MEMS 0051 - Introduction to Thermodynamics

Department of Mechanical Engineering and Materials Science
University of Pittsburgh

Spring 2019

Contact Information

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Class Information

- Pre-reqs: PHYS 0150, 0174, 0201 or 0475 and CHEM 0101, 0110, 0111, 0410, 0710, 0760 or 0960.
- Text: Sonntag, Borgnakke, Van Wylen, **Fundamentals of Thermodynamics**, 8^{th} Edition, Wiley, 2013.
- TopHat course: Introduction to Thermodynamics - MEMS 0051. Join code: 157932. Course password: 1060.

Course Description

- To introduce students to the First and Second Laws of Thermodynamics for open and closed systems (i.e. energy, work, heat and entropy).
- To build upon the fundamentals and introduce calculus-based thermodynamics.

  The chapters from the text will be covered in the following manner:

  - Chapter 1: Introduction
  - Chapter 2: Properties of Pure Substance
  - Chapter 3: First Law of Thermodynamics and Energy
  - Chapter 4: Energy Analysis for a Control Volume
  - Chapter 5: Second Law of Thermodynamics
  - Chapter 6: Entropy
  - Chapter 7: Second Law Analysis for a Control Volume

Grading Policy

- The grading scheme is as follows:
  1. Homework: 15%
  2. Quizzes: 15%
  3. Midterm 1: 20%
  4. Midterm 2: 20%
  5. Final: 30%

- The grading scale is as follows:

Numeric Score	Letter Grade	Numeric Score	Letter Grade
98-100	A+	78-79.$\overline{9}$	C+
92-97.$\overline{9}$	A	72-77.$\overline{9}$	C
90-91.$\overline{9}$	A-	70-71.$\overline{9}$	C-
88-89.$\overline{9}$	B+	68-69.$\overline{9}$	D+
82-87.$\overline{9}$	B	62-67.$\overline{9}$	D
80-81.$\overline{9}$	B-	60-61.$\overline{9}$	D-
		0-59.$\overline{9}$	F

Class Schedule

Week	Date	Lecture	Topic	Homework	Quiz	Section(s)
1	7-Jan		Syllabus			
	9-Jan	1	Introductory Material, Conservation of Mass			1.1-1.6, 3.13
	11-Jan	2	Introductory Material Continued			1.7-1.11
2	14-Jan	3	Substances and P-v-T			2.1-2.3
	16-Jan	4	Thermodynamic Tables			2.4, 2.6-2.7
	18-Jan	5	Two-Phase Systems	#1		2.5
3	21-Jan		Dr. Martin Luther King's birthday			
	23-Jan	6	Ideal Gas and Compressibility		#1	2.8-2.9
	25-Jan	7	Energy and the 1^{st} Law of Thermodynamics	#2		3.1-3.2
4	28-Jan	8	Energy, Work and Heat			3.1, 3.3, 3.5
	30-Jan	9	Evaluation of Work, Conservation of Mass		#2	3.4, 3.13
	1-Feb	10	Internal Energy and $C_\forall$ Specific Heat	#3		3.7, 3.10
5	4-Feb	11	Enthalpy and C_P Specific Heat			3.9, 3.10
	6-Feb	12	U, H and C of Ideal Gases		#3	3.11
	8-Feb		Review for Midterm #1	#4		
6	11-Feb	13	HE, Refrigerators and the 2^{nd} Law			5.1, 5.2
	13-Feb	14	Reversibility and Irreversibility		#4	5.3, 5.4
	15-Feb		**Midterm #1**			
7	18-Feb	15	The Carnot Cycle and it's Propositions			5.5, 5.6
	20-Feb	16	Thermodynamic & Ideal Gas Temp. Scales			5.7, 5.8
	22-Feb	17	Ideal vs. Real Machines	#5		5.9
8	25-Feb	18	The Clausis Inequality			6.1
	27-Feb	19	Entropy as a Property and of a Substance		#5	6.2, 6.3
	1-Mar	20	Entropy of Reversible Processes	#6		6.4
9	4-Mar	21	Entropy Change of Solids, Liquids and Gases			6.5-6.8
	6-Mar	22	Entropy Change, Generation and Increase		#6	6.9-6.12
	8-Mar		Review for Midterm #2	#7		
10	11-Mar		Spring Break			
	13-Mar					
	15-Mar					
11	18-Mar	23	C.O.M. and Energy for a C.∀.,			4.1, 4.2
	20-Mar	24	C.O.E. for Steady State, Nozzles/Diffusers		#7	4.3, 4.4
	22-Mar		**Midterm #2**			
12	25-Mar	25	Pumps and Turbines			4.4
	27-Mar	26	Heat Transfer Devices			4.4, 4.5
	29-Mar	27	Cycles	#8		4.4
13	1-Apr	28	Second Law for C.∀.			7.1
	3-Apr	29	2^{nd} Law: Nozzles/Diffusers		#8	7.2
	5-Apr	30	2^{nd} Law: Pumps and Turbines	#9		7.2
14	8-Apr	31	2^{nd} Law: Heat Transfer Devices			7.2
	10-Apr	32	Increase of Entropy Principle		#9	7.4
	12-Apr	33	Efficiency	#10		7.5
15	15-Apr	34	Special Topics			
	17-Apr	35	Special Topics		#10	
	19-Apr		Review for Final Exam	#11		
16	22-Apr		Final Exam Week			
	24-Apr					
	26-Apr					

