

Fall 2019

MECH 2311 (12365) INTRODUCTION TO THERMAL-FLUID SCIENCES

- Course Description** An introduction to basic concepts of thermodynamics and fluid mechanics to include properties, property relationships, states, and fluids. Presentation of the basic equations of thermal-fluid science, continuity, first and second laws of thermodynamics, and momentum. *Prerequisites are MATH 1312 Calculus II with a grade of “C” or better.*
- Instructor** Miguel Cedeno, PhD
Lecturer
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Office Hours: TR 1400 – 1500 by appointment.
- Textbook** *Fundamentals of Thermal-Fluid Sciences* Fifth Edition (2017)
by Yunus Cengel, John Cimbala, and Robert Turner
McGraw Hill
- Course Content** 1. Introduction the Thermodynamics and Fluid Mechanics (Chapter 1)
- Part 1
2. Basic Concepts of Thermodynamics (Chapter 2)
- Systems and Control Volumes
 - Properties of a System
 - Density and Specific Gravity
 - State and Equilibrium
 - Zeroth Law of Thermodynamics
 - Pressure
 - The Manometer
3. Energy, Energy Transfer, and General Energy Analysis (Chapter 3)
- Forms of Energy
 - Energy Transfer by Heat
 - Energy Transfer by Work
 - Mechanical Forms of Work
 - First Law of Thermodynamics
 - Energy Conversion Efficiencies

4. Properties of Pure Substances (Chapter 4)
 - a. Phases of a Pure Substance
 - b. Phase-Change Processes of Pure Substances
 - c. Property Diagrams for Phase-Change Processes
 - d. Property Tables
 - e. The Ideal-Gas Equation

5. Energy Analysis of Closed Systems (Chapter 5)
 - a. Moving Boundary Work
 - b. Energy Balance for Closed Systems
 - c. Specific Heats
 - d. Internal Energy, Enthalpy, and Specific Heats of Ideal Gases
 - e. Internal Energy, Enthalpy, and Specific Heats of Liquids

6. Mass and Energy Analysis of Control Volumes (Chapter 6)
 - a. Conservation of Mass
 - b. Flow Work and the Energy of a Flowing Fluid
 - c. Energy Analysis of Steady-Flow Systems

7. The Second Law of Thermodynamics (Chapter 7)
 - a. Introduction to the second law
 - b. Thermal Energy Reservoirs
 - c. Heat Engines
 - d. Refrigerators and Pumps
 - e. Reversible and Irreversible Processes
 - f. The Carnot Cycle
 - g. The Carnot Principles
 - h. Thermodynamic Temperature Scale
 - i. Carnot Heat Engine
 - j. The Carnot Refrigerator and Pump

8. Introduction to Properties of Fluids (Chapter 8)
 - a. The No-Slip Condition
 - b. Classification of Fluid Flows
 - c. Viscosity

Part 2

9. Fluid Statics (Chapter 11)
 - a. Introduction to Fluid Statics
 - b. Hydrostatic Forces on Submerged Plane Surfaces

10. Bernoulli and Energy Equations (Chapter 12)
 - a. The Bernoulli Equation
 - b. General Energy Equation

c. Energy Analysis of Steady Flows

11. Momentum Analysis of Flow Systems (Chapter 13)

- a. Newton's Laws
- b. Choosing a Control Volume
- c. Forces Acting on a Control Volume
- d. The Reynolds Transport Theorem
- e. The Linear Momentum Equation

Grading	Quizzes	200
	<u>Tests (4 given – 3 best will count)</u>	<u>300</u>
	Possible Points	500

A (500-450): B (449-400): C (399-350): D (349-300): F (299 and Below)

There will be ten quizzes of 20 points each and four 80-minute tests of 100 points each. There will be no makeups for the tests or quizzes. Your lowest test grade will be dropped.

