Identification	**Subject**	ENGR 311 Engineeing Thermodynamics 6 ECTS
	Department	Chemistry and Chemical Engineering
	Program	Undergraduate
	Term	Fall, 2023
	Instructor	Dr. Rasoul Moradi
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	Hours /Class	Monday 15:20-16:50 /302N, Wednesday 15:20-16:50 /202N
	Office hours	Tuesday, Wednesday, 17:00 – 18:00
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	Main textbook: (References) 1. Fundamentals of Thermodynamics: Gordon J.Van Wylen, Claus Borgnakke, Richard E. Sontag. Wiley.6th Ed. 2002. Supplementary material: Class Lecture Handouts and Additional Reading Materials	
Course outline	General Outline of Topics Covered: ➢ Introductory comments ➢ Concepts and definitions ➢ Properties of a pure substance ➢ Work and heat ➢ The first law of thermodynamics ➢ First-law analysis for a control volume	
Course objectives	The objective of this course is to provide the students with an understanding the primitive principals and terminology relevant to first law of thermodynamics and their application to engineering systems. Analyses of various states and equations governing on a system, e.g. ideal gas, real gas (virial equation) and evaluation of energy conservation in some devices such as nozzles, turbines, pumps and turbines are two principal objectives.	
Learning outcomes	After successful completion of this course, the student will be able to: • Understand the thermodynamic properties of general working substances. • Evaluate the properties and property changes for an ideal gas. • Apply conservation of energy through the First Law of Thermodynamics to closed and control volume systems. • It is expected that the students will gain a fundamental physical and mathematical understanding of this topic rather than memorizing the equations and situations. By this, it is implied that the student will be able to correctly apply the course content to new situations so as to evaluate potential industrial applications of thermodynamic systems through both physical induction and mathematical analysis.	
Teaching methods	Lecture	x
	Group discussion	x

Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Midterm Exam		30
	Quizzes& Homework		10
	Class Presentation		10
	Final Exam		50
	Total		100

Policy	▪ **Ethics** Use of any electronic devices is prohibited in the classroom. All devices should be turned off before entering class. This is a university policy and violators will be reprimanded accordingly.

- **Preparation for class**
  The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions.

  - **Quizzes& Homework**

  A consistent method of gauging your understanding of the content covered in class is through quizzes. They assist you and your teacher in evaluating your comprehension of important ideas and identifying any areas that can benefit from more explanation. The quiz is conducted in written form. Open-ended questions are worth 1 or 2 points depending on the level of difficulty. 1 or 2 homeworks related to the subject are given at the end of lesson. At the end, the homework and quiz marks are summed up, and the average point is calculated. The sum of the two is maximum 10 points.
  The topics covered in class are often covered through homework assignments. You can strengthen your understanding of important concepts by doing puzzles and activities on your own. Your understanding of fundamental concepts like atomic structure, chemical processes, and stoichiometry is strengthened as a result of your active participation.

  - **Class Presentation**

  Students frequently have to explain difficult chemical ideas to their classmates when they work in groups or make presentations. As they must break it down into simpler terms and respond to inquiries from their classmates, teaching others can help students get a deeper knowledge of the content. The presentation consists of the student taking a topic and working on it, and then presenting it in the form of a lecture or presentation in power point in front of the audience. The presentation is evaluated on a 10-point scale.

- **Withdrawal (pass/fail)**
  This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.

- **Cheating/plagiarism**
  Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.

- **Professional behavior guidelines**
  The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.

Tentative Schedule

Week	Topics	Textbook/Assignments
1	Introduction 1.1 Terminology and semantics 1.2 Historical milestones 1.3 Philosophy of science note	Ref. 1

	1.4 Some practical applications 1.5 Example to illustrate homework solution	
2,3	Concepts and definitions 2.1Thermodynamic system and control volume 2.2 Macroscopic versus microscopic 2.3 Properties and state of a substance 2.4 Processes and cycles 2.5 Fundamental variables and units 2.6 Zeroth law of thermodynamics	Ref. 1 Quiz 1
4	Properties of Pure Substances 3.1 The pure substance 3.2 Vapor-liquid-solid phase equilibrium 3.3 Independent properties 3.4 Thermal equations of State 3.4.1 Ideal gas law 3.4.2 Non-ideal thermal equations of state 3.4.2.1 van der Waals 3.4.2.2 Redlich-Kw 3.5 Compressibility factor	Ref. 1, Quiz 2
5	Work and Heat 4.1 Mathematical preliminaries: exact differentials 4.1.1 Partial derivatives 4.1.2 Total derivatives 4.2 Work 4.2.1 Definitions 4.2.2 Work for a simple compressible substance 4.2.3 Other forms of work 4.3 Heat	Ref. 1 Quiz 3
6-8	The first law of thermodynamics 5.1 Representations of the first law 5.1.1 Cycle 5.1.2 Process 5.2 Specific internal energy for general materials 5.3 Specific enthalpy for general materials 5.4 Specific heat capacity	Ref. 1 Quiz 4-5
9	**Midterm Exam**	
10,11	First law analysis for a control volume 6.1 Detailed derivations of control volume equations 6.1.1 Relevant mathematic	Ref. 1 Quiz 6,8
11-14	Mass and Energy Conservation 6.1 Mass conservation in brief 6.2 Energy conservation in brief 6.3 Some devices 6.3.1 Throttling device 6.3.2 Nozzles and diffusers 6.3.3 Turbine 6.3.4 Pumps and compressors	Ref. 1 Quiz 9,10
15	Pre-Exam Problem Solving Session	Ref. 1
16	**Final Exam**	