

## **AME310 Engineering Thermodynamics, Spring 2024**

**Lecture:** M, W 4:00pm to 5:50pm, at THH212

**Discussion section:** Th 5:00pm to 5:50pm, at GFS116

**Instructor:** Takahiro Sakai, PhD

**Contact information:** Email: [tsakai@usc.edu](mailto:tsakai@usc.edu), Office: OHE430H, Phone: 213(740)5367

**Office hour:** MW 10:00-11:00am

**Teaching Assistant:** TBD

**Learning Management:** Blackboard and Gradescope for homework submissions

**Textbook:** Borgnakke and Sonntag, Fundamentals of Thermodynamics 10<sup>th</sup> edition, Wiley

### **Covered Topics:**

Chapter 1: Introduction and preliminaries

Chapter 2: Properties of pure substance

Chapter 3: Energy equation and first law of thermodynamics

Chapter 4: Energy Analysis for a control volume

Chapter 5: The second law of thermodynamics

Chapter 6: Entropy

Chapter 7: Entropy analysis for a control volume

Chapter 8: Exergy

Chapter 9: Power and refrigeration systems – With phase change

Chapter 10: Power and refrigeration systems – Gaseous working fluids

**Caution:** Since the course contents are dense, the materials will be covered in fast pace throughout the semester. You are expected to pre-and-post-study materials by reading my slides and textbook and doing homework assignments in regular basis.

### **Learning Objectives:**

- Understand the roles of working fluid as a medium of energy transfer and learn how to find thermodynamic properties of working fluids, including ideal gases and pure substances in liquid, steam, and vapor phases in thermodynamic equilibrium.
- Apply the laws of thermodynamics to various control volumes in steady and transient settings and analyze the performance of thermodynamic devices in terms of energy, entropy, and exergy.
- Understand the concepts of thermodynamic cycles used as heat engines, heat pumps and refrigerators and their efficiency measures; understand the basic roles of subcomponents that constitute such thermodynamic cycles.

- Obtain insights on irreversibility in actual thermodynamic processes and understand the importance of minimizing irreversibility in designing efficient thermodynamic systems.
- Exposure to currently used thermodynamic cycles in power, refrigeration and propulsion systems and their performance analysis using idealized model cycles.

**Grading weights:** Homework 10%, Exam-1 30%, Exam-2 30%, and Final exam 30%

**Homework Assignment:** Weekly homework assignments will be posted to Blackboard by Friday evening. It is due in one week. You must submit the work saved as a single PDF file to your Gradescope account (<https://www.gradescope.com/>). Score will be quartile. Your lowest three scores will be dropped.

**Exams:** There will be three exams scheduled on **Wednesday, February 6 (Exam 1)**, on **Wednesday, March 20 (Exam 2)** and on **Wednesday, May 1, 4:30pm to 6:30pm (Final exam)**. Please avoid planning trip on those dates.

**Makeup Policy:** There is no makeup for any missed homework assignment in any circumstance. Instead, we will drop three lowest homework scores. This is purposed as a fringe for unforeseen emergency regardless of the nature, but not to reward a better grade or some escape from study duty during the semester. If you unfortunately encounter a family or a medical or similar types of emergencies that completely hampered you from taking a midterm exam, a makeup exam will be provided later, provided you were able to provide legitimate proofs. The makeup exam would be completely different and necessarily more difficult than the original exam. Therefore, it is not always recommended to take advantage of this policy. This makeup is allowed one-time only. Makeup would be never allowed for the final exam strictly per the university policy.

**Letter Grade Policy:** The standard letter grade scaling adopted by U.S. colleges will be used as a standard metrics for the course letter grades: A (93-100); A- (90-92); B+ (88-89); B (83-87); B- (80-82); C+ (78-79); C (73-77); C- (70-72); D+ (68-69); D (63-67); D- (60-62); F (59 and below) This scaling applies to the total weighted score earned during the semester (after dropping scores of homework established by the course instructor). Number under the decimal point will be truncated (e.g., 89.99 truncates to 89 with B+). If the class average falls below 80 (cutoff of B-), then this scaling will be adjusted so that the class average is set to be a new cutoff of B-. If the class average ends up higher than 80 (B-), then the original scaling will be used with no change.