Major Course Objectives

Upon completion of this course, students should be able to:

- 1. Understand concepts of temperature, pressure, and energy
- 2. Evaluate properties of pure substances and use property data for solving problems
- 3. Apply the principles of conservation of mass and energy to closed and open systems
- 4. Understand and apply the second law of thermodynamics, including concepts such as irreversibility and Carnot cycle
- 5. Understand the basic concepts of fluid mechanics and properties such as viscosity and surface tension
- 6. Solve fluid statics problems
- 7. Apply the Bernoulli and energy equations
- 8. Apply the conservation of linear momentum to control volumes

Policy for Quizzes

Quizzes will be based on helping you study for both the Fundamental of Engineering (FE) and Professional Engineering (PE) exams (<http://www.ncees.org/exams/>).

I recommend that you use an approved calculator similar to what you will use for your certification exams for all your work since this will help you learn how to use all the features of your calculator. These calculators include Casio: All fx-115 models. Any Casio calculator must contain fx-115 in its model name, Hewlett Packard: The HP 33s and HP 35s models, and Texas Instruments: All TI-30X and TI-36X models.

ABET Program This class significantly addresses the following ABET objectives:
Outcomes (a) an ability to apply knowledge of mathematics, science, and engineering
Impacted (b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to identify, formulate, and solve engineering problems

Academic dishonesty

All graded materials must represent the student's individual work. Scholastic dishonesty is the attempt of any student to present as his or her own work of another, or any work which he has not honestly performed, or attempting to pass any examination by improper means. *Scholastic dishonesty is a serious offense and will not be accepted.* Academic misconducts will be handled according to the current university policy.

Reasonable Accommodation Policy: If you need classroom accommodation, please contact The Center for Accommodations and Support Services (CASS) at 915-747-5148, or by email to cass@utep.edu, or visit the office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

Department of Mechanical Engineering Safety Statement

The Department of Mechanical Engineering at the University of Texas at El Paso is committed to a model of excellence in education that includes providing a safe and healthy environment for its students, staff, faculty and the general public.

Our goal is to maximize education and research training that can only occur if you, the individual, minimize hazards and risks. This can be done by:

- Providing adequate control of the health and safety risks arising from any and all activities;
- Consulting with employees on matters affecting their health and safety
- Providing and maintaining safe laboratories and equipment;
- Ensuring safe handling and use of substance;
- Ensuring all employees are competent to do their task and have adequate training; and
- Maintaining clean, safe and healthy working conditions

The principal investigator or individual in charge of each laboratory is ultimately responsible for safety in that respective lab. This includes training and ultimate release of the laboratory. Within the Department, we hold every employee (staff, faculty, student) responsible for implementing our safety practices and our departmental safety policy. We hold every employee (staff, faculty, student) responsible for providing leadership within our department to establish effective environmental safety and occupational health standards.

TENTATIVE CLASS SCHEDULE
MEETING TIME: MW 1200-1320
MEETING LOCATION: Physical Science Building 208

Week	Dates	Chapter(s)	Read Sections	Self-Study Problems	Scheduled and DUE
1	08/26	1 – Intro	1.1-6	-	Nothing due this week
	08/28	2 – Basic Concepts of Thermodynamics	2.1-3	2-16C, 2-27C, 2-32E, 2-37	
2	09/02	UNIVERSITY CLOSED SEPTEMBER 2 LABOR DAY	-	-	-
	09/04	2 – Basic Concepts of Thermodynamics	2.4-8	2-38E, 2-49, 2-46, 2-52E	Quiz 1 – 09/04 - Covering Chap. 2
3	09/09	3- Energy, Energy Transfer, and General Energy Analysis	3.1-5	3-10, 3-12, 3-13, 3-15, 3-17C, 3-22C, 3-27E, 3-28E, 3-30E, 3-35	-
	09/11	Chapter 3 Cont.	3.6-7	3-37C, 3-41E, 3-48, 3-58E, 3-69E, 3-70	Quiz 2 – 09/11 - Covering Ch. 3
4	09/16	Test Review 1 Chapters 1-3	Week 1-3 Readings	Week 1-3 Self-Study Problems	-
	09/18	-	-	-	TEST 1 09/25 Chapters 1 - 3
5	09/23	4 – Properties of Pure Substances	4.1-3	Understand T-v, P-v, and P-T Diagrams	-
	09/25	Chapter 4 Cont.	4.4-5	4-6C, 4-7C, 4-10C, 4-15C, 4-26, 4-27E	Quiz 3 – 09/25- Covering Chap. 4

