

AME 310
Engineering Thermodynamics I
Spring 2023
THH 212 (TuTh 12:30-1:50)

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Discussion section: GFS 106, W 5:00 – 5:50 pm.

Required Textbook: C. Borgnakke and S. E. Sonntag, *Fundamentals of Thermodynamics*. The latest edition is **10th edition** (Wiley, 2019) but earlier editions (e.g., **9th** (Wiley, 2017), **8th** (Wiley, 2013), **7th** (Wiley, 2009)) can be used as well and hardcopies may be less expensive. However, electronic version is available from Wiley only for the 10th edition.

Grading:	Midterm 1	20%
	Midterm 2	20%
	Final	40%
	Homework	20%

Examinations:	Midterm 1:	Feb. 2 (Chapters 1-2).
	Midterm 2:	March 9 (Chapters 3-4).
	Final:	May 10 (cumulative with focus on Chapters 5-7).

Remarks:

- 1) There will be 13 homework assignments but only 10 with highest scores will count. You can miss 3 assignments, no questions asked. Each assignment is worth 2% irrespective of number of problems in the assignment.
- 2) Homework assignments will be given every Thursday and are due the following Thursday by 12:30 p.m. when solutions will be posted on Blackboard (there might be exceptions due to midterms and holidays that will be announced separately). Once solutions are posted no homework will be accepted and graded.
- 3) Each homework assignment should be **submitted electronically as a single PDF file** via the course Blackboard website. For a paper-based version of your homework assignment, you can use a scanner or any existing smart phone app that uses the phone

camera as a scanner. Please make sure to append all pages into a single PDF document before submitting.

- 4) All examinations will be open book.
- 5) 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).
- 6) The best way to do well in this course is to keep up with all aspects of the class (e.g., following lectures, doing the homework, etc.).

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 10, 12	Syllabus. Ch. 1: Thermodynamic systems, state, and properties (pressure, density, temperature). Thermodynamic equilibrium, processes, and cycles; systems of units.
2	Jan 17, 19	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 24, 26	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 31 Feb 2	Ch. 3: 1 st law of thermodynamics. Mechanical work; boundary work in compressible system. Midterm exam 1
5	Feb 7, 9	Ch. 3: Polytropic processes; examples of computing work; other expressions for work. Definition of heat; comparison of work and heat; heat transfer modes; examples.
6	Feb 14, 16	Ch. 3: Internal energy and enthalpy; examples.
7	Feb 21, 23	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.

8	Feb 28, Mar 2	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.
9	Mar 7 March 9	Ch. 5: 2 nd law vs. 1 st law; heat engine, refrigerator, AC, heat pump; thermal efficiency. Midterm exam 2.
	Mar 12-19	Spring break
10	Mar 21, 23	Ch. 5: Clausius and Kelvin-Planck formulations of 2 nd law; reversible and irreversible processes. Ch. 5: Carnot cycle. Efficiency of reversible/irreversible cycles; Carnot propositions; thermodynamic temperature scale and absolute temperature.
11	Mar 28, 30	Ch. 5: Heat engines and heat pumps. Ideal vs. real efficiencies. The inequality of Clausius. Steam power plant.
12	Apr 4, 6	Ch. 6: Definition of entropy. Computation of entropy for reversible processes. Gibbs' relations. Calculating entropy changes for incompressible solid/liquid.
13	Apr 11, 13	Ch. 6: Entropy changes for compressible gases (ideal gas). Polytropic processes. Entropy generation for a system.
14	Apr 18, 20	Ch. 6: Principle of the increase of entropy. Net entropy generation (system+surroundings). The entropy rate equation for control mass.
15	Apr 25, 27	Ch. 7: The 2 nd law for a control volume. Steady state processes. Reversible steady state processes. Transient processes.
	May 10 (Wed) 2-4 p.m.	Final Exam

USC Technology Support Links

[Learning Technology Tools](#)

[Blackboard help for students](#)

[Software available to USC Campus](#)

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 Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. 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>.

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.

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student: personal, financial, and academic. studentaffairs.usc.edu/ssu

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.

Provides overall safety to USC community. dps.usc.edu

Page last updated: January 3, 2023.

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