

MEMS 0051 - Introduction to Thermodynamics

Department of Mechanical Engineering and Materials Science
University of Pittsburgh

Summer 2020 - Term 2207

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**, 8th Edition, Wiley, 2013.
- We will be using TopHat. The course is “MEMS 0051 - Introduction to Thermodynamics”, with join code 830884.
- We will be using Gradescope for all assignments. The course is “MEMS 0051” with entry code 9JJJ7N.

Course Description

- Basic concepts and interlinking relationships of thermodynamics, fluid mechanics and heat transfer; fluid statics; system and control volumes; thermodynamic properties; work and heat; first law of thermodynamics for control mass and control volume; integral forms of conservation of mass and momentum.

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

- Chapter 1: Introduction
- Chapter 2: Properties of Pure Substance
- Chapter 3: 1st Law of Thermodynamics & Energy
- Chapter 4: Energy Analysis for a Control Volume
- Chapter 5: Second Law of Thermodynamics
- Chapter 6: Entropy
- Chapter 7: 2nd Law Analysis for a Control Volume
- Chapter 9: Power and Refrigeration Systems

Grading Policy

- The grading scheme is as follows⁰:
- The grading scale is as follows:

1. Homework: 10%
2. Quizzes: 10%
3. Midterm 1: 20%
4. Midterm 2: 20%
5. Final Project: 10%
6. Final: 30%

Numeric Score	Letter Grade	Numeric Score	Letter Grade
98-100	A+	78-79.9	C+
92-97.9	A	72-77.9	C
90-91.9	A-	70-71.9	C-
88-89.9	B+	68-69.9	D+
82-87.9	B	62-67.9	D
80-81.9	B-	60-61.9	D-
		0-59.9	F

⁰No assignment (homework/quiz/project) will be curved. Exams (midterms/final) may be curved if a single student does not earn a 100%, not including bonus. In the event not a single student earns a 100%, the exam will be curved by the difference of the possible points less the highest points earned by any student. Discretion left to instructors.

Class Schedule¹

Week	Date	Lecture	Topic	Homework	Quiz	Section(s)
1	7-May		Syllabus	0		
		1	Introductory Material, Conservation of Mass			1.1-1.6, 3.13
		2	Introductory Material Continued			1.7-1.11
2	14-May ²	3	Substances and P-v-T	1	0	2.1-2.3
		4	Thermodynamic Tables			2.4, 2.6-2.7
		5	Two-Phase Systems			2.5
3	21-May	6	Ideal Gas and Compressibility	2	1	2.8-2.9
		7	Energy and the 1 st Law of Thermodynamics			3.1-3.2
		8	Energy, Work and Heat			3.1, 3.3, 3.5
4	28-May	9	Evaluation of Work, Conservation of Mass	3	2	3.4, 3.13
		10	Internal Energy and C _v Specific Heat			3.7, 3.10
		11	Enthalpy and C _p Specific Heat			3.9, 3.10
5	4-Jun	12	U, H and C of Ideal Gases	4	3	3.11
		13	HE, Refrigerators and the 2 nd Law			5.1, 5.2
			Midterm #1			
6	11-Jun	14	Reversibility and Irreversibility		4	5.3, 5.4
		15	The Carnot Cycle and it's Propositions			5.5, 5.6
		16	Thermodynamic & Ideal Gas Temp. Scales			5.7, 5.8
7	18-Jun	17	Ideal vs. Real Machines	5		5.9
		18	The Clausis Inequality			6.1
		19	Entropy as a Property and of a Substance			6.2, 6.3
8	25-Jun	20	Entropy of Reversible Processes	6	5	6.4
		21	Entropy Change of Solids, Liquids and Gases			6.5-6.8
		22	Entropy Change, Generation and Increase			6.9-6.12
9	2-Jul ³	23	Increase of Entropy Principle	7	6	7.4
		24	C.O.M. and C.O.E. for a C.V.,			4.1-4.4, 4.6
		25	C.O.E. for Steady State, Nozzles/Diffusers			4.3, 4.4
10	9-Jul	26	C.O.E. for Pumps and Turbines	8	7	4.4
		27	C.O.E. Heat Transfer Devices			4.4, 4.5
			Midterm #2			
11	16-Jul	28	Cycles - Rankine		8	4.4, 9.2
		29	Cycles - Superheat and Reheat Rankine			4.4, 9.4
		30	Cycles - CFWH and OFWH Rakine			4.4, 9.5
12	23-Jul	31	Cycles - Refrigeration	9		4.4, 9.8-9.9
		32	Second Law for C.V.			7.1
		33	2 nd Law: Nozzles/Diffusers			7.2
13	30-Jul	34	2 nd Law: Pumps and Turbines	10	9	7.2, 9.6
			Work on Final Project			
14	6-Aug		Final Exam Week			

