Western Engineering

DEPARTMENT OF ***CHEMICAL AND BIOCHEMICAL*** ENGINEERING

***CBE2214* – ENGINEERING THERMODYNAMICS**

Course Outline Fall/Winter 2026

Instructor: Dr. Sohrab Rohani

LECTURE:	3hrs per week
LAB or TUTORIAL:	2hrs per week
ANTIREQUISITE(s):	MME 2204A/B
PREREQUISITE(s):	Applied Mathematics 1411
CEAB Academic Units:	Engineering Science 75%, Engineering Design 25%
TEXT / Course Resources / References (Recommended)	Lecture slides, pre-recorded lectures Recommended but not required text: "Thermodynamics, An Engineering Approach", Yunas A. Cengel, Michael A. Boles, McGraw Hill, 7th, 8th or higher editions.
COURSE DESCRIPTION (50 words max) Engineering thermodynamics deals with the macroscopic relationships among thermal energy, heat transfer, and work in systems at equilibrium or under steady-state conditions. It examines the principles governing the conversion of thermal energy into useful work and vice versa. These principles form the foundation for the analysis and design of energy conversion systems, including heat engines (such as power plants, internal combustion engines, and jet engines), refrigeration systems, heat pumps, and air-conditioning units.	

General Learning Objectives (CEAB Graduate Attributes)

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

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).

Learning Outcomes	(CAEB) Graduate Attribute
Understand various forms of energy that can be interconverted (First Law of Thermodynamics).	KB1
Learn how to write steady-state and non-steady-state mass and energy balance on closed and open systems.	KB2
Make the necessary assumptions, determine if the system is an open, a closed system, or a cycle	PA1
Learn how to convert thermal energy to useful work (Heat Engines, Power Cycles, Internal Combustion Engines, Diesel Engines, Jet Engines)	PA2
Design various open and closed devices such as a pump, a compressor, a turbine, heat exchangers, a mixing tank, a nozzle, etc.	DE1
Grasp the idea of efficiency of a device and a thermodynamic cycle (Second Law of Thermodynamics and the concept of Entropy) and extend the concept to open-ended complex engineering problems	DE2

Evaluation Components

Name	% Worth	Due Date	Learning Outcomes
Ten Weekly Assignments	10%	Every week	
Three **announced** quizzes during Class time or Tutorial time, **NO MAKEUP QUIZZEZ**, two out of three best quizzes, each worth 5 marks, will contribute to the final total quiz mark. The students who miss quizzes LEGITIMATELY, the corresponding marks of their missed quizzes will be added to their FINAL exam weight.	10%		• To develop a conceptual understanding of the fundamental elements of classical thermodynamics • To be able to identify the thermodynamic state of a substance under any given condition • To develop knowledge of different equations of state for

			predicting PVT properties of pure substances. • To develop an understanding of closed and open systems and how to account for the transfer of energy via work and heat • To develop knowledge of the 1st and 2nd laws of thermodynamics. The students will be taught how to set up and solve real engineering problems.
Midterm Exam (two-hour exam) (The midterm is a closed-book examination; however, students may bring one formula sheet, either handwritten or typed, on one side of a standard US letter-size page. Derivations, P–v, T–v, and T–s diagrams, as well as thermodynamic cycle and device diagrams, are not permitted on the formula sheet)	30%		
Final Examination (three-hour exam) (The final exam is closed book. Students may bring one formula sheet, either handwritten or typed, on both sides of a standard US letter-size page. As with the midterm, derivations,	50%		

P–v, T–v, and T–s diagrams, as well as thermodynamic cycle and device diagrams, are not permitted on the formula sheet)			

EXTRA COURSE INFORMATION

Chapter 0: A general introduction to the course content and the engineering applications based on the principles of thermodynamics

Chapter 1: Introduction – basic concepts, systems and surroundings, properties of a system, a cycle, pressure and temperature

Chapter 2: Energy, heat, work, different forms of work, the first law of thermodynamics, heat engine efficiency, combustion efficiency, generator efficiency, motor efficiency, etc.

Chapter 3: Properties of pure substances, steam tables, quality index of water-steam mixture, ideal gas, compressibility factor, other equations of state

Chapter 4: Energy and mass analysis of closed systems, the first law of thermodynamics, the polytropic process

Chapter 5: Energy and mass analysis of open systems (control volumes), steady state, steady flow systems, nozzles and diffusers, turbines, compressors and fans, throttling devices, mixing chambers, heat exchangers, pumps

Chapter 6: The second law of thermodynamics, heat engines, heat pumps, coefficient of performance, Kelvin-Plank statement of the second law, Clausius statement of the second law, the Carnot cycle, reverse Carnot cycle, Carnot efficiency

Chapter 7: Entropy, the Clausius inequality, isentropic process, entropy balance.

