

California State University, Chico
College of Engineering, Computer Science, and Construction
Management
Mechanical and Mechatronic Engineering and Sustainable
Manufacturing

**MECH 432, Energy Systems (Advanced Thermodynamics) Section 01,
Fall 2019**

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Office hours:	See MMEM Department Faculty and Staff website and current semester schedule
Class days and times:	Lecture: Tue and Thu 9:30AM – 10:45AM
Classroom:	Lecture: OCNL 124
Prerequisites:	MECH 338 – Heat Transfer

Overview

Energy systems is a challenging course and essential for becoming a competent and successful engineer. It builds upon concepts presented in thermodynamics but with an emphasis on the analysis of more complex systems and cycles. Additionally, there is a laboratory component to energy systems where one works directly with the engines that are analyzed and studied in the classroom. This provides a unique and excellent way to witness engineering principles in action.

How to Succeed in this Class

To be successful in college one should understand what learning is. Learning is the process of creating new connections in the brain. This is normal. Building these connections takes time and effort. This is normal. At times, the effort to create these connections will cause one to get frustrated and feel like learning is a hopeless struggle. This is normal. Eventually, the brain creates enough connections that new information can be quickly and efficiently accessed and used. When this happens, a powerful set of tools will be available for understanding, analyzing, and solving immensely diverse and important problems.

Succeeding in this class and succeeding in college in general has been researched extensively. There are known behaviors, situations, and attitudes that directly relate to student success.

A powerful attitude or understanding that significantly improves student success is based on the idea that intelligence does not predetermine one's abilities or level of mastery in anything. In fact, believing that intelligence will lead to a high level of achievement and understanding is negatively correlated with success. Watch the following educational research-based video on this topic, https://youtu.be/KUWn_TJTrnU.

I believe that everyone in my class is fully capable of succeeding at their highest level and that they belong in my class and in the university. I never thought that I would be a college professor. In fact, here is a short video that I made a couple years ago during a teaching workshop about my path to becoming a professor, <https://youtu.be/uxLUj7jD6Ws>.

Here is some practical advice for succeeding in class. A minimum of 3 hours of outside class work is required for every 1 hour of in-class work for most upper-division engineering courses. A total of 12 hours should be scheduled outside of class every week for this course. Combined with the hours spent in class, a total of 16 hours per week should be dedicated to studying energy systems to make it possible to earn a C or better grade. If an engineering student is taking four engineering classes, a total of 48 hours per week should be set aside in order to do well in all classes. If one does not have these many hours because of work or other obligations, then one's level of understanding and grades will likely suffer. So, there is a choice to be made.

Remember, a degree in engineering while it may take four, five, or six+ years, will pay off. Starting salary data for the class of 2017, <https://www.payscale.com/college-salary-report/majors-that-pay-you-back/bachelors/page/2>

Rank	Major	Degree	Starting Salary	Percentage
39	Computational & Applied Mathematics	Bachelor's	\$66,600	40%
40	Aerospace Engineering	Bachelor's	\$69,900	58%
40	Pharmaceutical Sciences (PS)	Bachelor's	\$50,200	72%
42	Ocean Engineering (OE)	Bachelor's	\$66,300	56%
43	Naval Architecture	Bachelor's	\$69,000	N/A
44	Welding Engineering	Bachelor's	\$76,300	42%
45	Information & Computer Science	Bachelor's	\$74,900	58%
46	Bioscience	Bachelor's	\$47,900	N/A
47	Industrial & Systems Engineering	Bachelor's	\$68,500	48%
47	Mechanical & Aeronautical Engineering	Bachelor's	\$66,300	60%
49	Electronics & Communications Engineering	Bachelor's	\$63,500	51%
49	Operations & Information Systems Management	Bachelor's	\$61,800	33%

Course Description and Goals

Catalog Description

Thermodynamics of power cycles, refrigeration, air-conditioning, and combustion processes; analysis, design, and testing of systems involving both conventional and renewable energy sources for power generation, heating, and cooling applications. 3 hours discussion, 3 hours laboratory.

Course Goals

Apply fluids, thermodynamics, heat transfer among other engineering principles to analyze the performance and efficiency of modern power systems. Develop critical thinking and judgment skills to setup, run, and monitor various data acquisition systems. Become proficient at communicating technical information and experimental results in a lab report. Understand the consequences of using resources for our daily energy needs as an industrialized country and what that means for other countries or other generations and what considerations and/or responsibilities we have to support sustainable practices.

