

## MCEN 4122 Thermodynamics 2

## Spring 2009 Syllabus

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| <b>Catalog Description</b>            | Offers advanced topics and applications in thermodynamics, including gas mixtures, combustion, psychrometrics and HVAC systems, fluid machinery and compressible flow.  |
| <b>Learning Objectives</b>            | <ol style="list-style-type: none"> <li>1. Students will be able to determine nonreacting gas mixture properties and perform energy analyses on gas mixtures.</li> <li>2. Students will be able to analyze reacting (i.e. combustion) systems from a First and Second Thermodynamic Law perspective.</li> <li>3. Students will be able to apply psychrometrics to heating, ventilation and air conditioning systems.</li> <li>4. Students will be able to apply fundamentals of fluid dynamics and thermodynamics to compressible flow systems.</li> <li>5. Students will be able to apply fundamentals of fluid machinery (pumps, fans, compressors, turbines) to design problems.</li> </ol>   |
| <b>Importance of the course</b>       | Thermodynamics is the study of energy, work and heat, focusing on how to create and manipulate them. Thermodynamics is essential for power production, automotive engineering, renewable energy, heating, air conditioning, refrigeration, meteorology, environmental engineering and energy in biological systems. It is one of the most important courses in the engineering curriculum because its concepts are so widely used.  |
| <b>Shelly Miller office and phone</b> | Office: ECME 222<br>Telephone and voicemail: (303) 492-0587<br>E-mail: <a href="mailto:shelly.miller@colorado.edu">shelly.miller@colorado.edu</a><br>Website: <a href="http://stripe.colorado.edu/~shellym">http://stripe.colorado.edu/~shellym</a>   |
| <b>TA</b>                             | Jill Cooper, <a href="mailto:Jill.Cooper@colorado.edu">Jill.Cooper@colorado.edu</a><br>Xi Xia, <a href="mailto:Xi.Xia@Colorado.edu">Xi.Xia@Colorado.edu</a>   |
| <b>Prerequisites</b>                  | MCEN 3012   |
| <b>Text</b>                           | <p><i>Thermodynamics: An Engineering Approach</i>, Cengel and Boles, 6th Edition, McGraw-Hill, 2008, including student resources DVD with Engineering Equation Solver (EES).</p> <p>This is a very practical textbook. I will follow it closely, covering over half the content. Take advantage of the learning objectives and summaries included in each chapter to check your understanding and for review purposes, even if they are not assigned. You may also want to take advantage of the supplementary materials provided on the DVD and the online learning center at <a href="http://www.mhhe.com/cengel">www.mhhe.com/cengel</a>.</p> <p>You should plan to keep this book, as it will also be useful for Senior Design.</p> |
| <b>Course Website and Email list</b>  | CU Learn<br>I will frequently make use of a class email list to send out announcements and updates about assignments. You are responsible for all information sent to you via this class email list.  |
| <b>Office Hours</b>                   | TBD (posted on Website)   |

Also by appointment

**Help Sessions** TBD (posted on Website). These sessions will be run by a TA and will focus on working thermo problems. Please come by my office during office hours if you need one-on-one help or have administrative questions.

**Clickers** I will be using the CUClickers i-clicker system on a regular basis for this course. If you haven't already done so, you will need to purchase an i-clicker remote (available at the bookstore) and register it in CUConnect.

Beginning on Monday, Jan. 26, clicker responses will be recorded and used to assess class participation.

For further information see <http://www.colorado.edu/its/cuclickers/index.html>.

**Homework** Assignments will be given mostly weekly. These problems are assigned for your benefits, because the best way to master thermodynamics is to work lots of problems.

Selected problems from each assignment will be graded. These problems will be selected at random after the assignments have been submitted. The same problems will be graded for all students. Solutions to the problems will be posted on CULearn 2 days after the assignment is due. You should review the solutions to all problems and make sure you understand them.

Homework will be due at 5pm to the TAs on the specified dates. Unexcused late homework will not be accepted.

