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| **COURSE** | Thermodynamics II |
| **COURSE NUMBER** | MCEN 3032 |
| **CREDITS** | 3 credits |
| **INSTRUCTOR** | Dr. Nathan McNeill<br>AEC 206<br>nmcneill@colorado.edu<br>(970) 248-1623 |
| **OFFICE HOURS** | M W 9:00 AM – 12:00 PM, 1:00– 5:00 PM<br>T Th 9:00 AM – 11:00 AM |
| **MEETING TIMES** | T Th 1:00 – 2:50 PM |
| **MEETING LOCATION** | AEC 205 |
| **PREREQUISITE(S)** | MCEN 3012 and MCEN 3021 |
| **TEXTBOOK** | Thermodynamics: An Engineering Approach (8th Edition)<br>by Çengel and Boles<br>ISBN: 978-0073398174 |
| **WEBSITE** | https://learn.colorado.edu |
| **GRADING** | Assignments 38 %<br>Exams 20 %<br>Journal article 7 %<br>Project 20 %<br>Quizzes 15 % |

Letter grades will be assigned as follows:

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|---|---|
| A | 92.00 – 100 % |
| A- | 90.00 – 91.99 % |
| B+ | 87.00 – 89.99 % |
| B | 82.00 – 86.99 % |
| B- | 80.00 – 81.99 % |
| C+ | 77.00 – 79.99 % |
| C | 72.00 – 76.99 % |
| C- | 70.00 – 71.99 % |
| D+ | 67.00 – 69.99 % |
| D | 62.00 – 66.99 % |
| D- | 60.00 – 61.99 % |
| F | < 60.00 % |

## COURSE DESCRIPTION

The focus of this second course in thermodynamics is on the analysis, modeling, and design of thermodynamic systems. As such, this is primarily a project-based course in which you will build on, and apply, concepts learned in the previous semester of thermodynamics.

This course will require significant reading of the textbook as well as watching online videos of example problems. The reading schedule can be found on the calendar below with readings to be completed by the date on which they are listed. You will also be expected to read one journal article and present it to the class. Quizzes will occur frequently throughout the semester and may occur more often than indicated on the syllabus. A considerable amount of class time will be devoted to problem solving exercises that are due on the dates indicated on the calendar below. Assignments are due at the beginning of class on the dates indicated and late assignments will generally not be accepted. You can expect to spend up to three hours working outside of class for every hour that you spend in class.

There will be two exams in this course. Each exam will be worth 10 % of your total grade. The first exam will be a review of problems that we learned to solve in the first semester of this course. As with homework, organization and neatness will account for a significant portion of the grade on the first exam. Providing answers alone (without supporting equations and diagrams) will not sufficient for full credit. The second exam will be a final exam and will be made up of a multiple choice questions similar to those found on the FE exam.

## LEARNING OBJECTIVES

Upon completion of this course you should:

1. Be able to analyze complex vapor power systems, gas power systems, refrigeration systems, and heat pump systems. These systems will incorporate features such as: superheat, reheat, absorption, regeneration, intercooling, and different compression/cut-off/pressure ratios.
2. Be able to determine nonreacting gas mixture properties and perform energy analyses on gas mixtures.
3. Be able to analyze reacting (i.e., combustion) systems from First and Second Thermodynamic Law perspectives.
4. Be able to apply psychrometrics to heating, ventilation, and air conditioning systems.
5. Be able to apply the principles of engineering, the basic sciences, and math to the design of thermodynamic power and refrigeration/heat pump systems.
6. Have designed a thermodynamic system. Such a system could include: a thermal power system or heat engine, a refrigeration system, or a heat pump system.
7. Learned about current developments in thermodynamics research as well as commercial thermodynamic systems.