Chapter 9: Gas power cycles, Carnot cycle, Otto cycle, diesel cycle

Chapter 10: Steam power cycles, limitations of the Carnot vapor cycle, the Rankine cycle, the reheat cycle

Chapter 11: Vapor compression refrigeration cycle, heat pump systems

Chapter 12: Thermodynamic property relations, Maxwell relations, reciprocity and the cyclic relations, Clapeyron equation, Clapeyron-Clausius equation, Joule-Thompson coefficient.

TERM STRUCTURE

Course content is delivered through PowerPoint presentations supplemented by detailed explanations using the whiteboard/blackboard. In addition, lectures covering all aspects of the course are recorded and made available to students. Prerecorded lectures and tutorials are also posted on the Brightspace site for students to review at their convenience.

Each week, two hours are dedicated to tutorials and problem-solving sessions. These sessions are conducted by the course instructor to help students strengthen their problem-solving skills and deepen their understanding of course concepts.
Three announced quizzes will be administered two before and the third one after the Midterm Exam covering the material presented after the Midterm Exam. The quizzes will contribute 10% of the final course grade.
The Midterm Examination will cover all material presented up to the week of the exam and will account for 30% of the final course grade. The midterm is a closed-book examination; however, students may bring one formula sheet, either handwritten or typed, on one side of a standard US letter-size page. Derivations, P–v, T–v, and T–s diagrams, as well as thermodynamic cycle and device diagrams, are not permitted on the formula sheet.
The Final Examination, scheduled by the Central Exam Office, will account for the remaining 50% of the final course grade and will cover the entire course content. The final exam is also closed book. Students may bring one formula sheet, either handwritten or typed, on both sides of a standard US letter-size page. As with the midterm, derivations, P–v, T–v, and T–s diagrams, as well as thermodynamic cycle and device diagrams, are not permitted on the formula sheet.

BRIGHTSPACE RESOURCES
https://westernu.brightspace.com/d2l/home/128264

COURSE MATERIALS
https://westernu.brightspace.com/d2l/home/128264

ASSESSMENTS
Weekly assignments are posted on Brightspace. The assignments will contribute 10% of the final course grade. Students are expected to submit the assignments on Brightspace and carefully review the solutions to develop a solid understanding of the fundamental steps involved in solving thermodynamics problems.

LAB INFO
This course does not have an experimental laboratory. There is a computer/tutorial laboratory two hours per week.

1 Faculty of engineering Policies and Procedures-Undergraduate

The Faculty of Engineering has established for 2025 a set of Policies and Procedures for Undergraduate Students. The policy covers:

- Absence/Late Accommodation Policy
- Religious Accommodation
- Academic Integrity
- Academic Offences
- Faculty of Engineering AI Policy
- Accessibility
- Inclusivity, Diversity, and Respect
- Health and Well-being

See the following subsections for notes on specifics on how some of these policies apply in the context of Engineering Thermodynamics, CBE 2214.

1.1 Absence/Late Accommodation Policy

In general, you are expected to advise the Course Coordinators if you are having problems completing an assignment on time (**prior to the due date of the assignment**).

Individual Assignments

1. This course employs flexible deadlines for **individually submitted assignments** (not group assignments). For each assignment, you are expected to submit the assignment by the deadline listed. Should illness or extenuating circumstances arise, you are permitted to submit your assignment up to 72 hours past the deadline without academic penalty.
2. Assignment submissions **will not be accepted beyond 72 hours** past the deadline. As flexible deadlines are used for these assessments, requests for academic consideration will not be granted. If you have a long-term academic consideration or an accommodation for disability that requires greater flexibility than provided here, please reach out to the Course Coordinators at least one week prior to the posted deadline.

In addition to the above Faculty rules, if you miss the deadline of an assignment without a legitimate reason discussed above:

Assignments submitted after the due date are accepted within 24 hours of the due date, with a 10 percent reduction in the mark.
Any question/concern about the mark or late submission (within 24 hours after the specified due date) MUST be directed to the TAs:
Laura Marhefka
Milad Vahidi
Harasavardanan Velumani jayaraman

2.1 Academic Considerations

Engineering Thermodynamics (CBE 2214) follows the Faculty and University policies for Academic Considerations. In accordance with the policy that instructors are permitted to designate one assessment per course per term as requiring supporting documentation to receive academic consideration.