Student Expectations

- Homework deadlines will be found on the top of assignment and on the course schedule. Homework is due at the beginning of class on the day due. Late homework will not be accepted.
- Homework is to be done on the assigned class homework submission sheet. Your name, the date, class and assignment number, and page numbers, should appear in the proper fields. Homework assignments are to be stapled in the top left hand corner; paper-clips, folded edges or paper-tears will result in only the first page of the homework being graded. Each problem is to be clearly numbered, with the solution boxed. Work should be clear and coherent, starting from problem givens, working through the methodology and arriving at a clear solution. Homework is a representation of your work - it should be neat, clean and clear. Your work should follow a logical flow and provide substantiation for your results.
- Only 3 questions from the homework assignments will be selected at random and graded; the entire assignment will not be graded, thus it is important to completely answer each question.
- Graded homework, quizzes and exams will be redistributed the following week. Uncollected homework will placed in the hanging folder outside room 204 and will remain there for one week. If the assignment is still uncollected, it will go into storage and will only be accessible during office hours.
- Statute of limitations - upon redistributing graded assignments, you have two weeks to bring up any potential grading issues. After the two week period, your assignment will not be re-evaluated.
- Quizzes will be issued the Wednesday following homework submission, giving sufficient time to review the posted homework solutions. Quizzes will be issued during the last 10 minutes of class.

Helpful Hints

- Read the assigned chapters (completely), work through the practice problems and start the homework early! This way, when you encounter a problem with obtaining a solution or understanding a concept, you will have time to seek assistance and resolve the problem.
- Class attendance is strongly recommended (in addition to homework submission and quizzes).
- Working together and discussion amongst yourselves is encouraged - in research and industry you rarely work alone - however, you are expected to do your own work and submit your own assignments.
- I am available for help through office hours, email or phone (worst case scenario). If you are struggling, please seek assistance immediately before things get out of control.

Policies

- No makeup quizzes or tests will be given without extenuating circumstances or prior approval. If you are anticipating you will miss an exam for a legitimate reason, you must reschedule the exam two weeks prior to the originally scheduled data.
- Please be respectful - no talking, eating drinking or playing on your phone. Please silence your phones.

Disability Resource Services

If you have a disability for which you are or may be requesting and accommodation, please contact both me and Disability Resources Services, 216 William Pitt Union, (412) 648-7890/(412) 383-7355 (TTY), as early as possible in the term. DRS will verify your disability and determine reasonable accommodations for this course. Their website is http://www.drs.pitt.edu.

Academic Integrity

Students are expected to comply with the University of Pittsburgh's Policy on Academic Integrity , which is found at http://www.as.pitt.edu/fac/policies/academic-integrity. Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. To foster a high level of academic integrity,

the MEMS Department has recently established a coordinated and uniform approach to dealing with violations of academic regulations against cheating and plagiarism. This approach involves disciplinary actions that increase in severity with number of instances a student has been found in violation of academic integrity. The Mechanical Engineering and Materials Science department has the following policy:

- The penalty for the first offense for plagiarism or cheating will be a zero on the assignment(s).
- The penalty for a second offense will be a zero on the assignment(s) plus the loss of one letter grade from their final grade.
- From there, you will be referred up to higher authorities (undergraduate director, department chair, associate dean of academic affairs, etc.).

Diversity and Inclusion

We ask that everyone in the class strive to help ensure that other members of this class can learn in a supportive and respectful environment. No form of harassment (e.g. racist or sexist jokes) will be tolerated in my class, particularly if directed against a student's gender, sexual orientation, race, etc. If you experience or witness harassment or discrimination inside or outside of this class, please contact the Title IX Coordinator by calling 412-648-7860, or e-mailing titleixcoordinator@pitt.edu. You may also choose to report incidents to me; however, I am required to communicate information about harassment to the University's Office of Diversity and Inclusion. If you wish to maintain complete confidentiality, you may also contact the University Counseling Center (412-648-7930).

By signing and dating the syllabus, you agree to the class, departmental and university policies:

Printed Name: _____

Signature: _____

Date: _____