

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

MECH 432 “Energy Systems” (Advanced Thermodynamics)

Instructor:	Sergey Smirnov
Office location:	OCNL 427
Telephone:	(530) 898-4619
E-mail:	ssmirnov@csuchico.edu
Office hours:	Posted on Canvas
Class days and times:	Discussion: Tue and Thu 9:30-10:45 AM Laboratory: Wed and Thu 2:00-4:50 PM
Classroom:	Discussion: Plumas Hall 201 Laboratory: LANG 122
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 is exposed to the systems 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. Building these connections takes time and effort. 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/2nF90sAW-Yg>. Take this quiz, <https://youtu.be/3vz6HU1LIQU>. I believe that everyone in my class is fully capable of succeeding at their highest level and that they belong in my class and at the university.

Here is some practical advice for succeeding in class. A minimum of 3 hours of outside class work is required for every 1 credit hour of in-class work for most upper-division engineering courses. A total of 12 hours should be scheduled outside of class every week to study energy systems. 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.

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.

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 including diesel and turbine engines, wind tunnel, photovoltaic and battery storage system, heat exchanger and thermoelectric refrigerator. 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

Students shall be able to:

1. Define, using words familiar to a lay-person, basic principles including energy, power, heat, temperature, enthalpy, entropy, state postulate, 1st law, 2nd law, open, closed, and isolated systems, entropy generation, flow work/energy, and mechanical energy.
2. Calculate the efficiency and total or specific power or energy, of a gas power, vapor-compression refrigeration, heat pump, and vapor power system.
3. Use a psychrometric chart to evaluate the changes of state of moist air during cooling, heating, humidifying and de-humidifying.
4. Operate and monitor various data acquisition systems including diesel and turbine engines, wind tunnel, photovoltaic and battery storage system, heat exchanger and thermoelectric refrigerator.
5. Prepare written reports that clearly identify and state the engineering principles observed during laboratory experiments.
6. Use data and sound science and reasoning to interpret and explain results and clearly justify the significance of the findings.
7. Understand the consequences of using resources for our daily energy needs as an industrialized country and what this means for other countries or other generations and what considerations and/or responsibilities we have to support sustainable practices.

8. Perform limited research on a topic related to energy and suggest possible design solutions based on a thermodynamic analysis.

Required Materials

Textbook

Çengel and Boles, "Thermodynamics, An Engineering Approach, 9th Edition", McGraw-Hill Education.

MECH 432 course covers Chapters 8, 9, 10, 11, 13, 14 and 18 (web chapter).

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 Canvas

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

Classroom Protocol

Learning Environment

This is an upper division engineering course. Please come to class prepared and ready to engage in discussion and exploration in various topics most of which will be about engineering.

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/>)

Attendance and In-Class Activities

Attendance and In-class activities are extremely important to learning. Attendance will be monitored.

Assignment Policy

Exams and Homework

Midterm and all HWs will be assigned, evaluated and graded via McGraw-Hill CONNECT system. Final Exam is conducted in-person. The total points available for each homework assignment is based on completing all problems assigned.

Midterm will consist of 5 problems and cover the material from Chapters 8, 9 and 10. Students will have 2 days to complete the exam. 2 attempts are given to complete the exam.

Final Exam (in-person) will consist of 5 problems from Chapters 11, 13, 14 and 18. It is an open-book/open-notes exam.

HWs cover the material from Chapters 8, 9, 10, 11, 13, 14 and 18. Each HW consists of 10 problems. Students have 2 attempts and 2 weeks to complete each HW assignment.

All McGraw-Hill CONNECT assignments are automatically graded after the closing hour. The solutions to all HW and Midterm problems become available immediately after the grade is assigned. Please keep track of your grades.

Laboratory Reports

A laboratory report is due 2 weeks after completing the laboratory experiment. One report will be turned in per team by the team leader. The requirements for writing an acceptable laboratory report will be reviewed in class prior to the first experiment. Grading of lab reports will follow the Lab Grading Rubric.

