

AME 310
Engineering Thermodynamics I
Spring 2019
GFS 101 (TTh 12:30-1:50)

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Office Hours: M 11:00-1:00, W 10:00-12:00 in VHE 202 and by email appointment

Discussion session: 5:00 – 5:50 pm, THH 114, Wednesday

Required Textbook: C. Borgnakke and S. E. Sonntag, *Fundamentals of Thermodynamics*. Current edition is **9th edition** (Wiley, 2017) but **8th edition** (Wiley, 2013) or **7th edition** (Wiley, 2009) can be used as well.

Grading:	Midterm 1	20%
	Midterm 2	20%
	Final	40%
	Weekly Quizzes (5 best of 8)	20%

Examinations:	Midterm 1:	Jan. 31 (Chapters 1-2).
	Midterm 2:	March 7 (Chapters 3-4).
	Final:	May 8 (cumulative with focus on Chapters 5-7).
	Quizzes:	Each Tuesday with the following exceptions: no quiz the first and the last week of classes; no quiz in week 6; no quiz Tuesdays immediately before and after midterm exams. Days with quizzes and exams marked in red in the class schedule.

Remarks:

1. Homework assignments will be given every **Tuesday**. Homework will not be graded but homework problems will be used in weekly exams/quizzes the following Tuesday.

2. All examinations will be open book and a calculator ONLY. Homework and other written materials will not be allowed.
3. Is it on the test? The purpose of AME 310 is to acquaint you with the basic principles of Thermodynamics, not only for its intrinsic merit, but also to acquaint you, as future professionals, with one of the fundamental pillars of modern engineering. There is much to this field that cannot be covered in the lectures of any single course (including this one) and, conversely, you may not encounter many things that will be discussed in class ever again (even on exams).
4. The best way to do well in this course is to keep up with all aspects of the class (e.g., attending lectures, doing the homework, participating in class discussions, etc.). That being said, I do not take attendance and, as you can see from the grading policy above, it is possible to receive an A in this course without doing any homework at all. I do not recommend such an approach since the best way to succeed in this class is practice, practice, practice.

This course is intended to:

- Teach students basic principles of classical thermodynamics.
- Train students to identify, formulate and solve engineering problems in classical thermodynamics involving both closed and open systems under either steady state or transient conditions.
- Teach students how to apply both 1st and 2nd Law analysis methods to thermodynamic systems.

Class Schedule:

Wk	Dates	Lecture Topics
1	Jan 8, 10	Syllabus. Ch. 1: Thermodynamic systems, state, and properties (pressure, density, temperature). Thermodynamic equilibrium, processes, and cycles; systems of units.
2	Jan 15, 17	Ch. 2: Pure substance; phase transitions and phase diagrams; saturated water/vapor; quality. Independent thermodynamic properties; plots and tables of properties; examples of use.
3	Jan 22, 24	Ch. 2: P-v-T diagram; equation of state; ideal gas; compressibility factor. Examples of using the equation of state and the compressibility chart.
4	Jan 29 Jan 31: Midterm1	Ch. 3: 1 st law of thermodynamics. Mechanical work; boundary work in compressible system. Polytropic processes; examples of computing work; other expressions for work.
5	Feb 5, 7	Ch. 3: Definition of heat; comparison of work and heat; heat transfer modes; examples. Internal energy and enthalpy; examples.

6	Feb 12, 14	Ch. 3: Specific heats for solids, liquids, and gases. Examples of calculations of enthalpy and energy for ideal gases. 1 st law as a rate eq.
7	Feb 19, 21	Ch. 4: The 1 st law for C.V.; mass, energy, enthalpy flow. Steady state process. Steady state process applications: heat exchanger, nozzle, throttle, turbine, compressor. Transient processes.
8	Feb 26, 28	Ch. 5: 2 nd law vs. 1 st law; heat engine, refrigerator, AC, heat pump; thermal efficiency.
9	Mar 5 Mar 7: Midterm2	Ch. 5: Clausius and Kelvin-Planck formulations of 2 nd law; reversible and irreversible processes. Carnot cycle. Efficiency of reversible/irreversible cycles; Carnot propositions; thermodynamic temperature scale and absolute temperature.
10	Mar 19, 21	Ch. 5: Heat engines and heat pumps. Ideal vs. real efficiencies. The inequality of Clausius. Steam power plant.
11	Apr 2, 4	Ch. 6: Definition of entropy. Computation of entropy for reversible processes. Gibbs' relations. Calculating entropy changes for incompressible solid/liquid.
12	Apr 9, 11	Ch. 6: Entropy changes for compressible gases (ideal gas). Polytropic processes. Entropy generation for a system.
13	Apr 16, 18	Ch. 6: Principle of the increase of entropy. Net entropy generation (system+surroundings). The entropy rate equation for control mass. Ch. 7: The 2 nd law for a control volume. Steady state processes. Reversible steady state processes.
14	Apr 23, 25	Ch. 7: Transient processes. Principle of the increase of entropy. Review.
	May 8 (W) 2 – 4 p.m.	Final Exam

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university

community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Page last updated: December 20, 2018.

Weekly information will be updated without notice. Change in policies, important dates, and project content will be announced in class.