

MAE 201: Thermal-Fluid Sciences (Thermodynamics)
(Joint NC State / UNC Asheville Engineering Programs)
Fall 2024 Syllabus

Instructor: Eugene K. Ungar, Ph.D.
Office: Rhodes/Robinson 204F
Email: eungar@unca.edu (preferred contact method)
Office Hours: T/Th 9:00 to 10:00 AM
T/Th 1:45 to 2:45PM (these are office hours for heat transfer, but if you have a conflict with the early times, you may use these)
other times by appointment through email

Class Meetings: Rhodes Robinson Hall rm 112, Tuesdays/Thursdays 10:15-11:30pm

Course Prerequisites/Restrictive Statements/Departmental Requirements

Prerequisites: MA 242, plus PY 208 or PY 202

Goals and Objectives of the Course

Course Motivation: This course is an introduction to the concept of energy. It provides the basic tools necessary for the analysis of any engineering system in which energy transfer or energy transformations occur; thus, thermodynamics is an important part of the training of almost all engineering disciplines.

In addition, concepts from Fluid Mechanics (MAE 308) and Heat Transfer Fundamentals (MAE 310) will be introduced and explored at a preliminary level.

Course Objectives: The students will be asked to demonstrate their knowledge of the material covered in MAE 201 through their mastery of the following course objectives. Through the study of MAE 201 the student will be able to:

1. Determine properties of real substances, such as steam and refrigerant 134-a, and ideal gases from either tabular data or equations of state.
 - Use absolute, gage, and vacuum pressures correctly.
 - Calculate gage and vacuum pressures using the manometer equation.
 - Use absolute and Celsius temperatures correctly.
 - Determine property data using the steam and R-134a tables.
 - Sketch P-v, T-v, and P-T plots for steam, R-134a, and ideal gases.
 - Locate data states on P-v, T-v, and P-T plots for steam, R-134a, and ideal gases.
 - Determine the condition of a data state as a compressed, saturated, or superheated state and determine the thermodynamic properties at that state by using property tables.
 - Demonstrate the use of quality in finding properties of two-phase substances.

- Apply the concept of the generalized compressibility factor to demonstrate when the ideal gas equation may be used to determine the state of a gas.
 - Apply the ideal gas equation to solve problems involving pressure, temperature, and volume of ideal gases.
 - Determine changes in internal energy and enthalpy for ideal gases.
 - Determine mass flow rate from its definition and relation to volume flow rate.
2. Analyze processes involving ideal gases and real substances as working fluids in both closed systems and open systems or control volumes to determine process diagrams, apply the first law of thermodynamics to perform energy balances and determine heat and work transfer.
- Determine the pressure-volume relation for processes and plot the processes on P-v and diagrams.
 - Calculate the boundary work for a variety of processes for closed systems.
 - Apply the first law to closed systems containing ideal gases, steam, or R-134a to determine heat transfer, work, or property changes during processes.
 - Apply the first law to steady-flow open systems containing ideal gases, steam, and refrigerant-134a to determine heat transfer, work, and property changes during processes.
3. Analyze internal flow processes:
- Use the Bernoulli's equation to analyze flows.
 - Use control volume analysis to evaluate forces across internal flow devices.
 - Determine pressure losses in internal flows.
4. Analyze canonical heat transfer problems:
- Evaluate heat conductivity and heat transfer coefficients.
 - Determine heating rates in internal flows for conduction, convection and radiation.
5. Analyze systems and control volumes through the application of the second law.
- Determine the efficiency of heat engines and compare with the Carnot heat engine efficiency.
 - Determine the coefficient of performance of refrigerators and heat pumps and compare with refrigerators and heat pumps operating on the reversed Carnot cycle.
 - Determine entropy changes for both ideal gases and real substances.
 - Determine the properties of a working fluid at the end of an isentropic process.
 - Plot processes on both P-v and T-s diagrams.
 - Apply both the first and second laws to determine heat transfer, work, and property changes during processes occurring in both closed and open systems.

Required Textbook

Y. A. Çengel and M. A. Boles, **Thermodynamics: an Engineering Approach**, 9th Ed, The McGraw Hill Companies, New York, 2019.

The 8th edition is virtually identical to the 9th edition.

Supplemental Textbooks

Andrew L. Gerhart, Philip M. Gerhart and John I. Hochstein, **Munson, Young and Okiishi's Fundamentals of Fluid Mechanics**, 9th Edition, Wiley, 2021.

Earlier editions of Munson, Young and Okiishi are widely available.

Fundamentals of Heat and Mass Transfer, Theodore L. Bergman; Adreinne S. Lavine; Frank P. Incropera; David P. DeWitt, 8th Edition, Wiley, 2019.

Earlier editions of Incropera and Dewitt are widely available.

Electronic resources

This course uses Moodle through NC State University. Log in at <https://wolfware.ncsu.edu>. This course also uses the Top Hat app.

MAE201 Student Learning Outcomes

ABET Student Outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Schedule

The schedule is subject to change at any time. Updates will be discussed in class and/or via email. The most current schedule will be posted on the Moodle site.

Food and Drink

No food will be allowed in the classroom. Water will be allowed in closed containers.

Class Attendance

Attendance and promptness are expected. Students may not enter the classroom until 5 minutes before class starts to allow time for the previous class to exit. Students are expected to stay in class until the class has ended.

In accordance with NCSU policy, instructors in 100- and 200-level courses must keep a record of attendance throughout the semester. A student is considered absent from class if not present at the time when attendance is taken. Absences will be excused only on a case-by-case basis, at the discretion of the instructor. Students are expected to attend all classes. Attendance will be taken and is part of the course grade.

