Course Information

Title:	Thermodynamics_1 (620323)
Prerequisite:	General Physics (2) - 210102, Calculus (2) - 250102
Credit Hours:	3 credit hours (16 weeks per semester, approximately 44 contact hours) Star1959
Textbook:	Thermodynamics, An Engineering Approach, Yunus A. Cengel and Micheal A. Boles 9th Edition.
References:	• Fundamentals of thermodynamics, Sonntag, Richard E., Borgnakke, Claus. John Wiley & Sons, 2014, 8th ed. • Engineering thermodynamics: Principles and practices. Kummar D. S. New Delhi: Kataria & Sons. 2013.
Description:	The course is a requirement for Mechanical Engineering students. At completing this course, the student should be able to understand the following: • Basic concepts of engineering thermodynamics. • Energy, energy transfer and general energy analysis. • Properties that can be used to quantitatively describe a thermodynamic system. These properties include: pressure, temperature, specific volume, internal energy, enthalpy, entropy, etc. • Energy analysis of closed. • Mass and energy analysis of control volumes. • The second law of thermodynamics • The basic laws of entropy.
Instructor:	**Professor Munzer Ebaid** **Office**: Mechanical Engineering building, room E61305, ext.: 2445

Course Topics:

week	Basic and support material to be covered
(1+2)	Introduction and Basic Concepts of Thermodynamics
(3+4)	Energy, Energy Transfer and General Energy Analysis
(5)	Properties of Pure Substance.
(6)	**Mid Exam**
(6)	Properties of Pure Substance.
(7+8+9)	Energy analysis of a closed system.
(10+11+12)	Mass and energy analysis of control volumes
(13+14)	The second law of thermodynamics.
(15+16)	Entropy
(16)	**Final Exam**

ABET Student Outcomes (SOs)

1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3	An ability to communicate effectively with a range of audiences
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Course Learning Outcomes and Relation to ABET Student Outcomes:

Upon successful completion of this course, a student should be able to:

1.	Understand the basic concepts of engineering thermodynamics. This should include (a) Thermodynamics and energy. (b) Systems and control volumes. (c) The state postulate. (d) Processes and cycles. (e) Temperature and the Zeroth law of thermodynamics. (f). Pressure and pressure measurement devices.	[1]
2.	Acquire the knowledge of energy, energy transfer and general energy analysis. This should include (a). Forms of energy. (b). The nature of internal energy. (c) The concept of heat and the terminology associated with energy transfer by heat (d). The concept of work, including electrical work and several forms of mechanical work. (e). First law of thermodynamics, energy balance, and mechanisms of energy transfer to or from a system. (f). Mass, heat, and work to or from a control surface. (g). Energy conversion efficiencies. (h) The importance of energy conversion to the environment.	
3.	Understand thermodynamics properties of pure substances. This should include. (a). the concept of pure substance. (b). The physics of phase change processes. (c). Understanding of pressure versus specific volume diagrams and temperature versus specific volume diagrams. (d). The ability to use and find thermodynamics properties using steam tables such pressure, temperature, specific volume, internal energy, enthalpy, entropy. (e). The ideal gas equation of state and the compressibility factor. (f). Other equations of state.	[1]
4.	Carryout energy analysis of a closed system. This should include. (a). The moving boundary work encountered in systems such as automotive engines and compressors. (b). The general energy balance of a closed system. (c). The specific heat at constant volume and the specific heat at constant pressure. (d). Calculations of the changes in internal energy and enthalpy of ideal gases. (e). Incompressible substances and determine the changes in their internal energy and enthalpy. (f). Solve energy balance problems for closed systems that involve heat and work interactions for general pure substances, ideal gases, and incompressible substances.	[1]
5.	Carryout mass and energy analysis of control volumes. This should include. (a). The conservation of mass principle. (b). Applying the conservation of mass principle to various systems including steady and unsteady flow control volumes. (c). The first law of thermodynamics as a statement of the conservation of energy principle to control volumes. (d). Energy carried by a fluid stream crossing a control surface. (e). The property enthalpy as a combination of internal energy and flow work. (f). Solve energy balance problems for common steady flow devices such nozzles, compressors, turbines, throttling valves, mixing chambers, heaters, and heat exchangers. (g). Solve energy balance problems for unsteady flow processes.	
6.	The second law of thermodynamics. This should include. (a). Understanding the concept of the second law of thermodynamics. (b). identifying valid processes as those that satisfy both the first and second laws of thermodynamics. (c). identifying thermal energy reservoirs,	[1, 2]

	reversible and irreversible processes, heat engines, refrigerators, and heat pumps. (d). The understanding of Kelvin-Planck and Clausius statements of the second law of thermodynamics. (e). The concepts of perpetual motion machines. (f). Applying the second law of thermodynamics to cycles and cyclic devices. (g). Applying the second law to develop the absolute thermodynamics temperature scale. (f) The concept of Carnot cycle and the idealized Carnot heat engines, refrigerators, and heat pumps. To determine thermal efficiencies of reversible heat engines, heat pumps, and refrigerators.	
7.	The basic laws of entropy. This should include. (a). Applying the second law of thermodynamics to processes. (b). The property entropy. (c). The increase of entropy principle. (d). Calculation of entropy changes for pure substances, incompressible substances, and ideal gases. (e). Identify isentropic processes, and to develop the property relations for these processes. (f). The reversible steady work relations. (g). the isentropic efficiencies for various flow devices.	[1]

Teaching methodology: Online, Blended or both

Electronic platform: Microsoft-teams

Assessment Instruments:

Evaluation of students' performance (final grade) will be based on the following categories:

Mid Exam: Two written exams will be given. Each will cover about 3-weeks of lectures

Quizzes: Ten-minute quizzes will be given to the students during the semester. These quizzes will cover material discussed during the previous lecture(s).

Homework: Problem sets will be given to students. Homework should be solved individually and submitted before the due date.

Copying homework is forbidden, any student caught copying the homework or any part of the homework will receive zero mark for that homework

Participation: Questions will be asked during lectures and the students are assessed based on his/her response

Final Exam: The final exam will cover all the class material.

Grading policy:

Mid-Exam	30%
Four Quizzes	30%
Final Exam	40%
Total:	**100%**

Attendance policy:

Absence from classes and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse, acceptable to and approved by the Dean of the relevant college/faculty, shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

February, 2021