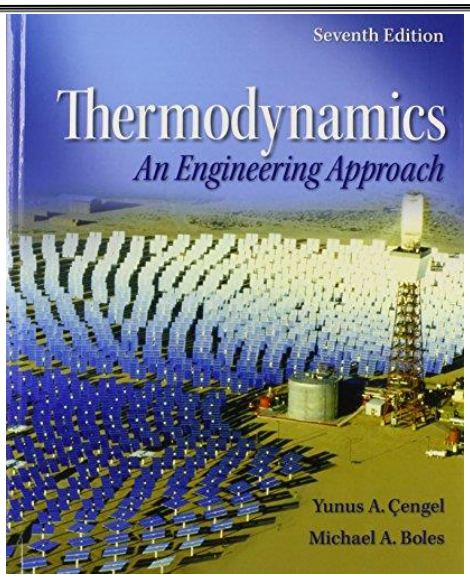

COURSE INFORMATION

MECH 2311: Thermodynamics
CRN: 22638
Term: Fall 2025
Delivery Method: In- person or as informed by the Instructor
Meeting Day and Time: 09:00 – 10:20 and TR
Location: Liberal Arts Building, 319

INSTRUCTOR INFORMATION
Instructor: Dr. Piyush Kumar
Email: pkumar2@utep.edu
Phone Number: (915)-747-7976
Office Location: Engineering Building, Room E-330
Office Hours:

- Face-to-Face: TR (12:00-13:30) at E-330 (Engineering Building) or by appointment through email
- Virtual: Friday through Teams by taking an appointment through email

REQUIRED MATERIALS

Textbook: "*Y.A. Çengel and M.A. Boles, Thermodynamics: An Engineering Approach, 7th Edition, McGraw-Hill, ISBN 9780073529325*"
"*Yunus Cengel, John Cimbala, and Robert Turner, Fundamentals of Thermal-Fluid Sciences Sixth Edition (2021) by McGraw Hill.*" Instructors may provide additional reading materials.

Prerequisite: Introduction to Thermal Fluid Sciences, and Basic concept of Mathematics.

COURSE DESCRIPTION:

This course introduces the fundamental principles of thermodynamics and their applications in various engineering systems. It covers topics such as the laws of thermodynamics, energy conservation, work and heat, properties of pure substances, and thermodynamic cycles. The course emphasizes the understanding of energy transformations in physical and chemical processes, along with the application of thermodynamic concepts to real-world engineering problems. Students will develop a solid foundation in thermodynamic principles, essential for analyzing and designing thermal systems in fields like mechanical, chemical, and aerospace engineering.

COURSE OBJECTIVES:

The course objectives are designed to equip students with a comprehensive understanding of thermodynamic principles and the ability to apply these concepts to solve practical engineering problems.

- Understand and apply the basic principles and laws of thermodynamics.
- Analyze thermodynamic systems and processes, including work and heat interactions.
- Calculate thermodynamic properties of substances and evaluate system states using thermodynamic tables and charts.

- Understand the behavior of ideal and real gases in various thermodynamic processes.
- Analyze and apply thermodynamic cycles such as the Carnot cycle, Rankine cycle, and refrigeration cycles.
- Develop the ability to solve real-world engineering problems involving heat engines, refrigerators, and heat pumps.

LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

- Explain and apply the first and second laws of thermodynamics to a wide range of engineering problems.
- Use the concept of entropy to evaluate reversible and irreversible processes in thermodynamic systems.
- Apply thermodynamic tables and equations of state to calculate the properties of gases and liquids.
- Solve problems involving heat, work, and energy in a variety of thermodynamic systems.
- Analyze and evaluate the performance of thermodynamic cycles, including efficiency and performance parameters.
- Critically assess energy efficiency and sustainability considerations in engineering designs involving thermal processes.