For any absence, the student is responsible for getting missed notes and information from another student in attendance.

Homework

- Homework will be due after the completion of each chapter.
- Assignments will be posted on Moodle.
- Homework will be done on engineering green sheets or the equivalent (available at the bookstore and at Amazon).
- Students may consult with each other on homework, but you must do your own work.
- Homework will be submitted in class on the due date.
- No late homework will be accepted for credit, but with a valid excuse the homework will not be counted.

Grading

This course follows NC State University Policy on grading. Assignment due dates will be listed in Moodle.

As a rule, re-grades on individual problems are not given - however, if the points on your homework or exam were added or recorded incorrectly, contact me and the problem will be fixed.

Raw grades will be posted on Moodle during the semester so that students may calculate their averages (Moodle will not show course averages). It is the student's responsibility to contact the instructor by 5:00pm on the last day of classes if any recorded grade has a typographical error. Final course averages will be calculated from the posted grades and are not negotiable.

Final course grades will be determined as follows:

Attendance	10%
Homework	15%
In term exams Tests (2)	45%
<i>The lowest of the two will be worth 20% and the two highest 25% each</i>	
Final Exam	30%

Grading Scale:

A+: > 97	B+: 87 – 89.9	C+: 77 – 79.9	D+: 67 – 69.9	F: < 60
A: 93 – 96.9	B: 83 – 86.9	C: 73 – 76.9	D: 63 – 66.9	
A-: 90 – 92.9	B-: 80 – 82.9	C-: 70 – 72.9	D-: 60 – 62.9	

UNCA does not use A+ or D- so those grades will be recorded as A and D at UNCA.

University Academic Policies

NCSU Policies:

<https://policies.ncsu.edu/category/academic-affairs/>

UNCA Policies:

<http://catalog.unca.edu/content.php?catoid=20&navoid=1217>

Academic Integrity

All submitted work in this class shall be done alone by each individual student, without help from anyone else. If a student is suspected of violating this policy, then the NCSU and UNCA academic integrity policies and procedures will be followed.

Students are required to comply with the NCSU policy on academic integrity in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>.

Students are also required to comply with the UNCA policy on academic misconduct found at <https://studenthandbook.unca.edu/student-conduct/academic-misconduct-and-grievances-procedures/>.

Your name on any test or assignment, on paper or through electronic means, indicates “I have neither given nor received unauthorized aid on this test or assignment.” Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02, UNCA SD 43965).

Disability Resources

The Joint NCSU/UNCA Engineering Program is committed to making courses accessible to persons with documented disabilities. Students requiring reasonable accommodations must register with the UNCA Office of Academic Accessibility (<https://accessibility.unca.edu/>) by providing supporting documentation. All information provided will remain confidential. For more information, please contact the Office of Academic Accessibility at

academicaccess@unca.edu or (828) 251-6646. Students in the Joint Engineering Program do not need to register with NCSU's Disability Resource Office.

Non-Discrimination Policy

NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <https://oied.ncsu.edu/divweb/>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

The University of North Carolina at Asheville is committed to equality of educational experiences for students and is an Equal Employment Opportunity employer. UNC Asheville will not discriminate against students, applicants or employees on the basis of race, color, religion, sex, sexual orientation, genetic information, national origin, age, disability, political affiliation or any other legally protected status with respect to all terms, conditions or privileges of university-sponsored activities, employment and the use of university facilities.

Bullying will not be tolerated in the Joint NCSU/UNCA Engineering Programs.

Promoting Gender Equity; Addressing Sexual Misconduct

UNC Asheville is dedicated to cultivating and maintaining a safe, respectful, and inclusive environment, free from harassment and discrimination. We strive to ensure that all have equal access to the educational and employment opportunities the University provides. If you or someone you know has been affected by sexual misconduct, including sexual or gender-based harassment, sexual assault, dating or domestic violence, or stalking, please know that help and support are available. UNC Asheville strongly encourages all members of the community to take action, seek support, and report incidents of sexual harassment to the Title IX Office. You may contact the Title IX Office or Heather Lindkvist, the Title IX Coordinator, directly at (828) 232-5658 or at titleix@unca.edu. Learn more by visiting <https://titleix.unca.edu/>.

As a faculty member, I am a "responsible employee" and private resource. This means that if you share any information or discuss an incident with me regarding sexual or gender-based harassment, I must disclose this information to the Title IX Coordinator. Our goal is to ensure you are aware of the range of options available to you and have access to the resources you may need.

If you wish to speak with a confidential resource, contact University Health and Counseling Services at (828) 251-6520. Off-campus confidential resources include Our Voice (24-Hour Hotline at (828) 255-7576) and HelpMate (24-Hour Hotline at (828) 254-0516).

Health and Well-Being Resources

These are difficult times, and academic and personal stress is a natural result. Everyone is encouraged to take care of themselves. If you need additional support, there are many resources on campus to help you:

- Health and Counseling Center: (<https://healthandcounseling.unca.edu/>)
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the UNCA CARE and Crisis team:
(<https://dos.unca.edu/referring-a-concern/concerned-about-a-fellow-student/>)
- If you or someone you know are experiencing food, housing, or financial insecurity, please contact the UNCA Dean of Students (<https://dos.unca.edu/>).

Other Important Resources

- <https://engineering.unca.edu/>
- Learning with Moodle, a student's guide to using Moodle:
<https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>

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