# San José State University
# Mechanical Engineering Department
# ME 210: Advanced Thermodynamics, Spring 2016

## Course and Contact Information


**Instructor:** Kathryn Gosselin

**Office Location:** ENG 310C (Main Mechanical Engineering Office)

**Telephone:** 408-924-8354

**Email:** kathryn.gosselin@sjsu.edu


**Office Hours:** Tuesdays and Thursdays, 4:30-5:30 PM, or by appointment

**Class Days/Time:** Tuesdays and Thursdays, 6:00-7:15 PM

**Classroom:** Central Classroom Building (CCB) 101

**Prerequisites:** ME 113 or equivalent undergraduate thermodynamics course

## Canvas and Course Materials

I will post all course materials (notes, homework, exam details, syllabus, etc.) on Canvas, so make sure to check it regularly. I will also post announcements with important information, so please check your settings to make sure that these are emailed to you when I post them.

## Course Description

This course covers classical thermodynamics concepts at a graduate level. It covers applications of the first and second laws of thermodynamics to the analysis of engineering systems, as well as availability (exergy) analysis, equations of state, thermodynamic property relations, mixtures, chemical equilibrium, and combustion. If we have time, we will also touch on statistical thermodynamics.

### Course Learning Outcomes (CLO)

Upon successful completion of this course, students will be able to:

1. CLO1 Use classical thermodynamics to analyze a variety of complex engineering systems.
2. CLO2 Apply advanced mathematics to solving thermodynamics problems.
3. CLO3 Collect, analyze, and evaluate scientific manuscripts related to thermodynamics topics.
4. CLO4 Develop and deliver an informational presentation on an advanced thermodynamics topic.

## Required Texts/Readings

### Textbook

There is no official textbook for this course; rather, I will compile, deliver, and post notes using a variety of sources to cover the material in this course.

**Other Readings**

The material in this course will be culled from a variety of sources, including the following:

- *Thermodynamics: an Engineering Approach*, Çengel and Boles, 8th Edition (978-0073398174)
- *Fundamentals of Engineering Thermodynamics*, Moran and Shapiro, 6th Edition (978-0471787358)
- *Fundamentals of Thermodynamics*, Sonntag, Borgnakke, van Wyle, 6th Edition (978-0471152323)
- *Modern Thermodynamics*, Kondepudi and Prigogine, 2nd Edition (978-1118371817)
- *Thermodynamics: Principles and Practice*, Saad, 2nd Edition (978-0134905259)
- *Thermodynamics and an Introduction to Thermostatistics*, Callen, 2nd Edition (978-0471862567)
- *Statistical Thermodynamics: Fundamentals and Applications*, Laurendeau, 1st Edition (978-0521154192)

**Course Requirements and Assignments**

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf.

- There will be approximately 8 homework assignments.
- I will post the homework assignments on Canvas, and they will be due approximately 10-14 days after they are assigned.
- There will also be a project, which will include several intermediate deliverables, as well as a presentation at the end of the semester.
- The assignments and project will challenge your problem solving skills and may require tools such as Excel, Matlab, Engineering Equation Solver, etc.
- Homework assignments must be turned in at the beginning of class on the date they are due.
- Homework assignments submitted late will be penalized 10 points (out of 100) each day after the due date.
- If you are unable to make it to class when the homework is due, you can scan and email it to me (cell phone pictures are fine as long as they are legible) to avoid a penalty.

For all homework problems, please include the following:

- List your name, the date, and the homework assignment number at the top of the assignment.
- Summarize the problem statement before beginning the problem. Give enough information that you could return to the problem a month or year from now and still understand what is being asked.
- Drawing a figure may be helpful, especially on complex problems.
- List all assumptions.
- Write down equations in symbolic form first, before plugging in numbers.
- Write units next to all equations! This will keep you from making mistakes. If you learn nothing else from this class, please learn to keep track of your units.

University policy F69-24 at http://www.sjsu.edu/senate/docs/F69-24.pdf states, "Students should attend all meetings of their classes, not only because they are responsible for material discussed therein, but because active participation is frequently essential to insure maximum benefit for all members of the class. Attendance per se shall not be used as a criterion for grading."