## SCHEDULE

| Date | Topic | Readings | Due |
|---|---|---|---|
| **Week 1** | | | |
| Jan 17 | Gas and steam cycle review | | |
| Jan 19 | Gas and steam cycle review | | |
| **Week 2** | | | |
| Jan 24 | Chapter 9 – Jet-propulsion | 9–11 | Quiz 1 |
| Jan 26 | Exam | | |
| **Week 3** | | | |
| Jan 31 | Chapter 9 – Gas power cycles | 9–1 to 9–5 | Assignment 1<br>Journal article |
| Feb 2 | Chapter 9 – Gas power cycles | 9–6 to 9–7 | Quiz 2 |
| **Week 4** | | | |
| Feb 7 | Chapter 11 – Refrigeration cycles/EES | 11–1 to 11–4 | Assignment 2 |
| Feb 9 | Chapter 11 – Refrigeration cycles | 11–6 to 11–7 | Quiz 3 |
| **Week 5** | | | |
| Feb 14 | Chapter 10 – Vapor power cycles | 10–6, 10–8 | Assignment 3 |
| Feb 16 | Chapter 10 – Vapor power cycles | | |
| **Week 6** | | | |
| Feb 21 | Project | | |
| Feb 23 | Project | | |
| **Week 7** | | | |
| Feb 28 | Project | | |
| Mar 2 | Project | | |
| **Week 8** | | | |
| Mar 7 | Project | | |
| Mar 9 | Project | | |
| **Week 9** | | | |
| Mar 14 | Project | | |
| Mar 16 | Project | | |
| **Week 10** | | | |
| Mar 21 | **No Class – Spring Break** | | |
| Mar 23 | **No Class – Spring Break** | | |
| **Week 11** | | | |
| Mar 28 | Chapter 10 – Vapor power cycles | | Project report |
| Mar 30 | Chapter 10 – Vapor power cycles | | |

| Date | Topic | Readings | Due |
|---|---|---|---|
| **Week 12** | | | |
| Apr 4 | Chapter 13 – Gas mixtures | 13–1 to 13–3 | Assignment 4 |
| Apr 6 | Chapter 13 – Gas mixtures | | Quiz 4 |
| **Week 13** | | | |
| Apr 11 | Chapter 14 – HVAC | 14–1 to 14–5 | Assignment 5 |
| Apr 13 | Chapter 14 – HVAC | 14–6 to 14–7 | Quiz 5 |
| **Week 14** | | | |
| Apr 18 | Journal articles | | |
| Apr 20 | Journal articles | | |
| **Week 15** | | | |
| Apr 25 | Chapter 15 – Chemical reactions | 15–1 to 15–3 | Assignment 6 |
| Apr 27 | Chapter 15 – Chemical reactions | 15–4 | Quiz 6 |
| **Week 16** | | | |
| May 2 | Chapter 15 – Chemical reactions | | |
| May 4 | Final exam review | | Assignment 7 |
| **Finals Week** | | | |
| May 8 – 11 | Final exam (date and time to be determined) | | |

**COUNSELING SERVICES**

A variety of services are available to help you if you are struggling academically, feeling discouraged, overwhelmed, depressed, stressed, anxious, or, if you are struggling with relationships, family problems, grief, health problems, disabilities, hunger, or finances. If you are having suicidal thoughts you can call the Colorado West Mental Health Suicide Hotline at 970-241-6022, the National Suicide Hotline at 1-800-784-2433, or Behavioral Clinical Services any time at 970-241-6500.

The Student Services Office, in Lowell Heiny Hall, Room 107, has mentors who can help you with many academic, financial, and personal concerns. You can stop by during normal business hours or call 970-248-1366. If they are unable to help you, they can refer you to services that can provide help. (http://www.coloradomesa.edu/studentservices/index.html)

Counseling services are provided by Behavioral Clinical Services located at 1005 North 12th St. #105, phone number 970-241-6500 (answered 24/7). All students paying student fees are eligible for $5 co-pay counseling sessions. You may contact Behavioral Clinical Services directly at 970-241-6500 to set up an appointment. All sessions are confidential and students dealing with personal matters affecting their academic life are encouraged to speak with a professional counselor.

**COURSE POLICIES: UNIVERSITY OF COLORADO--BOULDER**

A primary objective of the Mechanical Engineering Department is to prepare each of our students for careers in the engineering profession. As professionals, engineers must meet high standards of technical competence as well as ethical behavior. According to the Accreditation Board of Engineering and Technology (ABET) code of ethics, engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

1. *Using their knowledge and skill for the enhancement of human welfare;*
2. *Being honest and impartial, and serving with fidelity the public, their employers, and clients;*
3. *Striving to increase the competence and prestige of the engineering profession.*

The Department of Mechanical Engineering (ME) believes that it is essential for you to learn the professional behavior that will prepare you for your career after college. Therefore, in each mechanical engineering course you will be required to practice the professional behavior that will be expected by your future employers. This syllabus clearly outlines the ME policy regarding academic integrity and academic climate. These policies will be upheld in each of your courses throughout the mechanical engineering curriculum. However, we also expect that this culture of professionalism will pervade all of your University of Colorado experiences.

