

**AME 310**  
Engineering Thermodynamics I  
Spring 2021  
MHP 101 & Online (TuTh 12:30-1:50)

**Instructor:** Julian A. Domaradzki  
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**Teaching Assistant:** TBA  
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**Discussion session:** 5:00 – 5:50 pm, Wednesday

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

<b>Grading:</b>	Midterm 1	20%
	Midterm 2	20%
	Final	40%
	Homework	20%

<b>Examinations:</b>	Midterm 1:	Feb. 11 (Chapters 1-2).
	Midterm 2:	March 18 (Chapters 3-4).
	Final:	May 12 (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 Tuesday by 12:30 p.m. when solutions will be posted on Blackboard (there might be exceptions due to midterms and wellness days 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 19, 21	Syllabus. Ch. 1: Thermodynamic systems, state, and properties (pressure, density, temperature). Thermodynamic equilibrium, processes, and cycles; systems of units.
2	Jan 26, 28	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	Feb 2, 4	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	Feb 9 Feb 11	Ch. 3: 1 <sup>st</sup> law of thermodynamics. Mechanical work; boundary work in compressible system. Midterm exam 1
5	Feb 16, 18	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 23, 25	Ch. 3: Internal energy and enthalpy; examples.
7	Mar 2, 4	Ch. 3: Specific heats for solids, liquids, and gases. Examples of calculations of enthalpy and energy for ideal gases. 1 <sup>st</sup> law as a rate eq.

8	Mar 9, 11	Ch. 4: The 1 <sup>st</sup> law for C.V.; mass, energy, enthalpy flow. Steady state process. Steady state process applications: heat exchanger, nozzle, throttle, turbine, compressor.
9	Mar 16 March 18	Ch. 5: 2 <sup>nd</sup> law vs. 1 <sup>st</sup> law; heat engine, refrigerator, AC, heat pump; thermal efficiency. Midterm exam 2.
10	Mar 23 Mar 25	Wellness Day – no class Ch. 5: Clausius and Kelvin-Planck formulations of 2 <sup>nd</sup> law; reversible and irreversible processes.
11	Mar 30 Apr 1	Ch. 5: Carnot cycle. Efficiency of reversible/irreversible cycles; Carnot propositions; thermodynamic temperature scale and absolute temperature. Ch. 5: Heat engines and heat pumps. Ideal vs. real efficiencies. The inequality of Clausius. Steam power plant.
12	Apr 6, 8	Ch. 6: Definition of entropy. Computation of entropy for reversible processes. Gibbs' relations. Calculating entropy changes for incompressible solid/liquid.
13	Apr 13, 15	Ch. 6: Entropy changes for compressible gases (ideal gas). Polytropic processes. Entropy generation for a system.
14	Apr 20 Apr 22	Ch. 6: Principle of the increase of entropy. Net entropy generation (system+surroundings). The entropy rate equation for control mass. Wellness Day – no class
15	Apr 27, 29	Ch. 7: The 2 <sup>nd</sup> law for a control volume. Steady state processes. Reversible steady state processes. Transient processes.
	May 12 (Wed) 2-4 p.m.	Final Exam

### USC technology rental program

We realize that attending classes online and completing coursework remotely requires access to technology that not all students possess. If you need resources to successfully participate in your classes, such as a laptop or internet hotspot, you may be eligible for the university's equipment rental program. To apply, please fill out this form:

<https://studentbasicneeds.usc.edu/resources/technology-assistance/>. The Student Basic Needs team will contact all applicants in early August and distribute equipment to eligible applicants prior to the start of the fall semester.

### USC Technology Support Links

[Zoom information for students](#)

[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](http://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](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](http://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](http://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](http://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](http://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](http://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](http://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](http://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/ssa](http://studentaffairs.usc.edu/ssa)

#### *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](http://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](http://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](https://dps.usc.edu)

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Page last updated: January 5, 2021.

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