

Spring 2024

MECH 3312 (21501) Thermodynamics

Course Description Continuation of learning the basic principles of thermodynamics started in MECH 2311 “Introduction to Thermal-Fluid Sciences”
Application of these principles to the analysis of power and refrigeration cycles as well as to engineering problems involving psychrometrics and air conditioning. *Prerequisites are MECH 2311 Intro to Thermal-Fluid Sci with a grade of “C” or better.*

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<https://outlook.office365.com/owa/calendar/OfficeHoursSpring2024@minersutep.onmicrosoft.com/bookings/>

[Click here for Booking](#)

Additional Tutoring and Grades Review Teaching Assistant:
Office Hours:

Textbook Y.A. Çengel and M.A. Boles, *Thermodynamics: An Engineering Approach*, 10th Edition, 2024, McGraw-Hill, ISBN 1266664483

Course Content

1. Entropy (Chapter 7)
 - a) The Increase of Entropy Principle
 - b) Entropy Change of Pure Substances
 - c) Isentropic Processes
 - d) Property Diagrams Involving Entropy
 - e) What is Entropy?
 - f) The T ds Relations
 - g) Entropy Change of Liquids and Solids
 - h) The Entropy Change of Ideal Gases
 - i) Reversible Steady-Flow Work
 - j) Minimizing the Compressor Work
2. Exergy (Chapter 8)
 - a) Exergy: Work Potential of Energy

- b) Reversible Work and Irreversibility
 - c) Second-Law Efficiency
 - d) Exergy Change of a System
 - e) Exergy Transfer by Heat, Work, and Mass
 - f) The Decrease of Exergy Principle and Exergy
 - g) Exergy Balance: Closed Systems
 - h) Exergy Balance: Control Volumes
3. Gas Power Cycles (Chapter 9)
- a) Basic Considerations in the Analysis
 - b) The Carnot Cycle and its Value
 - c) Air-Standard Assumptions
 - d) An Overview of Reciprocating Engines
 - e) Otto Cycle: the Ideal Cycle for Spark-Ignition Engines
 - f) Diesel Cycle: the Ideal Cycle for Compression-Ignition Engines
 - g) Stirling and Ericsson Cycles Brayton Cycle: the Ideal Cycle for Gas-Turbine Engines
 - h) The Brayton Cycle with Regeneration
 - i) The Brayton Cycle with Intercooling, Reheating, and Regeneration
 - j) Ideal Jet-Propulsion Cycles
 - k) Second-Law Analysis of Gas Power Cycles
4. Vapor and combined power cycles (Chapter 10)
- a) The Carnot Vapor Cycle
 - b) Rankine Cycle: the Ideal Cycle for Vapor Power Cycles
 - c) Deviation of Actual Vapor Power Cycles From Idealized Ones
 - d) How Can we Increase the Efficiency of the Rankine Cycle?
 - e) The Ideal Reheat Rankine Cycle
 - f) The Ideal Regenerative Rankine Cycle
 - g) Second-Law Analysis of Vapor Power Cycles
 - h) Cogeneration
 - i) Combined Gas–Vapor Power Cycles
5. Refrigeration cycles (chapter 11)
- a) Refrigerators and Heat Pumps
 - b) The Reversed Carnot Cycle
 - c) The Ideal Vapor-Compression Refrigeration Cycle
 - d) Actual Vapor-Compression Refrigeration Cycle
 - e) Second-Law Analysis of Vapor-Compression Refrigeration Cycle
 - f) Selecting the Right Refrigerant
 - g) Heat Pump Systems
 - h) Innovative Vapor-Compression Refrigeration Systems
 - i) Gas Refrigeration Cycles
 - j) Absorption Refrigeration Systems
6. Gas mixtures (chapter 13)
- a) Composition of a Gas Mixture: Mass and Mole Fractions

- b) P-v-T Behavior of Gas Mixtures: Ideal and Real Gases
 - c) Properties of Gas Mixtures: Ideal and Real Gases
7. Gas-vapor mixtures and air-conditioning (chapter 14)
- a) Dry and Atmospheric Air
 - b) Specific and Relative Humidity of air
 - c) Dew-Point Temperature
 - d) Adiabatic Saturation and Wet-Bulb Temperatures
 - e) The Psychrometric Chart
 - f) Human Comfort and Air-Conditioning
 - g) Air-Conditioning Processes

Grading	Quizzes	20%
	Test 1	20%
	Test 2	20%
	Test 3	20%
	Test 4 (Final Comprehensive)	20%
	Possible Points	100%

A (100-90): B (89-80): C (79-70): D (69-60): F (59 and Below)

There will be no makeups for the tests or quizzes.

Optional HW Extra Credits: At Sunday midnight of each week, HW will be due. Submission is optional, but strongly recommended. Solving HW would be beneficial to reinforce concepts covered in class. At the end of the semester, the total extra credit worth of HW, would be calculated based on the performance of the course. To get the max allowed extra credits, it is recommended to submit every HW in a weekly based, since the total points would be proportional to the number of submissions. Once the submission link expires at the end of each week, it will not be activated again.

