University of Hawaii at Manoa
Department of Mechanical Engineering

ME 311 – Thermodynamics
Spring 2009

Instructor

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Office Hours: Wed 12:30-1:30 pm

Prerequisites

- MATH 244
- PHYS 170

Course description

This course introduces basic concepts of engineering thermodynamics, including Laws of Thermodynamics, concepts of work, heat, and entropy, properties of pure simple substances, ideal gases, and introduction to power and refrigeration cycles.

Course objectives

By the end of this course, the students are expected to:

- Be able to think in terms of thermodynamics
- Be familiar with the First and Second Laws of Thermodynamics
- Develop the ability to apply the Laws of Thermodynamics to practical engineering problems
- Develop problem solving skills in energy-related areas
- Understand the underlying principles behind current environmental and societal problems related to energy

Textbook

Fundamentals of Engineering Thermodynamics, 6th Ed., by M. J. Moran, and H. N, Shapiro

Topics

- Basic concepts — Ch. 1
- The 1st law of thermodynamics — Ch. 2
- Evaluating properties of pure substances — Ch. 3
- Control volume analysis — Ch. 4
- The 2nd law of thermodynamics — Ch. 5
- Entropy — Ch. 6
- Engineering applications of thermodynamics
  - Vapor power systems — Ch. 8.1-8.3, 8.4*
  - Gas power systems* — Ch. 9.5, 9.6, 9.9
  - Refrigeration and heat pump systems — Ch. 10.1-10.3, 10.6
- Special topic: surface thermodynamics

* will be covered only if time permits.

Course schedules

Lectures: Monday, Wednesday, Friday 10:30-11:20 am — at MSB 100
Problem solving: Monday 3:30-4:20 pm — at MSB 100

Course website

PDF files of lectures, solutions of homework, handouts are available at myUH portal.

Other online resources

www.wileyplus.com
Sections of "Prepare and present" and "Read, Study and Practice" (Thermonet)
Software: Interactive Thermo (IT) 3.0

Exams and Grading

- Homework — 10%
- Three in-class close-book exams
  - Chs 1 and 2 — 20%
  - Chs 3 and 4 — 20%
  - Chs 5 and 6 — 20%
- Final exam (all materials covered) — 30%

Homework

Weekly homework is due on each Monday at noon (12:00 pm). You can either turn in your homework in the morning lecture or leave it in a box, labeled ME311, outside my office, Post-207.

Lecture schedules

Date			Topic	Text	HW
Jan			Part I. Chapters 1&2 (8+2+1+1 lectures)		
(7)	12	M	1. Course outline & Introduction		
	14	W	2. Basic concepts	Ch.1.1-4	
	16	F	University Emergency Close (no lecture)		
	19	M	Martin Luther King Jr. Day (no lecture)		#1: Ch.1
	21	W	3. Intensive properties	Ch.1.5-9	10,24,26,27,31,37 ,42,47,51,55
	23	F	4. Introduction to energy and energy balance	Ch.2.1,3,5	#2: Ch.2-1
	26	M	5. Energy transfer by heat	Ch.2.4	3,7,9,11,17,42,43, 47,51,52
	28	W	6. Energy transfer by work	Ch.2.2	
	30	F	7. Energy analysis of cycles	Ch.2.6	#3: Ch.2-2
Feb	2	M	8. Applications of the 1st law of thermodynamics for closed systems	Ch.2.5	31,40,53,56,61, 68,71,72,76,84
(11)	4	W	Review I-1. Basic concepts		
	6	F	Review I-2: Energy balance for CS		
			Part II. Chapters 3&4 (8+3+1 Lectures)		
	9	M	1. Phase, phase equilibrium and transition	Ch.3.1-3	No HW
	11	W	2. p-v-T surface and projections	Ch.3.1-3	
	13	F	1st Midterm exam.: Chapters 1&2		
	16	M	Presidents' Day (no lecture)		
	18	W	Tutorial on 1st midterm		Ex.1: Ch.3
	20	F	3. Water properties – Steam tables	Ch.3.4-6,10	6,7,10,12
	23	M	4. Practice of steam tables		#4: Ch.3-1
	25	W	5. Gas properties – Ideal gas model	Ch.3.9,12-15	17,25,27,42,50,54 ,56,68,70,81
	27	F	6. Mass and energy conservation for control volumes	Ch.4.1-4	#5: Ch.3-2 & Ch.4-1
Mar	2	M	7. Steady-state control volume analysis	Ch. 4.5-11	115,126,129,135; 13,34,48,60,72,94
(10)	4	W	8. Transient-state CV analysis	Ch. 4.	
	6	F	Review II-1: Energy balance for CV		#6: Ch.4-2
	9	M	Review II-2: Water		100,102,106,110, 111,118
	11	W	Review II-3: Ideal gases		
			Part III. Chapters 5&6 (8+3+1 Lectures)		
	13	F	1. 2nd law of thermodynamics	Ch.5.1-4	
	16	M	2. Applying 2nd to cycles	Ch.5.5-8	No HW
	18	W	2nd Midterm exam.: Chapters 3&4		
	20	F	3. Evaluating performance of cycles	Ch.5.9-11	#7: Ch.5

	23	M	Spring Recess (no lectures)		
	25	W			
	27	F			
	30	M	1. Introduction to entropy (Afternoon: Tutorial on 2nd midterm)	Ch. 6.1,2,8	19,20,26,35,38,43 ,63,67,75, 77
Apr (12)	1	W	2. Entropy change-1 (Tds correlations)	Ch. 6.3-6	
	3	F	3. Entropy change-2 (T-s diagrams)	Ch. 6.3-6	#8: Ch.6
	6	M	4. Entropy balance	Ch. 6.7, 9, 10, 13	28,32,35,36,45,66 ,72,82,100,110
	8	W	5. Isentropic processes	Ch.6.11-12	
	10	F	Good Friday (no lecture)		
	13	M	Review III-1: 2nd law		Ex.2:Ch.6
	15	W	Review III-2: entropy		122,135,146
	17	F	3rd Midterm exam.: Chapters 5&6		
			Part IV. Applications (4 Lectures)		
	20	M	1. Vapor power systems (Afternoon: Tutorial on 3rd midterm)	Ch.8.1-3	
	22	W	2. Gas power systems	Ch.9.5,6,9	
	24	F	3. Refrigeration and heat pump systems	Ch.10.1-3,6	#9: Ch. 8-10
	27	M	4.Special topic: surface thermodynamics (Afternoon: concept inventory)		8.6, 17, 20; 9.41, 48, 49; 10.2,24,37
			Part V. Final review (4 Lectures)		
	29	W	Review V-1: system, property		
May (3)	1	F	Review V-2: state, process		
	4	M	Review V-3: cycle		
	6	W	Review V-4: balance		
	11	M	Final exam.		9:45-11:45 am
Tot.			43 lectures		