TOPICS

- Introduction And Basic Concepts
- Energy, Energy Transfer, And General Energy Analysis
- Properties Of Pure Substances
- Energy Analysis Of Closed Systems
- Mass And Energy Analysis Of Control Volumes
- The Second Law Of Thermodynamics
- Entropy
- Gas Power Cycles
- Vapor And Combined Power Cycles
- Refrigeration Cycles
- Thermodynamic Property Relations
- Gas–Vapor Mixtures And Air-Conditioning

ASSIGNMENT AND GRADING

There will be several Assignments/Homework at regular intervals during the semester. Students are required to submit the assigned work on or before the deadline. Late submission of the assigned work will not be allowed unless medical and emergency reasons exist. The following percentages of the assignments, exams, and projects will constitute the basis for the assigning of the final grade in the course:

Exam 1: 20%, Exam 2: 20%, Exam 3: 20%
Class performance & Quizzes: 20%

Homework and Assignments: 20%
Grading criterion:

A (≥ 90%)
B (<90% & ≥ 80%)
C (<80% & ≥ 70)
D (<70% & ≥ 60%)
F (<60%)

Note: Any outstanding issues related to grading of assigned work (quizzes, exams, homework or projects) must be resolved within two weeks from the day the graded work is returned.

Exams: There will be three exams. If you miss two exams, the instructor has the option to drop you from the class or assign an "F" grade. The exam grades will be calculated based on the average of the three highest test scores. A makeup exam will be provided in case of a documented emergency.

Assignment: The assignment will be uploaded on the blackboard as the pdf file or through the McGraw Hill Connect.

Quizzes: The quizzes will be given in class. No makeup quizzes.

TECHNOLOGY REQUIREMENTS

Some course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP email account is working and 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. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and MATLAB/Python. 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 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. The Help Desk is much better equipped than I am to assist you!

ATTENDANCE AND PARTICIPATION

Students must attend at least 75% of all the classes in-person.

ILLNESS PRECAUTIONS

Please stay home if you have symptoms of a communicable illness. If you are feeling unwell, please let me know as soon as possible so that we can work on appropriate accommodation.

EXAM INSTRUCTIONS

• Students are NOT allowed to go to restrooms during the test. Students with disabilities must have a letter of accommodation and coordinate this with the instructor.

- Students are NOT allowed access to any materials in their backpacks without permission.
- Students can NOT use devices during the exam (such as cell phones, iPads, iPods, and wristwatches).
- Late students are NOT allowed to take the exam 15 minutes after starting the test.
- No wearing hats is allowed during the test.

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.

EXCUSED ABSENCES AND/OR COURSE DROP POLICY

According to UTEP Catalog, "At the discretion of the instructor, a student can be dropped from a course because of excessive absences or lack of effort. A grade of "W" will be assigned before the course drop deadline and a grade of "F" after the course drop deadline." See Policies and Regulations in the UTEP Undergraduate Catalog for a list of excuse absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24-hour advance notice via email.

OR

I will not drop you from the course. However, if you feel that you are unable to complete the course successfully, please let me know and then contact the Registrar's Office to initiate the drop process. If you do not, you are at risk of receiving an "F" for the course.

MAKEUP WORK

Makeup work will be given *only* in the case of a ***documented*** emergency. Note that makeup work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a zero. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement. Once a deadline has been established for makeup work, no further extensions or exceptions will be granted.

ALTERNATIVE MEANS OF SUBMITTING WORK IN CASE OF TECHNICAL ISSUES

I strongly suggest that you submit your work with plenty of time to spare in the event that you have a technical issue with the course website, network, and/or your computer. I also suggest you save all your work (answers to discussion points, quizzes, exams, and essays) in a separate Word document as a backup. This way, you will have evidence that you completed the work and will not lose credit. If you are experiencing difficulties submitting your work through the course website, please contact the UTEP Help Desk. You can email me your backup document as a last resort.

INCOMPLETE GRADE POLICY

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

ACCOMMODATIONS POLICY

The University is committed to providing reasonable accommodations to students with documented disabilities. Students who become pregnant may also request reasonable accommodation, in accordance with state and federal laws and regulations and University policy. Accommodations that constitute undue hardship are not reasonable. To make a request, please register with the UTEP Center for Accommodations and Support Services (CASS). Contact CASS at 915-747-5148, email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

SCHOLASTIC INTEGRITY

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, 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.