6	09/30	4 – Properties of Pure Substances	4.5	4-35E, 4-36E, 4-39, 4-43, 4-46, 4-49, 4-50, 4-54E, 4-59,	-
	10/02	Chapter 4 Cont.	4.6	4-62, 4-64, 4-71, 4-74E	Quiz 4 – 10/02-Covering Chap. 4
7	10/07	Finish Chapter 4	-	-	-
	10/09	5 – Energy Analysis of Closed Systems	5.1-3	5-3, 5-8, 5-9, 5-12, 5-26E, 5-29E, 5-32, 5-33, 5-34	Quiz 5 – 10/09-Covering Chap. 4
8	10/14	5 – Energy Analysis of Closed Systems	5.4-5	5- 50E, 5-56, 5-67E, 5-68, 5-69, 5-78, 5-79, 5-85, 5-86	-
	10/16	6- Mass and Energy Analysis of Control Volumes	6.1-2	6-6E, 6-17, 6-18E, 6-20E, 6-28, 6-39E	Quiz 6 – 10/16-Covering Chap. 5
9	10/21	Test Review 2 Chapters 4 and 5	Week 6-8 Readings	Week 6-8 Self-Study Problems	-
	10/23	-	-	-	TEST 2 10/23 Chaps. 4 and 5
10	10/28	6- Mass and Energy Analysis of Control Volumes	6.3-4	6-44, 6-46E, 6-60E, 6-71, 6-75E, 6-78, 6-93E, 6-107, 6-108	-
	10/30	Finish Chapter 6		-	Quiz 7 – 10/30 - Covering Ch. 6

	Course Drop Deadline: Nov 1st				
11	11/04 11/06	Chapter 7 – Second Law of Thermodynamics Chapter 7 Cont.	7.1-4 7.5-10	7-17E, 7-20, 7-21, 7-22, 7-42, 7-43, 7-77, 7-78, 7-79, 7-90, 7-91, 7-94E, 7-96	- Quiz 8 – 11/06- Covering Chap. 7
12	11/11 11/13	Finish Chapter 7 Part 2 Chapter 11 – Introduction and Properties of Fluids	7.5-10 11.1-2	- 11-1C, 11- 3C, 11-4C, 11-5C, 11- 6C, 11-7C	- Quiz 9 – 11/13- Covering Chap. 7
13	11/18 11/20	Test Review 3 Chapters 6, 7, and 11 -	Week 10-12 Readings -	Week 10-12 Self-Study Problems -	- TEST 3 11/20 Chaps. 6, 7 and 11
14	11/25 11/27 Thanksgiving Holiday: November 28 and 29	Chapter 11 – Fluid Statics Chapter 12 – Bernoulli and Energy Equations	11.3-4 12.1-3	11-8, 11-10, 11-14, 11- 16 12-16, 12- 17, 12-26, 12-31, 12- 32, 12-35E	- Quiz 10 – 11/27- Covering Chap. 11
15	12/02	Finish Chapter 12	-	12-48, 12- 50, 12-51, 12-52, 12- 54, 12-55, 12-60, 12- 64E	Nothing due this week

	12/04	Chapter 13 – Momentum Analysis of Flow Systems	13.1-4	13-19, 13- 20, 13-25, 13-32E	
16	FINAL EXAM (TEST 4) Friday December 13th 1300-1545				