I can't (and won't) count attendance toward your grade, but I encourage you to attend class as often as possible. Although I will be posting all notes on Canvas, I will give additional explanations and answer questions in class. If you miss class, you should read and copy the notes from Canvas before seeing me with any questions about the material.

## Grading Policy

Grades will be computed as follows:

| | |
|---|---|
| Homework | 25% |
| Project | 25% |
| Midterm | 20% |
| Final | 30% |

Note that "All students have the right, within a reasonable time, to know their academic scores, to review their grade-dependent work, and to be provided with explanations for the determination of their course grades." See University Policy F13-1 at http://www.sjsu.edu/senate/docs/F13-1.pdf for more details.

## Classroom Protocol

Please put your phones on silent for the duration of class. If you need to take a call, please quietly step out of the classroom to do so. Please keep phone use to a minimum during class.

## University Policies

### General Expectations, Rights and Responsibilities of the Student

As members of the academic community, students accept both the rights and responsibilities incumbent upon all members of the institution. Students are encouraged to familiarize themselves with SJSU's policies and practices pertaining to the procedures to follow if and when questions or concerns about a class arises. To learn important campus information, view University Policy S90–5 at http://www.sjsu.edu/senate/docs/S90-5.pdf and SJSU current semester's Policies and Procedures, at http://info.sjsu.edu/static/catalog/policies.html. In general, it is recommended that students begin by seeking clarification or discussing concerns with their instructor. If such conversation is not possible, or if it does not address the issue, it is recommended that the student contact the Department Chair as the next step.

### Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage at http://www.sjsu.edu/provost/services/academic_calendars/. The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/**.** Students should be aware of the current deadlines and penalties for dropping classes.

Information about the latest changes and news is available at the Advising Hub at http://www.sjsu.edu/advising/.

### Consent for Recording of Class and Public Sharing of Instructor Material

University Policy S12-7, http://www.sjsu.edu/senate/docs/S12-7.pdf, requires students to obtain instructor's permission to record the course and the following items to be included in the syllabus:

- "Common courtesy and professional behavior dictate that you notify someone when you are recording him/her. You must obtain the instructor's permission to make audio or video recordings in this class. Such permission allows the recordings to be used for your private, study purposes only. The recordings are the intellectual property of the instructor; you have not been given any rights to reproduce or distribute the material."
- "Course material developed by the instructor is the intellectual property of the instructor and cannot be shared publicly without his/her approval. You may not publicly share or upload instructor generated

material for this course such as exam questions, lecture notes, or homework solutions without instructor consent."

If you wish to record me in class or during office hours, please ask first.

**Academic Integrity**

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

I take academic integrity *extremely seriously*. There are two main places where plagiarism can happen:

1. You have a number of written deliverables for your project. I will be using Turnitin to check all assignments for originality. Any instances of plagiarism will be subject to discipline, up to and including failing this course.
2. You have to turn in a number of homework assignments this semester. **Copying a solutions manual constitutes cheating. Copying homework from another person constitutes cheating.** I encourage you to work together in groups on homework, but the work you turn in must be your own. For example, you might discuss the best solution method for a particular problem with a friend, but you and your friend should work independently on actually doing the solution. Any instances of plagiarism will be subject to discipline, up to and including failing this course.

If you are tempted to cheat, please remember that **the grade for an incomplete assignment will always be higher than for a plagiarized assignment**. I love to give partial credit!

**Campus Policy in Compliance with the American Disabilities Act**

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 at http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at http://www.sjsu.edu/aec to establish a record of their disability.

**Accommodation to Students' Religious Holidays (Optional)**

San José State University shall provide accommodation on any graded class work or activities for students wishing to observe religious holidays when such observances require students to be absent from class. It is the responsibility of the student to inform the instructor, in writing, about such holidays before the add deadline at the start of each semester. If such holidays occur before the add deadline, the student must notify the instructor, in writing, at least three days before the date that he/she will be absent. It is the responsibility of the instructor to make every reasonable effort to honor the student request without penalty, and of the student to make up the work missed. See University Policy S14-7 at http://www.sjsu.edu/senate/docs/S14-7.pdf.