**Policy for Incomplete (IN) Grade:** If a student was unable to take the final exam due to uncontrollable incident unfortunately, the letter grade will be recorded as Incomplete (IN), provided the student's grade is Passing at the end of twelfth week of the semester, which includes two midterm exams. To complete the course, the student will need to take the formal AME310 final exam at the end of following semester. Once the semester is ended, the student will have no opportunity to receive any instructions, including attending or auditing any AME310 class, office hours, final exam review sessions, Blackboard, etc.

**Students and Disability Accommodations:** OSAS (Office of Student Accessibility Services) registered students must submit a letter of accommodations to the instructor within two weeks starting the semester. Accommodation will be arranged for exams by the instructor.

**Academic Integrity:** The USC Viterbi School of Engineering adheres to the University's policies concerning Academic Integrity as described in the *USC Student Handbook* (<https://policy.usc.edu/studenthandbook/>). All faculty, staff and students share the responsibility for

maintaining an environment of integrity. Students are expected to be aware of, and to observe, the academic integrity standards set forth in *the USC Student Handbook*.

### Tentative Weekly Schedule

Wk	Day	Mon/Wed	Topics
1	8-Jan	M	Concept and definitions
	10-Jan	W	Properties of pure substances
2	<b>15-Jan</b>	<b>M</b>	<b>MLK day (Holiday)</b>
	17-Jan	W	Properties of pure substances
3	22-Jan	M	Work and heat
	24-Jan	W	1st Law CM
4	29-Jan	M	1st Law CM
	31-Jan	W	1st Law CM, 1st Law CV
5	5-Feb	M	1st Law CV
	<b>6-Feb</b>	<b>W</b>	<b>Exam 1</b>
6	12-Feb	M	Heat engines
	14-Feb	W	2nd law
7	<b>19-Feb</b>	<b>M</b>	<b>President's day (Holiday)</b>
	21-Feb	W	2nd law
8	26-Feb	M	Entropy
	28-Feb	W	Entropy
9	4-Mar	M	Entropy
	6-Mar	W	Entropy
*	<b>11-Mar</b>	<b>M</b>	<b>Spring recess</b>
	<b>13-Mar</b>	<b>W</b>	<b>Spring recess</b>
10	18-Mar	M	2nd Law CV
	<b>20-Mar</b>	<b>W</b>	<b>Exam 2</b>
11	25-Mar	M	2nd Law CV
	27-Mar	W	Exergy
12	1-Apr	M	Exergy
	3-Apr	W	Exergy
13	8-Apr	M	Power and Refrigeration cycles
	10-Apr	W	Power and Refrigeration cycles
14	15-Apr	M	Power and Refrigeration cycles
	17-Apr	W	Air-standard cycles
15	22-Apr	M	Air-standard cycles
	24-Apr	W	Air-standard cycles
*	<b>1-May</b>	<b>W</b>	<b>Final Exam 4:30pm-6:30pm</b>

**Support Systems:**

***Counseling and Mental Health - (213) 740-9355 – 24/7 on call***

[studenthealth.usc.edu/counseling](http://studenthealth.usc.edu/counseling)

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

***National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call***

[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

***Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call***

[studenthealth.usc.edu/sexual-assault](http://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

***Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086***

[eetix.usc.edu](http://eetix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

***Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298***

[usc-advocate.symplicity.com/care\\_report](http://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

***The Office of Student Accessibility Services (OSAS) - (213) 740-0776***

[osas.usc.edu](http://osas.usc.edu)

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

***USC Campus Support and Intervention - (213) 821-4710***

[campussupport.usc.edu](http://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

***Diversity, Equity and Inclusion - (213) 740-2101***

[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

**USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call**

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

**USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call**

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.

**Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)**

[ombuds.usc.edu](http://ombuds.usc.edu)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

**Occupational Therapy Faculty Practice - (323) 442-3340 or [otfp@med.usc.edu](mailto:otfp@med.usc.edu)**

[chan.usc.edu/otfp](http://chan.usc.edu/otfp)

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

**Disclaimer:** The contents of this syllabus are tentative. The instructor reserves the right to make changes to this syllabus during the semester.