

MAE 201 Thermal-Fluid Sciences (Engineering Online)
Course Syllabus: Summer II 2025

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Office Hours:	by appointment

1. **Course Description:** An integrated introduction to the concept of energy and the laws governing the transfers and transformations of energy and momentum. Emphasis on thermodynamic properties and the First and Second Law analysis of systems and control volumes, internal flows and heat transfer in simple geometries.
2. **Prerequisite:** [MA 242](#), [PY 208](#) or [202](#)
3. **Course Objectives:** The objective of this course is to introduce students to the importance of fluid mechanics and thermodynamics, its relevance in the practical world, and teach them the principles and techniques which are used to solve real world problems. Upon completing the course, students will be able to:
 - a. Understand and apply the principles/laws of thermodynamics to calculate various parameters of interest such as pressure (P), temperature (T), volume (V), energy transfer, etc.
 - b. Determine property data from thermodynamic tables.
 - c. Sketch P-V, T-V, and P-T plots, which will then visualize the behavior of pure substances.
 - d. Carry out energy analysis in open and closed systems involving ideal gases and real gases as working fluids.
 - e. Understand the second law of thermodynamics and the working of heat engines, heat pumps and refrigerators; Calculate efficiency and coefficient of performance.
 - f. Understand the working of a few important power and refrigeration cycles.
 - g. Understand the basics of different types of fluid flow.
 - h. Understand the basic principles of fluid statics, buoyancy and stability.
 - i. Apply Bernoulli's equation for practical flow problems.
 - j. Carry out pressure drop and head loss analysis in internal flows.
 - k. Understand the different modes of heat transfer such as conduction, convection and radiation and carry out heat transfer analysis in simple systems.

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4. Course Outline:

- a. Introduction to thermal and fluid sciences; Relevance and applications.
- b. Basic concepts of thermodynamics and thermodynamic laws
- c. Properties of pure substances
- d. Forms of energy, energy transfer and analysis
- e. Energy analysis of open and closed system
- f. Second law of thermodynamics; Introduction to Entropy
- g. Power and refrigeration cycles
- h. Basic concepts of fluid mechanics
- i. Introduction to fluid statics and dynamics
- j. Internal flow
- k. Modes of heat transfer
- l. Heat transfer analysis in simple systems

5. Course Requirements:

- Number of assignments: 4; 50 points each; Lowest grade will be dropped
- Number of Quizzes: 5; 10 points Each; Lowest grade will be dropped
- Test 1: 50 points
- Test 2 (Final exam): 100 points

Course Total: 150 (Assignments) + 40 (Quizzes) + 50 (Test 1) + 100 (Test 2) = 340 points

6. Textbooks:

- Y.A. Cengel, J.M. Cimbala and R.H. Turner, Fundamentals of Thermal-Fluid Sciences, 5th Edition, The McGraw Hill Companies, New York, 2017. E-book will be provided by the instructor.
- Y. A. Çengel, M. A. Boles and Mehmet Kanoglu, Thermodynamics: an Engineering Approach, 10th Ed, The McGraw Hill Companies, New York, 2023. Earlier available

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editions will also work. Property tables booklet to accompany Thermodynamics, an engineering approach if borrowed from the library.

- Y.A. Cengel and J.M. Cimbala, Fluid Mechanics: Fundamentals and Applications, 4th Edition, The McGraw Hill Companies, New York, 2018. Earlier available editions will also work.

7. Software Requirements: Moodle will be used for this course. Other than that, no other software will be needed.

8. Calculators

Hewlett Packard – HP 33S, Casio – FX 115MS or FX 115MSPlus, Texas Instruments – TI 30X IIS, Texas Instruments – TI 36X SOLAR

9. Class Schedule and Required Reading (from the provided e-book)

Week	Topic	Reading
1	• Overview of thermal fluid sciences and application • Basic concepts of Thermodynamics • Temperature, Zeroth Law and Pressure • Forms of Energy, Energy Transfer and 1st law of Thermodynamics • Properties of Pure Substances	1-1 through 1-6 2-1 through 2-5 2-6 through 2-8 3-1 through 3-7 4-1 and 4-2
2	• Phase change process of pure substances and its property diagrams; Property tables • Ideal gas law and its deviation • Energy analysis of closed system • Energy analysis of open systems (control volumes) • Energy analysis of steady flow systems	4-3 through 4-5 4-6 through 4-7 5-1 through 5-4 6-1 and 6-2 6-3 through 6-4
3	• Second law of thermodynamics and Heat Engines • Refrigerators, Heat Pumps, Carnot cycle, Carnot Heat Engine • Entropy, Entropy change of pure substances, Isentropic processes, T-dS relations • Introduction to power cycles- Otto cycle, Diesel cycle, Ideal Rankine cycle	7-1 through 7-3 7-4 through 7.7, 7.9 8.1 through 8-4, 8-6 through 8-7 9-1 through 9-6, 9-10, 9-12