## Student Technology Resources (Optional)

Computer labs for student use are available in the Academic Success Center at http://www.sjsu.edu/at/asc/ located on the 1st floor of Clark Hall and in the Associated Students Lab on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include DV and HD digital camcorders; digital still cameras;

video, slide and overhead projectors; DVD, CD, and audiotape players; sound systems, wireless microphones, projection screens and monitors.

**SJSU Writing Center**

The SJSU Writing Center is located in Clark Hall, Suite 126. All Writing Specialists have gone through a rigorous hiring process, and they are well trained to assist all students at all levels within all disciplines to become better writers. In addition to one-on-one tutoring services, the Writing Center also offers workshops every semester on a variety of writing topics. To make an appointment or to refer to the numerous online resources offered through the Writing Center, visit the Writing Center website at http://www.sjsu.edu/writingcenter.

The writing center may be very helpful for the project in this class. Appointments open up approximately one week in advance, so check the schedule early and often if you think you will need help. You are expected to arrive at the writing center with a completed draft already done; they will not write it for you.

If English is not your first language and you are concerned about your writing skills, I am happy to provide feedback on that before the due date. You should finish a draft and come see me a week or two before it is due (earlier is better), and I will go through the paper with you to discuss how to improve your grammar, sentence structure, and word choice.

**SJSU Counseling and Psychological Services**

The SJSU Counseling and Psychological Services is located on the corner of 7th Street and San Carlos in the new Student Wellness Center, Room 300B. Professional psychologists, social workers, and counselors are available to provide confidential consultations on issues of student mental health, campus climate or psychological and academic issues on an individual, couple, or group basis. To schedule an appointment or learn more information, visit Counseling and Psychological Services website at http://www.sjsu.edu/counseling.

# ME 210: Thermodynamics, Spring 2016 Class Schedule

*This is the tentative and approximate schedule of topics for this semester. It is subject to change.*

**Course Schedule**

| Week | Date | Tentative Topics |
|---|---|---|
| 1 | 1/28 | Properties and States: properties of pure substances, state equations (ideal gas, van der Waals), compressibility factor, state theorem. |
| 2 | 2/2 | |
| | 2/4 | Energy and Energy Transfer: internal energy, enthalpy, work, heat transfer, 1st Law. |
| 3 | 2/9 | Phase Changes: pure substance phase changes, property diagrams, properties of two-phase mixtures. |
| | 2/11 | Multi-component mixtures: gas mixtures, gas-water mixtures. |
| 4 | 2/16 | Entropy: Clausius relation, generation and transfer, T-s diagrams, fundamental relation, evaluating $\Delta s$, 2nd Law. |
| | 2/18 | |
| 5 | 2/23 | Math: ODE's, PDE's, integral relations, LaGrange multipliers, numerical approximation. |
| | 2/25 | Advanced calculation with Excel, Matlab, Engineering Equation Solver. |
| 6 | 3/1 | Important Relations: fundamental relations, Maxwell relations, Clapeyron-Clausius equation, Joule-Thomson coefficient. |
| | 3/3 | |
| 7 | 3/8 | 1st Law of Thermodynamics: open systems, steady flow systems, unsteady flow systems. |
| | 3/10 | |
| 8 | 3/15 | 2nd Law of Thermodynamics: entropy, exergy/availability, Boltzmann's entropy formula. |
| | 3/17 | |
| 9 | 3/22 | |
| | 3/24 | MIDTERM EXAM |
| 10 | 3/29 | SPRING BREAK |
| | 3/31 | NO CLASSES |
| 11 | 4/5 | Chemical reactions: Gibb's free energy, chemical availability, equilibrium constant, adiabatic flame temperature. |
| | 4/7 | |
| 12 | 4/12 | |
| | 4/14 | |
| 13 | 4/19 | Power Generation/Refrigeration: ideal cycles (Carnot, Rankine, Stirling), real engines (Otto Diesel, Brayton, Stirling), heat pump, refrigerator, air conditioning. |
| | 4/21 | |
| 14 | 4/26 | |
| | 4/28 | Alternative energy: wind, solar, fuel cells, geothermal, nuclear. |
| 15 | 5/3 | |
| | 5/5 | Project Presentations |
| 16 | 5/10 | Project Presentations |
| | 5/12 | Review |
| 17 | 5/19 | FINAL EXAM, 5:15-7:30 PM |