GUIDANCE ON ARTIFICIAL INTELLIGENCE

AI prohibited

Use of A.I. technologies or automated tools, particularly generative A.I. such as ChatGPT or DALL-E, is ***not allowed*** for assignments in this class. Each student is expected to use critical and creative thinking skills to complete tasks and not rely on computer-generated ideas. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

A.I. allowed with proper acknowledgement

Use of A.I. technologies or automated tools, particularly generative A.I. such as ChatGPT or DALL-E, is ***only allowed with proper attribution given for its use***.

Students must properly cite and give full credit to the program used upon submission of every relevant assignment. For example, text generated using ChatGPT must be cited:

Chat-GPT(version). Date of query (year/month/day). "Text of your query."
Generated using OpenAI. https://chat.openai.com/

A short paragraph describing how the tool(s) was/were used for the assignment must be included.

COURSE RESOURCES: Where you can go for assistance

UTEP provides a variety of student services and support. Please refer to the Q.R. code below for a listing of campus resources or visit https://www.utep.edu/advising/student_resources/student-success-resource-hub.html.

ACES & Tutoring Center from the College of Engineering

Please note there are tutoring services available in the ACES center.
https://www.utep.edu/engineering/student-resources/student-resources-aces-tutoring.html

COURSE PLAN (Subject to Change)

INTRODUCTION AND BASIC CONCEPTS (Week 1, 2, 3, and 4)

Energy, Energy Transfer, and General Energy Analysis (Week 1)
- Systems and Control Volumes
- State and Equilibrium
- Temperature and the Zeroth Law of Thermodynamics
- Forms of Energy: Work and Heat
- First Law of Thermodynamics

Properties of Pure Substances (Week 2 and 3)
- P-v-T Relationships
- Real Gas Behavior
- Polytropic Process for an Ideal Gas
- Energy Analysis of Closed Systems
- Mass and Energy Analysis of Control Volumes

The Second Law of Thermodynamics (Week 4)
- The Kelvin-Planck Statement and Heat Engines
- The Clausius Statement: Refrigerators and Heat Pumps
- Reversible and Irreversible Process
- The Carnot Cycle

ENTROPY (Week 4 and 5)
- Entropy
- Entropy Change of Pure Substances
- Isentropic Processes
- Property Diagrams Involving Entropy
- The *T ds* Relations
- Entropy Change of Liquids and Solids
- The Entropy Change of Ideal Gases

GAS POWER CYCLES (Week 6 and 7)
- The Carnot Cycle
- Otto Cycle: the Ideal Cycle for Spark-Ignition Engines
- Diesel Cycle: the Ideal Cycle for Compression-Ignition Engines
- Brayton Cycle: the Ideal Cycle for Gas-Turbine Engines

VAPOR AND COMBINED POWER CYCLES (Week 8 and 9)
- The Carnot Vapor Cycle
- Rankine Cycle: the Ideal Cycle for Vapor Power Cycles
- Energy Analysis of the Ideal Rankine Cycle
- The Ideal Reheat Rankine Cycle
- The Ideal Regenerative Rankine Cycle

REFRIGERATION CYCLES (Week 10 and 11)

Refrigerators and Heat Pumps
The Reversed Carnot Cycle
The Ideal Vapor-Compression Refrigeration Cycle
Actual Vapor-Compression Refrigeration Cycle
Gas Refrigeration Cycles
Absorption Refrigeration Systems

THERMODYNAMIC PROPERTY RELATIONS (Week 12)

The Maxwell Relations
The Clapeyron Equation
General Relations for du, dh, ds, c_v, and c_p

GAS–VAPOR MIXTURES AND AIR-CONDITIONING (Week 13 and 14)

Dry and Atmospheric Air
Specific and Relative Humidity of air
Dew-Point Temperature
Adiabatic Saturation and Wet-Bulb Temperatures
The Psychrometric Chart
Human Comfort and Air-Conditioning
Air-Conditioning Processes

The above schedule, policies, and assignments in this course are subject to change in the event of extenuating circumstances or by mutual agreement between the instructor and the students.