Unless specified homework will be turned in individually. It is fine, however, to collaborate with your fellow students while you are working on your homework – this means you can discuss concepts, help each other if you get stuck on something, etc.

Representing someone else's work as yours (whether a classmate or a solution found on the web), or allowing someone else to represent your work as theirs, is a violation of the CU Honor Code. Any instances of dishonesty on homework or tests will result in a grade of zero and can be grounds for failure in the course. Honor Code violations will be reported to the Honor Council at my discretion.

At the end of the semester, the assignment with the lowest grade will be thrown out.

**Homework  
Format**

It is your responsibility to make your solutions clear and legible. The graders have the discretion to deduct points (up to and including full credit) for solutions that are hard to read. Unless the problem requires only a conceptual or short answer, the following format is *required*. This will facilitate grading and will assist you to approach problems in a consistent, organized way that will lead to the correct solution. Problems may be written by hand or printed out from EES, but must be submitted in hard copy. Email/electronic submittals will not be accepted.

Clear and succinct problem statement, including variables that are given and quantities to be found. **This should be in your own words.**

1. Schematic/sketch (unless it is obviously not needed). Show the system to be analyzed with dotted lines for the enclosing system boundary. List relevant information on the figure.
2. List of assumptions.
3. Physical laws/governing equations. Write the form you're going to apply for the 1st law, ideal gas law, etc. Label the equations.
4. List of known values, with units, including properties obtained from a table. Indicate the source, if applicable.
5. List of unknowns. Make sure they correspond to the sketch.
6. Solution:
  - a. First do the algebra, *in symbolic form*. Make sure the number of equations matches the number of unknowns. Obtain and present a simplified expression for the answer.
  - b. Then do the calculations, plugging in the numbers. Pay attention to a) units and b) significant figures. Show all work (unless you are using EES).
  - c. Present the answer with a box around it.
7. Verification. Check the answer against what common sense tells you. Do the units make sense? Do the results compare reasonably to a related known quantity? Briefly explain what you did to check the result and where applicable, discuss pertinent limitations of the analysis – e.g., assumptions that are limited in applicability.

**Weekly  
Quizzes**

A quiz will be given mostly weekly on the material covered over the previous week. These quizzes will be administered using clickers.

**Exams**

Three in-class midterms will be given.

**Class format,  
expectations,  
attendance**

Class periods will be used to introduce new material through short lectures, in-class problem sessions, clicker questions, etc., and to review material already covered during previous class sessions using quizzes, in-class problems or discussion.

When you are in class, you are expected to participate, ask questions, and engage yourself. Come to class prepared, you are required to have done the assigned readings and/or assignments ahead of time for that particular class session.

You are expected to come to class and be on time. Your presence in the classroom is important to me, the TAs, and to the other students! Excessive absences will not be tolerated and may result in lowered grades. Class participation will be assessed using clickers and I will randomly take attendance during the first 5 minutes before class.

**Class  
atmosphere**

Encouragement, support, questions, respect, and humor are all part of this class. I really like to get to know each of you, your interests, concerns, and questions. I appreciate feedback and am open to changes in class procedure, organization, and delivery. I will solicit from you during the semester what is working in the class and what you might suggest that would help you to learn better.

**Professor Accessibility** I would like to be as accessible to you as possible, while at the same time balancing my commitments to my research program, my departmental service, and my family. Think of me as your **coach** – I aim to help you determine and achieve your academic goals. I encourage you to come by during office hours, ask questions about the course or discuss other ideas and concerns.

**Course schedule** The most updated schedule will be available on the course website. You are responsible for following the current schedule. I will make adjustments to this schedule often, based on my perceived needs of the classroom and the time available in which we work together during the semester.

**Professional behavior** Professional behavior means that you take **professional responsibility** for your learning in this course AND that you treat your classmates, TAs, and instructors with **professional courtesy**. I appreciate professional behavior in the classroom. Because I think this is so important in the classroom, I will be evaluating you subjectively at the end of the semester and will award points according to whether I viewed your behavior as below average, average or outstanding professionally.