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: 94 – 100%

A-: 90 – 93.99%

B+: 86 – 89.99%

B: 83 – 85.99%

B-: 80 – 82.99%
 C+: 76 – 79.99%
 C: 73 – 75.99%
 C-: 70 – 72.99%
 D+: 66 – 69.99%
 D: 63 – 65.99%
 F: < 62.99%

Grade Weighting

Category	Weight
<i>Homework (7 assignments, each 8%)</i>	56%
<i>Lab grade</i>	24%
<i>Exams (1 Midterm – 5%, Final Exam – 15%)</i>	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 2 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. Anyone caught cheating will receive an automatic F for the course, a report will be submitted to Student Rights and Responsibilities Office, and retaking the course for forgiveness may not be possible.

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 Judicial Affairs. The policy on academic integrity and other resources related to student conduct can be found on the Student Judicial Affairs web site, <http://www.csuchico.edu/sjd/>.

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.

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.

MECH 432 Energy Systems - F23 - Weekly Schedule

Date	No.	Day	Wk	Discussion Topic	Assignmtns	Due Dates	Reading	Lab Wed (G1, G3)	Lab Thu (G2, G4)
8/22/2023	1	Tue	1	Intro, Thermo I Review			Chps 1 thru 7	Lab intro and safety	
8/24/2023	2	Thu	1	-			-		Lab intro and safety
8/29/2023	3	Tue	2	Exergy	*Hwk 1		Chp 8	G1 - Solar	
8/31/2023	4	Thu	2	-			-		G2 - Solar
9/5/2023	5	Tue	3	-			-	G3 - Solar	
9/7/2023	6	Thu	3	-			-		G4 - Solar
9/12/2023	7	Tue	4	Gas Power Cycles	Hwk 2	Hwk 1	Chp 9	No Lab (Work on Reports)	No Lab (Work on Reports)
9/14/2023	8	Thu	4	-			-		
9/19/2023	9	Tue	5	-			-	G1 - Wind	
9/21/2023	10	Thu	5	-			-		G2 - Wind
9/26/2023	11	Tue	6	Vapor and Combined Power Cycles	Hwk 3	Hwk 2	Chp 10	G3 - Wind	
9/28/2023	12	Thu	6	-			-		G4 - Wind
10/3/2023	13	Tue	7	-			-	No Lab (Work on Reports)	No Lab (Work on Reports)
10/5/2023	14	Thu	7	-			-		
10/10/2023	15	Tue	8	Refrigeration Cycles	Hwk 4	Hwk 3	Ch 11	G1 - TEC/Hukseflux	
10/12/2023	16	Thu	8	-			-		G2 - TEC/Hukseflux
10/17/2023	17	Tue	9	-	*Midterm		-	G3 - TEC/Hukseflux	
10/19/2023	18	Thu	9	-		Midterm	-		G4 - TEC/Hukseflux
10/24/2023	19	Tue	10	Gas Mixtures	Hwk 5		Chp 13	No Lab (Work on Reports)	No Lab (Work on Reports)
10/26/2023	20	Thu	10	-		Hwk 4	-		
10/31/2023	21	Tue	11	Gas-Vapor Mixtures and A/C	Hwk 6		Chp 14	G1 - Htxr	
11/2/2023	22	Thu	11	-			-		G2 - Htxr
11/7/2023	23	Tue	12	-		Hwk 5	-	G3 - Htxr	
11/9/2023	24	Thu	12	-			-		G4 - Htxr
11/14/2023	25	Tue	13	Renewable Energy	Hwk 7		Chp 18	G1 - Diesel	
11/16/2023	26	Thu	13	-		Hwk 6	-		G2 - Diesel
11/21/2023		Tue		No Class - Thanksgiving				No Class - Thanksgiving	
11/23/2023		Thu		No Class - Thanksgiving				No Class - Thanksgiving	
11/28/2023	27	Tue	14	-			-	G3 - Diesel	
11/30/2023	28	Thu	14	-			-		G4 - Diesel
12/5/2023	29	Tue	15	-		Hwk 7	-	G1, G3 - Turbojet	
12/7/2023	30	Thu	15	Review					G2, G4 - Turbojet
12/12/2023		Tue			Exam Final				

*Note: Midterm Exam and all HW assignments are posted on McGraw-Hill CONNECT