Summer 2025

MECH 2311 (31738) INTRODUCTION TO THERMAL-FLUID SCIENCE

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

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Office hours: TBD and
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Class hour: Monday to Friday 1:15 pm to 2:20 pm
Location: Liberal Arts 108

Teaching Assistant: TBD

Textbook

Fundamentals of Thermal-Fluid Sciences Sixth Edition (2021)
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)
   a. Systems and Control Volumes
   b. Properties of a System
   c. Density and Specific Gravity
   d. State and Equilibrium
   e. Zeroth Law of Thermodynamics
   f. Pressure
   g. The Manometer

3. Energy, Energy Transfer, and General Energy Analysis (Chapter 3)
   a. Forms of Energy
   b. Energy Transfer by Heat
   c. Energy Transfer by Work
   d. Mechanical Forms of Work
   e. First Law of Thermodynamics
   f. 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	10
Homeworks	20
Calss Participation	5
Test 1	30
Test 2	35
Possible Points	**100**

A (88-100): B (78-87): C (68-77): D (58-67): F (57 and Below)

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

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

Technology requirements
Course content is delivered via the Internet through the Blackboard Collaborate ULTRA. Ensure your UTEP e-mail account is working and that you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop, scanner, a webcam, and a microphone. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about Microsoft Office 365 and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP Help Desk as they are trained specifically in assisting with the technological needs of students. Please do not contact me for this type of assistance.

Allowed Calculators

The following will be the only calculators allowed in exams:

- 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, but no others.
- Texas Instruments: All TI-30X and TI-36X models. Any Texas Instruments calculator must contain either TI-30X or TI-36X in its model name.

Course Policies
What do you need to do to be successful in the course?
Attendance and participation Attendance on the course is determined by participation in the learning activities of the course. Your participation in the course is important not only for your learning and success but also to create a community of learners. Participation is determined by completion of the following activities:

- Reading/Viewing all course materials to ensure understanding of assignment requirements
- Other activities as indicated in the weekly modules such as HW (Self-study problems)
- Meet regularly with the TA during additional study sessions posted on BB

Academic dishonesty
Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test (Chegg), or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of

another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline.

Reasonable Accommodation Policy: The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

Copyright statement for course materials
All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

Course Resources
Where you can go for assistance UTEP provides a variety
of student services and support: Technology Resources

- Help Desk: Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.

Academic Resources

- UTEP Library: Access a wide range of resources including online, full-text access to thousands of journals and eBooks plus reference service and librarian assistance for enrolled students.
- University Writing Center (UWC): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.
- Math Tutoring Center (MaRCS): Ask a tutor for help and explore other available math resources.
- RefWorks: A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet

and Quick-Start Guide.

Individual Resources

- Military Student Success Center: Assists personnel in any branch of service to reach their educational goals.
- Center for Accommodations and Support Services: Assists students with ADA-related accommodations for coursework, housing, and internships.
- Counseling and Psychological Services: Provides a variety of counseling services including individual, couples, and group sessions as well as career and disability assessments.

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.

SYLLABUS

Week	Chapter(s)	Read Sections	Scheduled and DUE
1 6/9	1 – Intro 2 – Basic Concepts of Thermodynamics	1.1-6 2.1-2.8	-
2 6/16	3- Energy, Energy Transfer, and General Energy Analysis 4 – Properties of Pure Substances	3.1-3.7 4.1-4.5	-
3 6/23	Finish Chapter 4 5 – Energy Analysis of Closed Systems	4.6 5.1 – 5.5	
4 6/30	**Test 1** 6- Mass and Energy Analysis of Control Volumes	6.1- 6.4	**Test 1: Chapter 2-5 Date 6/30**
5 7/7	Chapter 7 – Second Law of Thermodynamics	7.1-7.10	
6 7/14	Chapter 11 – Fluid Statics Chapter 12 – Bernoulli and Energy Equations	11.1- 11.4 12.1-12.2	
7 7/21	Chapter 12 Continued Chapter 13 Momentum Analysis of Flow Systems	12.3 13.1-13.4	
8 7/28	Miscellaneous Test review **Test 2**		**Test 2** **Date: 7/30** **Syllabus: 6,7,11,12,13**

Note: The above schedule is tentative and is subjected to change