Student Learning Outcomes

1. Develop an intuition and understanding of energy principles through hands on experimentation, data collection, and analysis.
2. Be able to apply thermodynamics, fluids, and heat transfer principles to analyze and test various energy systems for performance and efficiency. Principles include:
 - a. The First Law of Thermodynamics
 - b. The Second Law of Thermodynamics
 - c. Fourier's Law of heat conduction
 - d. Newton's law of cooling for heat convection
 - e. Bernoulli's principle
 - f. Ideal gas law
3. Prepare written reports that clearly identifies and states the engineering principles observed during laboratory experiments. Use data and sound science and reasoning to interpret and explain results and clearly justify the significance of the findings.
4. Perform limited research on a topic related to energy and suggest possible design solutions based on a thermodynamic analysis.

Subject Areas Covered

- Gas Power Cycles including Otto, Diesel, Brayton, and Turbojet cycles
- Vapor Power Cycles including Rankine, Rankine with Reheat and Regeneration
- Vapor Compression Refrigeration Cycles
- Thermo-electric Refrigeration
- Heat Exchangers and the NTU method
- Solar PV
- Wind Power
- Heat Pumps and Air Conditioning Cycles
- Human Comfort and Psychrometrics
- Gas Mixtures and Combustion

Required Materials

Textbook

A textbook is required for this course, however I recognize that there are different levels of financial ability among students. Consider the following, it is helpful having a book in class during lectures, this could be electronic or hardcopy. Textbooks, electronic or hardcopy, are not allowed during exams. New textbook can be a valuable resource in the future.

Required: Çengel and Boles, "Thermodynamics, An Engineering Approach, 8th, 7th or 6th Edition," McGraw-Hill Education.

Permissible: 8th Ed. from CSU Bookstore, hardback or 3-ring binder.

Permissible: 7th Ed. or International 7th Ed., hardback, paperback, or 3-ring binder.

Permissible: 6th Ed., hardback or ring-binder.

Permissible: 8th, 7th, or 6th Eds. in electronic form.

Thermodynamics Properties Booklet

The American Society of Mechanical Engineers student chapter at Chico State prints a booklet of thermodynamic property data. This booklet is required for all students. The price for the booklet is \$15.00 and details on how to purchase the booklet will be provided during the first week of the semester. See me if the cost of this booklet causes financial hardship. A limited number of booklets are available on loan for the semester.

Equipment

Approximately every other week we will be working with heavy, complex equipment and electronic data acquisition systems. Safety is of the utmost importance. All students will have on file a signed "Acknowledgment of Lab Safety Policies and Procedures" for the semester in which they are enrolled in this class.

Course Usage of Blackboard Learn

Blackboard will be used to send announcements and emails to the entire class on occasion. Students are responsible for knowing and checking regularly the email account associated with their Chico State portal.

Course Usage of the Internet

All course materials are accessible through the following website created through Google Sites and available to all students within the mail.csuchico.edu domain.

<https://sites.google.com/mail.csuchico.edu/energy-systems>.

Classroom Protocol

Learning Environment

This is an upper division-engineering course, and I have high expectations of all students. Come to class prepared and ready to engage in discussion and exploration in various topics most of which will be about engineering.

I want to help all students develop into outstanding, productive engineers where one's sense of curiosity is supported and celebrated. My teaching style is casual and informal. I want my classroom to be dynamic, contributory, inquisitive, and fun.

Upon graduation and as a professional, you will be asked to solve problems for which there will be no known answer. This is okay, and in fact, it is part of the definition of engineering, i.e. to solve problems. I want you to readily embrace the challenges of being an engineer and to broaden your perspective and contribute to the solution of some of the many difficult problems that face our society and planet.

Respect

Students in this class are encouraged to speak up and participate during class meetings. Because the class will represent a diversity of individual beliefs, backgrounds, and experiences, every member of this class must show respect for every other member of this class. (Reference: <http://www.csuchico.edu/diversity/>)

Safe Zone Statement

I am part of the Safe Zone Ally community network of trained Chico State faculty/staff/students who are available to listen and support you in a safe and confidential manner. As a Safe Zone Ally, I can help you connect with resources on campus to address problems you may face that interfere with your academic and social success on campus as it relates to issues surrounding sexual orientation/gender identity. My goal is to help you be successful and to maintain a safe and equitable campus.

LGBTQ Equality Statement

I am firmly committed to diversity and equality in all areas of campus life, including specifically members of the LGBTQ community. In this class I will work to promote an anti-discriminatory environment where everyone feels safe and welcome. I recognize that discrimination can be direct or indirect and take place at both institutional and personal levels. I believe that such discrimination is unacceptable and I am committed to providing equality of opportunity for all by eliminating any and all discrimination, harassment, bullying, or victimization. The success of this policy relies on the support and understanding of everyone in this class. We all have a responsibility not to be offensive to each other, or to participate in, or condone harassment or discrimination of any kind.

