Principles of Thermodynamics II
(ME 3102)
Milwaukee School of Engineering
Fall 2018

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Office location: **S-146 (Northeast Corner of Science Building)**
Required textbook: Thermodynamics: An Engineering Approach, 8th Edition, by Cengel & Boles, McGraw Hill. Text has an online learning center at http://www.mhhe.com/cengel-boles

Prerequisite: ME 2101 Principles of Thermodynamics I

Course Description: This is a continuation of introductory thermodynamic concepts for mechanical engineering students. The course begins with a detailed treatment of entropy and the second law of thermodynamics. Isentropic efficiency, irreversibility and exergy are covered. Thermodynamic principles are applied to the study of gas power cycles, vapor power cycles, and refrigeration cycles. Thermodynamic performance parameters are used to characterize the cycles, including a discussion of energy use and environmental impacts.

Related Program Student Learning Outcomes:

This course addresses student outcomes of MEv11.0 by producing graduates who have:

(a) an ability to apply knowledge of mathematics, science, and engineering
(e) an ability to identify, formulate, and solve engineering problems
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
(l) ability to work professionally in both thermal and mechanical systems areas

Course Outcomes:
Upon successful completion of this course, the student will:

- Explain the different statements of the 2nd Law of Thermodynamics
- Determine when the 2nd Law is violated in hypothetical engineering scenarios
- Interpret processes and cycles on T-s and P-v diagrams
- Apply a 2nd Law analysis (entropy balance) to processes involving both closed and open systems
- Evaluate the performance of Rankine and Brayton cycles, with their modifications
- Analyze refrigeration cycles
- Relate energy conversion efficiency to emissions and economics

Course Topics:

- Heat engines and thermal efficiency
- Kelvin Planck statement of the 2nd Law
- Refrigerators, heat pumps and coefficient of performance
- Clausius statement of the 2nd Law
- Perpetual motion machines
- Reversible and irreversible processes
- Carnot cycle and Carnot principles
- Carnot heat engine, refrigerators, and heat pumps
- Entropy
- Entropy change of pure substances
- Isentropic processes
- T-s diagrams
- Statistical thermodynamics interpretation of entropy
- Tds relations
- Entropy change of solids, liquids and ideal gases
- Isentropic efficiency of steady flow devices
- Entropy balances on open and closed systems
- Exergy
- 2nd Law efficiency
- The decrease in exergy principle
- Carnot cycle
- Air-standard assumptions
- Brayton cycle
- Brayton cycle performance modifications including regeneration, reheating, and intercooling
- Carnot vapor cycle
- Ideal vs. Actual Rankine cycle processes
- Rankine cycle performance modifications inlcuding, reheating and regeneration
- Cogeneration and Combined gas-vapor power cycles
- Reversed Carnot cycle
- Ideal and actual vapor-compression refrigeration cycles

Methods of Assessing Student Learning Outcomes: quizzes, in-class exam, and a final exam

Letter Grades (This is a rough guideline. Grade determination will be discussed further in class.)

Letter Grade	% Equivalent
A	93-100
AB	87-93
B	80-87
BC	75-80
C	70-75
CD	65-70
D	60-65
F	0-60

Grade Calculation	
Quizzes (4) and homework	65 %
Final exam	35 %

Homework:
Homework will assigned periodically. I will often give a set of suggested problems that the quizzes will be based on.

In-Class quizzes:
Quizzes will be closed book/closed notes/closed laptop. You will be allowed one side of an 8.5”x11” sheet of paper for formulas and notes. Calculators are allowed.

A Note Regarding Exam and Quiz Problems:
ALWAYS circle your answers and ALWAYS express them in the appropriate units! In general, be careful about units and always include them in the answer. ***I will deduct points on correct numerical answers if units are not handled appropriately (they should be shown on every number that has units in a calculation!).***

Final Exam:
The final exam will be comprehensive. You will be allowed 2 sides of an 8.5”x11” sheet of paper for formulas and notes.

Attendance, Participation and Class Decorum:
Students are expected to attend lectures regularly and to participate fully in class discussions. Attendance in class is to your advantage. I will not take attendance & you will not be penalized for missing class, but certain important material and examples given here will **not** be in the textbook. Your level of effort will be used to determine borderline grades. Attendance is a factor in gauging your level of effort. **I will not drop students from the class for not attending.** If you desire to drop the course, you must do so with the university registrar.

Regarding Collaboration and Academic Honesty:
You may discuss assignments with the professor and with other students in the class, but you **must** do and submit your own work. You **must** write up your homework **independently,** unless you are specifically directed to do an assignment in a group. You may not examine the finished written work of other students, including those of a previous class. You are expected to conform to the MSOE code for academic honesty. Violation of this policy will result in ***grades of zero*** on the corresponding exam and/or assignment. Thus, the result may be an ***F for the course***. Per MSOE policy, you cannot drop the course to avoid the grade penalty for cheating. Further, cheating students will be reported to the Department Head and the VP of Academics. If you cheat you risk ***expulsion*** from MSOE.

Examples of cheating:

-copying lab reports or assignments from another student
-copying lab solutions or assignments from a website
-copying from another student on an exam
-permitting another student to copy from you on an exam, homework assignment, or lab report
-copying lab reports or assignments from previous terms
-copying lab solutions or assignments from a solutions manual or from previously distributed solutions
-copying a lab solutions or assignments from a student who is solving the problem for others in a group setting

Bottom line--Any time you represent the work of others as your own you are cheating.

Missed Exams and Quizzes:
A student will receive a zero on any exams and quizzes that are missed without a legitimate excuse (e.g. documented illness, family tragedy, etc.).

Tentative Schedule

Week 1	Course Overview, Review of Thermo. I	
Week 2	Chapter 6: Second Law of Thermodynamics	
Week 3	Chapter 6: Second Law of Thermo.	Quiz 1
Week 4	Chapter 7: Entropy	
Week 5	Chapter 7: Entropy	Quiz 2
Week 6	Chapter 8: Exergy	
Week 7	Chapter 9: Gas Power Cycles (Brayton)	
Week 8	Chapter 9: Gas Power Cycles (Brayton) Chap. 10: Vapor and Combined Power Cycles (Rankine)	Quiz 3
Week 9	Chap. 10: Vapor and Combined Power Cycles (Rankine)	
Week 10	Chapter 11: Refrigeration Cycles	Quiz 4
	Catch up as required and review	
Final Exam Date and Time to be determined	Review(Q&A) Session, Time and place TBA	

- I will post a comment/suggestion envelope outside my office. Please let me know what you think about the course. I would particularly like to know how you feel about the pace of the course (too fast, too slow, or about right).

For students with documented disabilities, chronic medication conditions and mental health concerns; MSOE provides services to make reasonable accommodations available. If you are a student who requires or anticipates the need for accommodations, please contact Student Accessibility Services Office at 414-277-7281, by email at moureau@msoe.edu, or in person at K250 to discuss appropriate accommodations and eligibility requirements.

