MEEN 315, Principles of Thermodynamics, sec. 505

Spring 2017

Instructor:	Mitchell Paulus	**Time:**	MWF 4:10-5:00 PM
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Required or Elective: Required course.

Objectives/Catalog Description: (3-0) Credit 3. Theory and application of energy methods in engineering, energy transfer by heat, work and mass; thermodynamic properties; analysis of open and closed systems; the second law of thermodynamics and entropy; gas, vapor and refrigeration cycles; and applications.

Class/Laboratory Schedule: Three 50 minute sessions per week, taught in lecture style. Project and problem-solving teaming emphasized. Teams of three or four are organized for out-of-class exercises.

Office Hours: Mon. 5-6, Tues. 11-12, Wed. 3-4, or by appointment.

Main References: This is a restricted list of various interesting and useful books that will be touched during the course. You need to consult them occasionally.

- Moran, Shapiro, Boettner and Bailey. 2014. *Fundamentals of Engineering Thermodynamics, 8th edition.*

Prerequisites: MEEN 221 or MEEN 225 (Engineering Mechanics), and MATH 251 or 253 (Engineering Mathematics III). It is the student's responsibility to ensure proper requirements are satisfied for enrollment in this course. Students not meeting course pre-requisites will be automatically dropped after the first week of class.

Course Learning Outcomes: At the end of the course, students should be able to:

1. look up thermodynamic properties in tables;
2. construct pressure-temperature, pressure-volume, or temperature-volume phase diagrams for pure substances;
3. indicate a process on an appropriate phase diagram;
4. use compressibility charts;
5. calculate expansion/compression work in a closed system;
6. apply conservation of energy to a closed system to determine heat transfer, work, or property changes;
7. use conservation of mass to determine change in mass of a system;
8. apply conservation of energy to an open system to determine heat transfer, work, or property changes;
9. analyze first law performance of simple engineering devices (valves, turbines, boilers, etc.);
10. determine maximum performance of cycles using the Carnot cycle;

11. identify sources of entropy generation in a system;
12. calculate work for isentropic processes;
13. calculate isentropic efficiencies of simple engineering devices: turbines, compressors, pumps, etc.
14. identify work/heat processes in any arbitrary cycle;
15. estimate work and efficiency for the Otto, Diesel, and Brayton cycles;
16. estimate work and efficiency for the Rankine power cycle;
17. team with other students to solve thermodynamic problems and write a technical paper.

Examinations: Two midterm exams and a comprehensive final exam are scheduled. Unexcused absences will result in a grade of zero for missed examinations. Known absences for a scheduled exam must be brought to the attention of the instructor as soon as possible. The second exam is comprehensive with emphasis on material covered since the first exam. The final exam is comprehensive with emphasis on the material covered since the second exam. YOU WILL NOT RECEIVE YOUR FINAL EXAM, OR A COPY OF YOUR FINAL EXAM, AT THE END OF THE SEMESTER. You may stop by my office to review your graded final exam after establishing an appointment with me.

Grading Policy:

Homework	15%
Quizzes	10%
Attendance	5%
Midterm 1	20%
Midterm 2	20%
Final	30%

Important Dates:

Midterm #1 ..... Feb 22, 7:00-9:00 PM
Midterm #2 ..... April 5, 7:00-9:00 PM
Final Exam ..... TBA

Attendance: Attendance is essential and expected. Short written quizzes will be given the beginning of each class in order to track attendance. A student can miss up to 2 classes and still receive full credit for attendance.

Honor Code: "An Aggie does not lie, cheat, or steal, or tolerate those who do." Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rules does not exclude any member of the Texas A&M University community from the requirements or the processes of the Honor System. For additional information please visit: aggiehonor.tamu.edu

On all course work, assignments, and examinations at Texas A&M University, the following Honor Pledge is implied regardless if it is preprinted and signed by the student: "On my honor, as an Aggie, I have neither given nor received unauthorized aid on this academic work."

ADA: The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that

all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 9798451637. For additional information, visit http://disability.tamu.edu.