Major Course Objectives

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

- Understand the concept of entropy, use relations and property diagrams involving entropy.
- Understand the concept of exergy, conduct second-law analysis of systems and cycles.
- Analyze ideal gas power cycles: write energy balance, determine heat and work, and calculate the cycle efficiency.
- Analyze vapor power cycles: write energy balance, determine heat and work, and calculate the cycle efficiency;

- Analyze refrigeration cycles: write energy balance, determine heat and work, and calculate the cycle coefficient of performance.
- Calculate properties of ideal gas mixtures.
- Determine the properties of dry air – water vapor mixtures and analyze processes involving these mixtures using energy and mass balances.

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 Outcomes Impacted

This class significantly addresses the following ABET objectives:

- (a) An ability to apply knowledge of mathematics, science, and engineering.
- (e) An ability to identify, formulate, and solve engineering problems.
- (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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 a number of ways we can keep the communication channels open:

- **Office Hours:** We will not be able to meet on campus, but I will still have office hours for your questions and comments about the course. My office hours will be held on MS Teams.
- **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 university identification number.
- **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)

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](#).

Test 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 12-1.20pm
MEETING LOCATION: Liberal Arts Building 222

Week	Date	Chapter(s)	Read Sections	HW Optional (Textbook)	Scheduled and DUE
	Monday, January 15, 2024	Dr. Martin Luther King, Jr. Holiday – University Closed			
1	Wednesday, January 17, 2024	Introduction and overview	7-1, 7-2	7-31 7-35 7-40 7-62 7-65	-
2	Monday, January 22, 2024	Entropy	7-3 – 7-6	-	Quiz 1
	Wednesday, January 24, 2024	Entropy	7-7 – 7-9	-	-
3	Monday, January 29, 2024	Entropy	7-10, 7-11	7-73 7-77 7-81 7-85 7-106 7-119	Quiz 2
	Wednesday, January 31, 2024	Entropy	7-12, 7-13	7-134 7-138 7-142 7-147	-
4	Monday, February 5, 2024	Exergy: a measure of work potential	8-1 – 8-3	8-33 8-53 8-62 8-81	Quiz 3
	Wednesday, February 7, 2024	Exergy: a measure of work potential	8-4 – 8-6	-	-
5	Monday, February 12, 2024	Exergy: a measure of work potential	8-7-	-	Quiz 4
	Wednesday, February 14, 2024	Exergy: a measure of work potential	8-8-	-	-
6	Monday, February 19, 2024	Test Review 1	-	-	-
	Wednesday, February 21, 2024	-	-	-	TEST 1 Chaps. 7-8
7	Monday, February 26, 2024	Gas power cycles	9-1 – 9-5	9-31 9-33 9-46	-

	Wednesday, February 28, 2024	Gas power cycles	9-6, 9-7	9-50 9-81 9-139	Quiz 5
	Monday, March 4, 2024	Gas power cycles	9-8 – 9-10	-	-
8	Wednesday, March 6, 2024	Gas power cycles	9-11, 9-12	-	Quiz 6
9	Monday, March 11, 2024 Wednesday, March 13, 2024		Spring Break		
10	Monday, March 18, 2024	Test Review 2 Chapter 9	-	-	-
	Wednesday, March 20, 2024	-	-	-	TEST 2 Chap. 9
11	Monday, March 25, 2024	Vapor and combined power cycles	10-1 – 10-4	10-14 10-26 10-34	-
	Wednesday, March 27, 2024	Vapor and combined power cycles	10-5, 10-6		-
12	Monday, April 1, 2024	Vapor and combined power cycles	10-7 – 10-9	10-83 10-86 10-98	Quiz 7
	Wednesday, April 3, 2024	Refrigeration cycles	11-1 – 11-7	11-14 11-15 11-18 11-22 11-42 11-59	-
	Monday, April 8, 2024	Refrigeration cycles	11-8-	11-73 11-79 11-89 11-90 11-91	Quiz 8
13	Wednesday, April 10, 2024	Refrigeration cycles	11-9, 11-10	11-102 11-104 11-105 11-106E	-

14	Monday, April 15, 2024	Test Review 3 Chapters 10 and 11	-	-	-
	Wednesday, April 17, 2024	-	-	-	TEST 3 Chaps. 10 and 11
15	Monday, April 22, 2024	Gas mixtures	13-1 – 13-2	13-8 13-9 13-11 13- 14	-
	Wednesday, April 24, 2024	Gas mixtures	13-2 – 13-3	13-29 13- 33 13-34 13-37 13- 42 13-72 13-79	Quiz 9
16	Monday, April 29, 2024	Gas-vapor mixtures and air- conditioning	14-1 – 14-4	14-14 14- 17 14-18 14-19	-
	Wednesday, May 1, 2024	Gas-vapor mixtures and air- conditioning	14-5 – 14-7	14-27 14- 39E 14-41 14-72 14- 79 14-95 14-100 14- 109 14-111 14-113	Quiz 10
17	Friday, May 10th	COMPREHENSIVE FINAL EXAM: 1-2.30pm (TEST 4)			