¹ Subject to change² May 15th, summer term add/drop period ends³ Summer term monitored withdrawal deadline & final exam conflict submission form deadline

Course Administration

- This course is administered remotely, with a combination of [synchronous](#) and [asynchronous](#) instruction. You are required to be present for the regularly scheduled class time. We ask that you join the regularly scheduled Zoom meeting 5 minutes before the start of class (i.e. 3:55 pm) such that we can let you into the class. You must [register](#) before attending the Zoom meeting. Instructions to register are also posted as announcement on Canvas titled “How to register for Zoom.” Please use your full name (no nick-names) and Pitt email address when registering. Failure to do so will prevent you from participating in office hours and lectures. The meeting password is 615093. This password is not to be shared within anyone not enrolled in the course.
- The lecture videos will be delivered asynchronously, and they can be viewed in Canvas, or on [YouTube](#). You are to watch the lecture videos ahead of class, at your own convenience. For example, Lectures 1 and 2 should be watched ahead of time for the May 7th class. You are to watch the lecture videos, complete the video questions, and work through the example problems prior to attending lecture.
- Class time will be broken down as follows:
 - The first 5-10 minutes will be for announcements.
 - The next 30-45 minutes will be a review, as well as Q&A, of the lectures. Approximately 10 to 15 minutes will be devoted to each lecture and questions pertaining to said lectures.
 - Then, there will be a brief break, approximately 5 minutes.
 - Once we return, we will break into groups to work on the in-class worksheets. These worksheets will be done through TopHat. Your participation in the in-class exercises is required. The instructors and grader will moderate the groups, answering any questions. The in-class exercise sessions will last approximately 50 minutes.
 - Then, there will be another brief break, approximately 5 minutes.
 - After the last break, we will administer the weekly quiz in the remaining 35 minutes. The quiz will be timed, and submitted through Gradescope. The quiz will close at the conclusion of the class (6:30 pm). The quizzes will normally take 10 minutes to complete, but extra time is provided for the submission of the quiz. Accommodations as requested by DRS will be made.
- Communication will be done through various modes:
 - The primary mode of communication will be announcements on Canvas. Announcements posted to Canvas will also be sent out as emails to your primary Pitt email address. Announcements will pertain to things such as the posting of notes and videos, the posting of homework and homework solutions, the posting of quiz and quiz solutions, the posting of exam and exam solutions, the posting of the project description, and any other item of importance, such as EES example scripts. If you do not receive an email before the first class, please check your spam/junk folder.
 - The secondary mode of communication will be through [Slack](#). Slack allows you to communicate with your classmates in a chat-based fashion. We encourage you to utilize Slack to ask questions, answer questions, and to have discussions. The instructors and grader will try to respond to questions posted in Slack in a timely manner. Matters of importance should directly be communicated to the instructors.
 - The tertiary mode of communication will be through email. You can email the instructors and grader directly with questions. Please note the instructors and grader will try to respond to your email in a timely fashion (within an hour), however, do not expect an immediate response if you email your question outside of regularly scheduled office hours. Additionally, do not send multiple emails about the same topic; this will delay the response time.
- Course documents will be posted in Canvas. If you go to “Course>Files”, you will find all the necessary course documents, i.e. the course text, the homework submission sheet, etc. If you go to “Course>Modules”, you will see all the associated files (lecture slides, lecture videos, etc.) for each lecture.
- Exams will not be administered during class, but outside of class. The exams will be administered over the course of a couple of days. The exams will be timed upon opening the document. Exams will be submitted through Gradescope.
- The final project will be released Week 11 and will be due during finals week. You will be using EES to complete the project. You will have familiarity with using EES after the completion of your first midterm.