Contribution to Meeting Requirement of Criterion 5:

Subject	Semester hrs	Subject	Semester hrs	Subject	Semester hrs
Mathematics		Engineering Science	3	General	
Basic Science		Engineering Design			

Relationship of Course to Program Outcomes

1. **ability to apply knowledge of mathematics, science and engineering**
2. ability to design and construct experiments, as well as to analyze and interpret data
3. ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. **ability to function on multi-disciplinary teams**
5. **ability to identify, formulate and solve engineering problems**
6. understanding of professional and ethical responsibility
7. ability to communicate effectively
8. broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. recognition of the need for, and an ability to engage in life-long learning
10. knowledge of contemporary issues
11. ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Tentative Schedule

Lecture	/Week		Date	Topic (Lecture Coverage)	Text Coverage	Notes
1	1	W	18-Jan	Introduction, Concepts and Definitions		HW 1 Out
2	1	F	20-Jan	Units, Dimensions, Volume, Pressure		
3	2	M	23-Jan	Temperature, Problem Solving Methodology		
4	2	W	25-Jan	Mechanical Concepts of Energy, Basic Work Processes		HW 1 DUE; HW 2 Out
5	2	F	27-Jan	Energy Transfer by Heat, Closed System Energy Balance		
6	3	M	30-Jan	Cycle Energy Analysis		
7	3	W	1-Feb	Phases, Fixing the State		HW 2 DUE; HW 3 Out
9	3	F	3-Feb	Using Tables for Pressure, Temperature, and Specific Volume		
10	4	M	6-Feb	Using Tables of Energy and Enthalpy, Energy Balance with Properties		HW 3 DUE; HW 4 Out.
11	4	W	8-Feb	Specific Heats, Evaluating Properties of Solids and Liquids		
12	4	F	10-Feb	General Compressibility Charts and Ideal Gas Model		
13	5	M	13-Feb	Property Changes and Energy Balances of Ideal Gases		HW 4 DUE, HW 5 Out (HW5 material is covered on Exam 1)
14	5	W	15-Feb	Polytropic Processes		End of Exam 1 Material (through Lecture 14). Sample exam posted online.
15	5	F	17-Feb	Conservation of Mass		
16	6	M	20-Feb	Control Volume Conservation of Energy and Steady-State Analysis		HW 5 DUE.
		W	22-Feb	Optional Review in Class		
17	6	W	22-Feb	**EXAM 1**		EXAM 1 (7 - 9 PM), Location TBA
18	6	F	24-Feb	Nozzles and Diffusers		
19	7	M	27-Feb	Turbines, Compressors, and Pumps		HW 6 Out.
20	7	W	1-Mar	Heat Exchangers and Throttling Devices		
21	7	F	3-Mar	System Integration and Transient Analysis		
22	8	M	6-Mar	Introducing the Second Law, Statements of the Second Law		HW 6 DUE; HW 7 Out
23	8	W	8-Mar	Irreversible and Reversible Processes, Interpreting the Kelvin Plank Statement		
24	8	F	10-Mar	Second Law applied to Thermodynamic Cycles, Heat Engines		
				SPRING BREAK MAR. 13-17		
25	9	M	20-Mar	Refrigeration / Heat Pumps, Maximum Performance		HW 7 DUE; HW 8 Out
26	9	W	22-Mar	Carnot Cycle and Clausius Inequality		
27	9	F	24-Mar	Entropy and Property Data		
28	10	M	27-Mar	TdS Equations, Entropy Changes for Solids and Liquids		HW 8 DUE; HW 9 Out (HW 9 material is covered on Exam 2).

Lecture	Week		Date	Topic (Lecture Coverage)	Text Coverage	Notes
29	10	W	29-Mar	Entropy Changes of Ideal Gases, Internally Reversible Closed Processes		End of Exam 2 material (through Lecture 29). Sample exam posted online.
30	10	F	31-Mar	Closed System Entropy Balance		
31	11	M	3-Apr	Increase in Entropy Principle		HW9 DUE
		W	5-Apr	Optional Review in Class		
32	11	W	5-Apr	**EXAM 2**		EXAM 2 (7 - 9 PM), Location TBA
33	11	F	7-Apr	Control Volume Entropy Equation, Steady State Analysis		
34	12	M	10-Apr	Isentropic Processes, Isentropic Efficiencies		HW 10 Out.
35	12	W	12-Apr	Rankine Vapor Power Cycle		
		F	14-Apr	**Reading day, Good Friday, no class.**		
36	13	M	17-Apr	Rankine Vapor Power Cycle		
37	13	W	19-Apr	Gas Power Cycles		HW 10 DUE; HW 11 Out.
38	13	F	21-Apr	Gas Power Cycles		
39	14	M	24-Apr	Refrigeration and Heat Pump Cycles		
40	14	W	26-Apr	Refrigeration and Heat Pump Cycles		
41	14	F	28-Apr	Cushion	Notes	
42	15	M	1-May	Conclusion, Course Evaluation	Notes	HW 11 DUE.
43	15	T	2-May	Redined Day		
				Final Exam Review		TBD
				FINAL EXAM		TIME (Room: Ordinary Classroom).