Attendance and In-Class Activities

Attendance and In-class activities are extremely important to learning. Attendance will be monitored by collecting in-class activities in and recording assignments not picked up when returned. Assignments and exams will be returned in class only once. At the end of the semester, students will receive one absence for each assignment including homework, in-class activities, and exams that were not picked up when originally returned in class. The participation grade will be reduced two percentage points for each absence. NO MAKE-UP IS AVAILABLE FOR IN-CLASS ACTIVITIES.

Assignment Policy

Homework

See the course rubric for additional help on how assignments will be evaluated and graded. The rubric is provided on the course website. All assignments will be returned with a zero grade if there is no organization, they are not legible, portions are missing or they are late. Additionally, all homework must be completed on engineering graph paper. This is the pale green or pale yellow paper with a grid on the backside. All homework must be original and

hand-written by the student who's name appears on the submitted assignment. All pages must be stapled and folded lengthwise with the student's name written on the outside of the fold.

All assignments that require a numerical solution will follow an organized problem solving process using the following headings:

- Given/Situation
- Find/Goal
- Assumptions/Generate Ideas
- Solution
- Review

LATE ASSIGNMENTS ARE ACCEPTED ONLY WITH AN APPROVED AND COMPLETED LATE ASSIGNMENT POLICY AGREEMENT. See Appendix A.

Grading Policy

CSUC Definition of Grading Symbols

A - Superior work; a level of achievement so outstanding that it is normally attained by relatively few students.

B - Very good work; a high level of achievement clearly better than adequate competence in the subject matter/skill, but not as good as the unusual, superior achievement of students earning an A.

C - Adequate work; a level of achievement indicating adequate competence in the subject matter/skill. This level or higher will usually be met by a majority of students in the class.

D - Minimally acceptable work; a level of achievement which meets the minimum requirements of the course.

F - Unacceptable work; a level of achievement that fails to meet the minimum requirements of the course. Not passing.

Grading

A	100 to 90%	C+	77.49 to 75%
A-	89.99 to 87.50%	C	74.99 to 70%
B+	87.49 to 85%	C-	69.99 to 67.50%
B	84.99 to 80%	D+	67.49 to 65%
B-	79.99 to 77.50%	D	64.99% to 60%
		F	< 60%

Grade Weighting

Category	Weight
Homework	15%
Laboratory grade	25%
Exams (2 midterms 10% each, 1 final 20%)	40%
Projects	20%
TOTAL	100.00%

Grade Disputes

Final grades are non-negotiable. If you think a grading error has been made for any graded assignment throughout the term, you must bring this to my attention within two weeks of

the date the grade was posted. Grade disputes brought up after final grades are posted will not be considered.

Cheating

Engineering is an honorable profession. Cheating is not honorable. Don't be a cheater. Anyone caught cheating on the exam or on any assignment will receive an automatic F for the course, a report will be submitted to Office of Student Conduct, Rights, and Responsibilities, and retaking the course for forgiveness may not be possible.

University Policies and Campus Resources

Dropping and Adding

You are responsible for understanding the policies and procedures about add/drops, academic renewal, etc. found <http://www.csuchico.edu/catalog/>. You should be aware of the new deadlines and penalties for adding and dropping classes.

Academic integrity

Students are expected to be familiar with the University's Academic Integrity Policy. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University's Academic Integrity Policy 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, Rights, and Responsibilities. The policy on academic integrity and other resources related to student conduct can be found on the Student Judicial Affairs web site, <https://www.csuchico.edu/scrr/integrity.shtml>.

IT Support Services

Computer labs for student use are located on the first and fourth floor of the Meriam Library, Room 116 and 450, Tehama Hall Room 131, and the Bell Memorial Union (BMU) basement. You can get help using your computer from IT Support Services; contact them through their website, <http://www.csuchico.edu/itss>. Additional labs may be available to students in your department or college.

Student Services

Student services are designed to assist students in the development of their full academic potential and to motivate them to become self-directed learners. Students can find support for services such as skills assessment, individual or group tutorials, subject advising, learning assistance, summer academic preparation and basic skills development. Student services information can be found at: <http://www.csuchico.edu/current-students>.

Americans with Disabilities Act

If you need course adaptations or accommodations because of a disability or chronic illness, 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. Please also contact Accessibility Resource Center (ARC) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations.

Accessibility Resource Center

<http://www.csuchico.edu/arc>

530-898-5959

Student Services Center 170

arcdept@csuchico.edu

Student Learning Center

The mission of the Student Learning Center (SLC) is to provide services that will assist CSU, Chico students to become independent learners. The SLC prepares and supports students in their college course work by offering a variety of programs and resources to meet student needs. The SLC facilitates the academic transition and retention of students from high schools and community colleges by providing study strategy information, content subject tutoring, and supplemental instruction. The SLC is online at <http://www.csuchico.edu/slc>. The University Writing Center has been combined with the Student Learning Center.

