of thermodynamics At the end of this section, students will be able to: a. Apply first law of thermodynamics to closed and open systems and represent processes using property diagrams b. Derive simplified forms of the first law, starting from the general form, for common thermodynamic systems including pumps, compressors, turbines, etc.	KB2, PA1, PA2
Power and refrigeration cycles At the end of this section, students will be able to: a. Analyze the operation of steam power cycles and refrigeration cycles Calculate the thermodynamic efficiencies of devices operating in a cycle and determine the maximum possible efficiency in the reversible limit	KB4, PA3
Second law of thermodynamics At the end of this section, students will be able to: a. Understand the Clausius and Kelvin-Planck statements of the second law, and demonstrate their equivalency b. Understand the concepts of entropy, reversible processes, irreversibilities, and disorder in systems	PA1, PA2
Entropy changes of closed, open, reversible, and irreversible systems At the end of this section, students will be able to: a. Evaluate the entropy change within closed, open, reversible, and irreversible systems undergoing a thermodynamic process b. Identify the entropy transfer associated with work and heat transfer	PA3

First and second law relationships and the universal principle of entropy increase At the end of this section, students will be able to: a. Apply the first and second law to solve thermodynamics problems b. Understand the concept of entropy increase and its application to thermodynamic systems c. Determine whether or not processes are theoretically possible, based on second law analysis	KB4, PA3
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EVALUATION:

Name	% Worth	Assigned	Due Date	CEAB GAs ASSESSED
Tutorial Exercises	10%			
Laboratory	10%			I2, I3
Term Test 1	15%			KB4
Term Test 2	15%			
Final Examination	50%			PA2

Note that the dates listed above are **tentative** and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

Homework Assignments: Ungraded homework assignments containing suggested practice problems will be assigned approximately on a weekly basis. Solutions will be provided the approximately one week after being assigned and will be discussed in tutorial.

Tutorial Exercises: Exercises will be assigned in most tutorial sessions for grading. Students may work in small groups of up to 4 students. Students will have full access to their notes, textbooks, calculators, etc. A maximum of one hour will be given to complete the exercise, including time to submit their work to Gradescope. A maximum of 8 exercises will be assigned. Students will be allowed to drop their lowest two grades from the calculation of their overall tutorial exercise grade.

Laboratory: There will be two lab exercises assigned. All lab data and calculations must be submitted by the end of the laboratory period for grading.

Term Tests: There will be two term tests. The tests will be closed book. An equation aid and thermodynamics tables will be provided. Non-programmable calculators are permitted. The tests are tentatively set to be held on October 2nd, 2025 and October 30th, 2025. Both will be held from 1:30 pm to 3:30 pm (corresponding with the tutorial period). The first term test is a critical aspect of this course and has been deemed the **designated assessment**. This means that requests for academic consideration without supporting documentation will be denied.

Final Examination: The final examination will take place during the regular examination period and will be 3 hours in duration. The final exam will be closed book. An equation aid and thermodynamics tables will be provided. Non-programmable calculators are permitted.

COURSE POLICIES:

Submitted Work: All work submitted must be of professional quality in the requested format. Material that is handed in dirty, illegible, disorganized, or in an unapproved format will be returned to the student for resubmission and the late submission penalty will take effect.

Computing requirements: All students are recommended to have a functional camera and microphone connected to their computer (irrespective of Windows or Mac-based). While the course is planned to be held in-person, virtual participation may be required based on extenuating circumstances.

Tutorial exercises: All tutorial exercises must be submitted the end of the designated writing period. No late submissions will be accepted. There are no make-up options regardless of the reason for which the exercise was missed. Of the maximum of 8 exercises, the two lowest grades will not be counted towards the student's grade. If students miss 1/8 exercises, the remaining 7 quizzes will be used in the calculation of the final grade. If students miss greater than 1 exercise, they will receive a grade of zero on each missed quiz.

Laboratory sessions: Attendance to laboratory sessions is mandatory. All pre-lab exercises must be completed prior to attending the lab in order to receive full grades. All lab data and calculations must be handed in by the end of the laboratory period for grading. Should a student miss a lab without legitimate reason, a grade of zero will be given and no opportunity to complete the lab at a later date will be provided.

Term tests: No make-up options will be offered for term tests, regardless of the circumstances for which the term test was missed. If a student misses a term test, the student must follow the Instructions for Students Unable to Write Tests and provide documentation to Undergraduate Services within 24 hours of the missed test. If a student is going to miss the term test for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam. Missing a test with academic consideration will automatically shift the weight of the missed test to the final exam. If no reasonable justification for missing a test is provided, then the student will receive a grade of zero for the test.

Final exam: To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less.

If the above conditions are not met, your final grade cannot be greater than 48%. Students who have failed this course (i.e., final average < 50%) must repeat all components of the course.

LATE SUBMISSION POLICY:

This course has 8 tutorial exercises with only 6/8 exercises counted towards your final grade. Academic consideration will not be granted for missed quizzes. If students miss 2/8 quizzes, the remaining 6 quizzes will be used in the calculation of the final grade. If students miss greater than 2 quizzes, they will receive a grade of zero on each missed quiz.

ATTENDANCE: Attendance is mandatory for all lectures and labs.

FACULTY OF ENGINEERING POLICIES:

Students must familiarize themselves with the policies of the Faculty of Engineering
<https://www.eng.uwo.ca/electrical/pdf/2025-UG-Policy-and-Procedures.pdf>