Students who routinely engage in rude behavior are disrupting class and doing a disservice to the other students. *Rudeness will not be tolerated.*

**Electronics** Students are **not permitted to use electronic devices** when class is in session. Such devices include (but are not limited to) laptops, cell phones (voice and text), ipods, hair dryers, toy cars, etc. ;-). There maybe exceptions when students will be asked to bring their laptops, for example, to conduct an on-line assessment survey.

**Extra credit** I do not give extra credit assignments.

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|--|-----------------------|---------------|
| <b>Grading<br/>(tentative<br/>and subject to<br/>change)</b> | <b>Categories</b>     | <b>Weight</b> |
|  | Quizzes               | 10%           |
|  | Homework              | 15%           |
|  | Exams                 | 60%           |
|  | Class participation   | 10%           |
|  | Professional behavior | 5%            |

There are always a number of questions about grading. The fact that there are different people grading your homework and exams makes it seem difficult to fairly assign grades. I do recognize these problems and strive to ensure that the grades are fairly assigned. The most important thing I can do is to normalize the grades in a way that compensates as much as possible for such variability.

At the mid-point of the semester, I will total all the scores from your exams, quizzes, etc and will normalize by the total points possible and weight as described above. I will the assign mid-term grades.

At the end of the semester, this same procedure for assigning grades will be followed.

The breakdown of grades will be assigned such that the class average plus one standard deviation **or more** approximately encompasses A – B grades, and the class average minus one standard deviation **or more** approximately encompasses B – D grades. The actual percentage breakdown of grades depends on the performance of the entire class. The actual percentage breakdown of grades depends on the performance of the entire class. The boundaries between grades are selected to

achieve the desired overall class GPA, which is 2.9 for an undergraduate class.

Grades will **not** be changed after they have been assigned at the end of the semester, except in extenuating circumstances. So, if you have any questions about your scores on assignments, professional conduct, quizzes, etc., that may affect your final class grade, you must ask/address them before the end of the semester.

Typically the following performance criteria will be rewarded with the grade as described below:

A: EXCELLENT - Work performed in excess of requirements, consistently throughout the semester. Homework, labs, and projects successfully completed and scored a very high percentage of the possible course points.

B: COMMENDABLE - Performed and produced more quality work than minimally required. Homework, labs, and projects successfully completed and scored a high percentage of the possible course points.

C: SUCCESSFUL - Work completed. Achieved minimum requirements. Homework, labs, and projects completed and scored a reasonable percentage of the possible course points.

D: MARGINAL - Work partly completed and/or turned in late and scored a minimal percentage of the of possible course points. Did not effectively contribute to the team projects.

#### Course Policy and Important Information

If you qualify for accommodations because of a **disability**, please submit to your instructor a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322.  
[www.Colorado.EDU/disabilityservices](http://www.Colorado.EDU/disabilityservices).

Campus policy regarding **religious observances** requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please notify your instructor of any obligations that conflict with your fulfillment of the course requirements.  
See full details at [http://www.colorado.edu/policies/fac\\_relig.html](http://www.colorado.edu/policies/fac_relig.html)

Students and faculty each have responsibility for maintaining an **appropriate learning environment**. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. Your instructor will gladly honor your request to address you by an alternate name or gender pronoun. Please advise him of this preference early in the semester so that I may make appropriate changes to my records. See polices at:  
<http://www.colorado.edu/policies/classbehavior.html>,  
and at [http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\\_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code)

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the **academic integrity policy** of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be

reported to the Honor Code Council ([honor@colorado.edu](mailto:honor@colorado.edu); 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at: <http://www.colorado.edu/policies/honor.html>, and at <http://www.colorado.edu/academics/honorcode/>

The University of Colorado at Boulder policy on **Discrimination and Harassment** (<http://www.colorado.edu/policies/discrimination.html>, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at: <http://www.colorado.edu/odh>