Student Expectations

- A 3-credit engineering course requires 6-9 hours per week of outside classroom work. This is in the form of reading the corresponding sections from the book ahead of lecture, completing the practices problems in the provided text, and completed recommended problems from the end of the assigned chapters.
- Evaluation tools (homework, quizzes, exams) are designed to test your understanding and mastery of, and ability to critically think about, course content. Your exams will not test your ability to regurgitate material or simply solve an equation, rather, how you can *apply* your knowledge of course concepts and mathematics to *analyze* and solve problems. See [Bloom's taxonomy](#).
- 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. Each problem is to be clearly numbered, with the solution placed in the box in the lower right-hand corner of the submission sheet, on a separate sheet. Units must be included, otherwise the problem will be marked incorrect. 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.
- Statute of limitations - upon grading your assignments, you have two weeks to bring up any potential grading issues. After the two week period, your assignment will not be re-evaluated. If an obvious, objective error is made (i.e. incorrect totaling of your score) is made, contact the instructors or the course grader. If a subjective error arises (i.e. you think more credit is deserved), you must submit a written appeal, which includes the original assignment, a cover page describing the problem and the perceived injustice, and how many points you believe should be awarded. The appeal must be submitted within the statute of limitations.
- Quizzes will be issued the following week of the corresponding homework submission, giving sufficient time to review the posted homework solutions.

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, nay, required. It is your responsibility to keep up with the course material based upon the provided schedule.
- 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.
- The instructors are available for help through virtual office hours, email or phone (worst case scenario). If you are struggling, please seek assistance immediately before things get out of control.

Course Policies

No makeup quizzes or tests will be given without extenuating circumstances or prior approval. If you are anticipating you will miss a quiz or an exam for a legitimate reason, you must reschedule the exam two weeks prior to the originally scheduled data.

University and Department Policies

Disability Resource Services

If you have a disability for which you are or may be requesting an accommodation, please contact both the instructors 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.

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).

Disciplinary Procedures for Student Transgressions

The MEMS Department takes great pride in both the potential and the accomplishments of our current and graduated students. As professionals in training, we view it as essential that students are instilled with a commitment to upholding the highest standards of honesty and integrity. A fundamental canon within the Code of Ethics published by the National Society of Professional Engineers is that engineers "conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession" (<https://www.nspe.org/resources/ethics/code-ethics>). To that end, the following MEMS Department procedures have been created to foster a sense of professional responsibility and to ensure a highly conducive and nonthreatening learning environment.

Academic Integrity

Students are expected to comply with the University of Pittsburgh's Policy on Academic Integrity, which is found through the following link: <http://www.as.pitt.edu/fac/policies/academic-integrity>. Adding to this obligation, and to cultivate a culture of ethical conduct, the MEMS Department has 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. Specifically, 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. A third offense will incur a serious penalty that will be determined on a case-by-case basis, but at a minimum will include a final grade of F. Offenses will be tracked in a student's temporary file in cooperation with other Schools within the University. This file will be destroyed upon graduation. Since classes vary, students are encouraged to seek advice from their professor if there is any question as to what may constitute a violation.

Student Conduct

Students are also expected to comply with the University of Pittsburgh's Student Code of Conduct, which is found through the following link: <http://www.studentaffairs.pitt.edu/conduct>. In particular, it is a violation of conduct when a student "disrupts or prevents the peaceful and orderly conduct of classes, lectures, quiet study, invited speaker presentations, and/or meetings or deliberately with the freedom of any person to express their views." This includes disrespectful conduct displayed by a student towards his or her professor, TA and/or classmate in or out of class. To foster a professional and collegial learning environment, the MEMS Department has established a three-strike approach to dealing with student conduct violations. Specifically, a student's first offense will incur a formal warning letter from the Department Chair (strike one). A second offense will impose a temporary ban on attending the MEMS class in which the conduct violation occurred together with a remedial action (strike two). The remedial action will be determined on a case-by-case basis, but will likely include counseling. A third offense will, at the very least, incur a complete ban on attending the class as well as referral of the case to the University's Office of Student Conduct (strike 3). Campus police will be contacted at 412-624-4040 (4-4040 for on-campus telephones) for any offense that is deemed unmanageable.

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

Printed Name: _____

Signature: _____

Date: _____