## I. ACADEMIC INTEGRITY

You may be asked to complete individual homework assignments in this course. Though you may work in groups to discuss and solve problems, it is expected that you will abide by the University of Colorado at Boulder honor code at all times. Therefore, **you may not plagiarize a problem set or allow another student to plagiarize your answers to a problem set.** Examples of plagiarism include: copying from a solution manual, copying from Internet sites, copying from previous academic year homework sets, and copying directly from classmates. If you have any doubt that you are using sanctioned materials to assist with your homework solution, please ask your current instructor/professor. On assignments that require you to use supplemental materials, it is also essential that you properly document the sources of information you use.

Any instances of dishonesty on homework or tests will result in a minimum sanction for your first violation of the honor code of a zero score and an entry in your department file. Additional sanctions will be imposed by the ME Department for subsequent violations, possibly including expulsion from the ME program. You may contest any accusation according to the campus honor code policy.

> **University of Colorado at Boulder Honor Code Policy:**
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> All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible of violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at http://honorcode.colorado.edu.
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> Helpful interactions between students are encouraged. The key difference between helping and cheating is that helping each other means communicating concepts; cheating means using/copying another's work as your own.

## II. ACADEMIC CLIMATE

**In Class Expectations:**
It is our expectation that each of you will be respectful to classmates and instructors at all times. In an effort to create a professional atmosphere within the classroom, it is requested that you:

- Arrive to class on time
- Turn off your cell phone during class
- Limit use of your laptop computer to class purposes
- Put away newspapers and magazines
- Refrain from having disruptive conversations during class
- Remain for the whole class, or if you must leave early do so without disrupting others
- Display professional courtesy and respect in all interactions related to this class

Compliance with these expectations will assist us with the creation of a learning community and a high quality educational experience. The University of Colorado Classroom behavior policy will complement the outlined classroom expectations.

**University of Colorado Classroom Behavior Policy:**

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the student code.

**Discrimination and Harassment:**

Discriminatory and harassing behavior will not be tolerated in the Department of Mechanical Engineering. A safe and inclusive environment will be created and maintained by students and instructing faculty member. Students with concerns about discrimination or harassment actions should immediately contact the instructor, the Department Chair or their academic advisor, or contact the Office of Discrimination and Harassment (see below).

Examples that may be considered harassment include:

- A teaching assistant or instructor asking a student for a date.
- Displaying sexually explicit material in an academic setting (including laptop wallpaper).
- Persisting in asking a classmate for a date after being turned down.
- Using degrading terminology in referring to others, including peers.

**University of Colorado Discrimination and Harassment Policy:**

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU-Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.

**Out of Class Expectations:**
Though many of the above stated policies address academic climate within the classroom, these policies should also be upheld outside of the classroom. As a member of the ME community you are expected to consistently demonstrate integrity and honor through your everyday actions. Furthermore, faculty and staff members are very willing to assist with your academic and personal needs. However, multiple professional obligations make it necessary for us to schedule our availability. Suggestions specific to interactions with faculty and staff include:

- Respect posted office hours. Plan your weekly schedule to align with scheduled office hours
- Avoid disrupting ongoing meetings within faculty and staff offices. Please wait until the meeting concludes before seeking assistance. Respect faculty and staff policies regarding use of email and note that staff and faculty are not expected to respond to email outside of business hours. Send emails to faculty and staff using a professional format. Tips for a professional email include:
    - Always fill in the subject line with a topic that indicates the reason for your email to your reader.
    - Respectfully address the individual to whom you are sending the email.
    - Avoid email, chat room or text message abbreviations.
    - Be brief and polite.
    - Add a signature block with appropriate contact information.
    - Reply to emails with the previously sent message. This will allow your reader to quickly recall the questions and previous conversation.

**Accommodation for Disabilities:**
In coordination with Educational Access Services, reasonable accommodations will be provided for qualified students with disabilities. Please meet with the instructor the first week of class to make arrangements. Dana VandeBurgt, the Coordinator of Educational Access Services, can be contacted at 248-1801, or in person in Houston Hall, Suite 108.

**Accommodation for Religious Holidays:**

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this course if students have conflicts with scheduled exams, assignments, experiments, etc. they should contact the instructor(s) at least two weeks in advance to determine appropriate steps to take. See campus policy regarding religious observances for full details.