

Fall 2022

MECH 2311 (12082) 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.*

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Office Hours Booking

Teaching Assistant: Luis Nunez - lanunez5@miners.utep.edu
Office Hours: MTWRF 1030-1130am & 330-430pm ACES (Classroom Bld)

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

Part 2

8. Fluid Statics (Chapter 11)
 - a. Introduction to Fluid Statics
 - b. Hydrostatic Forces on Submerged Plane Surfaces
9. Bernoulli and Energy Equations (Chapter 12)
 - a. The Bernoulli Equation
 - b. General Energy Equation
 - c. Energy Analysis of Steady Flows

10. 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
	Tests (4 given – 3 best will count)	300
	Possible Points	500

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

There will be ten 12-min-quizzes of 20 points each and four 65-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
(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 technological needs of students. Please do not contact me for this type of assistance.

Course Communication: *How we will stay in contact with each other*

There are several ways we can keep the communication channels open:

- **Office Hours:** My office hours will be held on MS Teams on Fridays 8-9am. If you need to meet with me during other time, feel free to stop by my office on campus when I'm there.
- **Email:** UTEP e-mail is the best way to contact me. I will make every attempt to respond to your e-mail within 24-48 hours of receipt. **When e-mailing me, be sure to email from your UTEP student account and please put the course number in the subject line.** In the body of your e-mail, clearly state your question. At the end of your e-mail, be sure to put your first and last name, and your UTEP ID.
- **Announcements:** Check the Blackboard announcements frequently for any updates, deadlines, or other important messages.

NETIQUETTE

As we know, sometimes communication online can be challenging. It's possible to miscommunicate what we mean or to misunderstand what our classmates mean given the lack of

body language and immediate feedback. Therefore, please keep these netiquette (network etiquette) guidelines in mind. Failure to observe them may result in disciplinary action.

- Always consider audience. This is a college-level course; therefore, all communication should reflect polite consideration of other's ideas.
- Respect and courtesy must be always provided to classmates and to the instructor. No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a face-to-face situation.
- **Blackboard is not a public internet venue**; all postings to it should be considered private and confidential. Whatever is posted on in these online spaces is intended for classmates and professor only. **Please do not copy documents and paste them to a publicly accessible website, blog, or other space such as Chegg.**

Course Policies: *What do you need to do to be successful in the course?*

Attendance and participation

Attendance in 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](#).

Quizzes proctoring software

Quizzes/Tests will make use of Respondus Lock Down Browser and Respondus Monitor inside of Blackboard to promote academic integrity. You are encouraged to learn more about how to use these programs prior to the first test. We're using Zoom Meetings to proctor the Tests, so have it ready in your phones.

Please review the following guidelines:

- The assessments will only be available at the times identified on the course calendar.
- You may take the test a given time window.
- A reliable Internet connection is essential to completing the exam. If you must go to a location to take the exam (such as the library), be sure to follow their health and safety requirements.
- Respondus Lockdown Browser will require that all internet tabs are closed prior to the start of the test/quiz.
- Respondus Monitor requires a webcam and microphone.
- You will be required to show the webcam your student ID prior to the start of the test.
- Your face should be completely visible during the test. Blocking the camera will disable the test.
- No notes or textbook materials are permitted during the test. Respondus Monitor requires you to take a video of your surrounding area (desk, chair, walls, etc.)
- You should not have conversations with other people and/or leave and return to the area during the test.

Plagiarism detecting software

Some of your course work and assessments may be submitted to SafeAssign, a plagiarism detecting software. SafeAssign is used to review assignment submissions for originality and will help you learn how to properly attribute sources rather than paraphrase.

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 Aerospace and Mechanical Engineering Safety Statement

The Department of Aerospace and 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: M W 900-1020
MEETING LOCATION: PSY 115

Week	Date	Chapter(s)	Read Sections	HW	Scheduled and DUE
1	August 22, 2022	1 – Intro	1.1-6	-	-
	August 24, 2022	2 – Basic Concepts of Thermodynamics	2.1-3	2-16C, 2-27C, 2-32E, 2-37	-
	August 29, 2022	-	2.4-8	2-38E, 2-49, 2-46, 2-52E	Quiz 1 Covering Chap. 2
2	August 31, 2022	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	-
	September 5, 2022	Labor Day Holiday – University Closed			
3	September 7, 2022	Chapter 3 Cont.	3.6-7	3-37C, 3-41E, 3-48, 3-58E, 3-69E, 3-70	Quiz 2 Covering Ch. 3
4	September 12, 2022	Test Review 1 Chapters 1-3	Week 1 Readings	Week 1 Self-Study Problems	-
	September 14, 2022	-	-	-	TEST 1 Chapters 1 – 3
5	September 19, 2022	4 – Properties of Pure Substances	4.1-3	Understand T-v, P-v, and P-T Diagrams	-
	September 21, 2022	Chapter 4 Cont.	4.4-5	4-6C, 4-7C, 4-10C, 4-15C, 4-26, 4-27E	Quiz 3 Covering Chap. 4

6	September 26, 2022	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,	-
	September 28, 2022	Chapter 4 Cont.	4.6	4-62, 4-64, 4-71, 4-74E	Quiz 4 Covering Chap. 4
7	October 3, 2022	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 Covering Chap. 4
	October 5, 2022	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	-
8	October 10, 2022	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 Covering Chap. 5
	October 12, 2022	Test Review 2 Chapters 4 and 5	Week 2-3 Readings	Week 2-3 Self-Study Problems	-
9	October 17, 2022	-	-	-	TEST 2 Chaps. 4 and 5
	October 19, 2022	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	October 24, 2022	Finish Chapter 6	-	-	Quiz 7 Covering Ch. 6
	October 26, 2022	Chapter 7 – Second Law of Thermodynamics	7.1-4	7-17E, 7-20, 7-21, 7-22, 7-42,	-

				7-43, 7-77, 7-78, 7-79, 7-90,	
11	October 31, 2022	Chapter 7 Cont.	7.5-10	7-91, 7-94E, 7-96	Quiz 8 Covering Chap. 7
	November 2, 2022	Finish Chapter 7	7.5-10	-	-
12	November 7, 2022	Part 2 Chapter 11 – Introduction and Properties of Fluids	11.1-2	11-1C, 11-3C, 11-4C, 11-5C, 11-6C, 11-7C	Quiz 9 Covering Chap. 7
	November 9, 2022	Test Review 3 Chapters 6, 7, and 11	Week 10-12 Readings	Week 4-5 Self-Study Problems	-
	November 14, 2022	-	-	-	TEST 3 Chaps. 6, 7 and 11
13	November 16, 2022	Chapter 11 – Fluid Statics	11.3-4	11-8, 11-10, 11-14, 11-16	-
14	November 21, 2022	Chapter 12 – Bernoulli and Energy Equations	12.1-3	12-16, 12-17, 12-26, 12-31, 12-32, 12-35E	Quiz 10 Covering Chap. 11
	November 23, 2022	Chapter 12 Cont.	12.1-3	-	-
15	November 28, 2022	Finish Chapter 12	-	12-48, 12-50, 12-51, 12-52, 12-54, 12-55, 12-60, 12-64E	-
	November 30, 2022	Chapter 13 – Momentum Analysis of Flow Systems	13.1-4	13-19, 13-20, 13-25, 13-32E	-