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	Refrigeration and Heat Pump, Reversed Carnot cycle, Ideal vapor compression refrigeration cycle	9-14 through 9-16
4	- Classification of fluid flows and fluid properties - Fluid Statics, Hydrostatic forces on submerged bodies, buoyancy and stability - Bernoulli and Energy Equation - Momentum analysis of flow systems - Internal flow in pipes, Head Loss	10-2, 10-3, 10-4 11-1, 11-3 and 11-4 12-1 and 12-2 13-1 through 13-3 14-1 through 14-5
5	- Heat Transfer- Conduction, Convection and Radiation and its mechanism - Steady State Heat Conduction - Forced and Natural Convection - Radiation Heat Transfer	16-1 through 16-5 17-1 through 17-4 19-1 through 19-3 (upto isothermal flat plate), 20-1, 20-2 (only Grashof number), 20-3 (upto eq. 20.18), Table 20.1 (selected, to be discussed in class) 21-1 through 21-5 (upto page 900); View factor tables not needed; 21-6

10. Assignment and Test Schedule

All assignments and quizzes will be posted on Moodle and needs to be submitted on Moodle. All exams will be open book/notes.

Assignments	Open Date	Close Date
1	6/27/2025, 8:00 am	7/4/2025, 8:00 am
2	7/4/2025, 8:00 am	7/11/2025, 8:00 am
3	7/11/2025, 8:00 am	7/18/2025, 8:00 am
4	7/18/2025, 8:00 am	7/25/2025, 8:00 am
Quizzes		
1	6/27/2025, 8:00 am	6/30/2025, 8:00 am
2	7/4/2025, 8:00 am	7/7/2025, 8:00 am
3	7/11/2025, 8:00 am	7/14/2025, 8:00 am
4	7/18/2025, 8:00 am	7/21/2025, 8:00 am
5	7/25/2025, 8:00 am	7/28/2025, 8:00 am

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Tests (Proctor Needed)	Date
1	7/14/2025
2	7/29/2025

11. Grading

The final grade will be determined as follows:

Letter	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
Highest, %	100.0	96.9	92.9	89.9	86.9	82.9	79.9	76.9	72.9	69.9	66.9	62.9	59.9
Lowest, %	97.0	93.0	90.0	87.0	83.0	80.0	77.0	73.0	70.0	67.0	63.0	60.0	0

12. Late submissions, extensions

Late submissions are accepted only with excused absence letters; the reasons are mentioned under section 3 in [NCSU Excused Absence Policy](#). It is the student's responsibility to inform the instructor and discuss the most appropriate action. Work that is late due to any other reason will not be accepted. Without any absence letter, each student might be able to receive one extension on any assignment for the semester if the extension request is submitted before the deadline.

13. Incomplete grades, withdrawals

Information on incomplete grades can be found at [grades and grade point average](#). If you encounter a serious disruption to your work not caused by you and you would have otherwise successfully completed the course, contact your instructor as soon as you can to discuss the possibility of earning an incomplete in the course for the semester, including an agreement on when the remaining work must be done in order to change the grade to the appropriate letter grade. If you must withdraw from a course or from the University due to hardship beyond your control, see [withdrawal process and timeline](#) for information and instructions.

14. Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct in [Office of Student Conduct](#). Therefore, students are required to uphold the Pack Pledge: "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. Please refer to the [Academic Integrity](#) web page for a detailed explanation of the

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University's policies on academic integrity and some of the common understandings related to those policies.

15. Student Resources

Academic and Student Affairs maintains a website with links for student support on campus, including academic support, community support, health and wellness, financial hardship or insecurity, and more [find help on campus](#).

16. Statement for students with disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (NCSU [REG 02.20.01](#)).

17. Syllabus Modification

With advanced notice, the course content, class schedule and assignment/quiz/test schedule may be altered to accommodate the goals and needs of the course.