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), Sections 01 & 02 or 04, Fall 2016

Instructor: Assistant Professor David G. Alexander
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E-mail: dgalexander@csuchico.edu
Office hours: W 2PM-5PM or by appointment
Class days and times: Lecture: TuTh 9:30AM – 10:45AM
Laboratory: Tu or Th 2:00 PM – 4:50 PM
Classroom: Lecture: OCNL 124
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 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/Yn966v5INaI?list=PL4111402B45D10AFC](https://youtu.be/Yn966v5INaI?list=PL4111402B45D10AFC).

Another highly researched topic that has been shown to affect individual performance is stereotype threat. Information about stereotype threat can be found here, [http://www.reducingstereotyphemthreat.org/situations.html](http://www.reducingstereotyphemthreat.org/situations.html). There are numerous studies that show when a particular group is identified as being different than the majority group, mentioning or noting the difference leads to significantly worse performance. For example, standardized test scores drop significantly when participants are asked to identify their race or gender prior to taking the test as compared to the performance of similar groups when questions of gender or race are asked after the test is completed. The simple identification of belonging to an underrepresented minority within a group causes anxiety that can result in decreased performance or unexpected uncharacteristic behaviors.

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 last year during a teaching workshop about my path to becoming a professor, [https://youtu.be/uxLUj7jD6Ws](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 2015,
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 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
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. Stefan-Boltzman's theory of radiation heat transfer
f. Bernoulli’s principle
g. Ideal gas law
h. Other engineering principles from kindergarten through junior year in college.

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.

5. Understand how to apply a systems approach to solving complex problems.

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.


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: 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.

Reading Book
“The Green and the Black,” by Gary Sernovitz is required reading for this class. It is available at the Wildcat bookstore.

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**

Copies of the course syllabus and major assignments are found on Blackboard Learn. You are responsible for regularly checking the online resources, which is accessed through the Chico State Portal at [http://portal.csuchico.edu](http://portal.csuchico.edu).

Some assignments will be administered online through Blackboard Learn. Deadlines for the last date and time to take and submit the assignment will be provided in Blackboard Learn. Once the deadline is reached the assignment will no longer be available. All assignment grades are final after the deadline.

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.

**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.

**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 Bblearn site. 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.

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

See the course rubric for additional help on how assignments will be evaluated and graded. The rubric is provided on the course Bblearn site or Appendix below.

Homework assignments will be returned with a zero grade if they are disorganized, illegible, missing parts or late. The total points available for each homework assignment is based on completing all problems assigned. The total points available for partially completed assignments is prorated based on the number of problems attempted. LATE ASSIGNMENTS ARE ACCEPTED ONLY WITH AN APPROVED AND COMPLETED LATE ASSIGNMENT POLICY AGREEMENT. See Appendix B or Bblearn.

**Laboratory Reports**

A laboratory report is due one week after completing the laboratory experiment. One report will be turned in per team. There will be approximately 4 teams per laboratory experiment. The requirements for writing an acceptable laboratory report will be reviewed in class prior to the first experiment. The grading of the report will follow the course rubric. LATE ASSIGNMENTS ARE ACCEPTED ONLY WITH AN APPROVED AND COMPLETED LATE ASSIGNMENT POLICY AGREEMENT. See Appendix B or Bblearn.

**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

<table>
<thead>
<tr>
<th>Grade</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93.3%</td>
<td>100.0%</td>
</tr>
<tr>
<td>A-</td>
<td>86.7%</td>
<td>93.3%</td>
</tr>
<tr>
<td>B+</td>
<td>80.0%</td>
<td>86.7%</td>
</tr>
<tr>
<td>B</td>
<td>76.7%</td>
<td>80.0%</td>
</tr>
<tr>
<td>B-</td>
<td>73.3%</td>
<td>76.7%</td>
</tr>
<tr>
<td>C</td>
<td>66.7%</td>
<td>70.0%</td>
</tr>
<tr>
<td>C+</td>
<td>70.0%</td>
<td>73.3%</td>
</tr>
<tr>
<td>D</td>
<td>56.7%</td>
<td>60.0%</td>
</tr>
<tr>
<td>D+</td>
<td>60.0%</td>
<td>63.3%</td>
</tr>
<tr>
<td>F</td>
<td>53.3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Grade Weighting

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Laboratory grade</td>
<td>25%</td>
</tr>
<tr>
<td>Exams (2 midterms 10% each, 1 final 20%)</td>
<td>40%</td>
</tr>
<tr>
<td>Online Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Lecture participation</td>
<td>10%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

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 Student Judicial Affairs, and retaking the course for forgiveness will 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/](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 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/](http://www.csuchico.edu/sjd/).

IT Support Services (Optional)

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/its](http://www.csuchico.edu/its). Additional labs may be available to students in your department or college.
Student Services (Optional)
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.
<table>
<thead>
<tr>
<th>Area</th>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
<th>Score 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrated Technical competency</td>
<td>Many math errors, no units</td>
<td>Frequent math errors, seldom uses units and does not check for unit consistency</td>
<td>Few math errors, inconsistent use of units and some checks for consistency</td>
<td>0 or 1 math errors, applies units most of the time and checks for consistency</td>
<td>No math errors, carries units throughout and checks for consistency</td>
</tr>
<tr>
<td>Demonstrated application of scientific and engineering principles</td>
<td>Does not apply principles correctly</td>
<td>Mostly does not apply principles correctly</td>
<td>Applies principles inconsistently</td>
<td>Mostly applies principles correctly</td>
<td>Applies principles correctly and to areas outside assignment</td>
</tr>
<tr>
<td>Organization and clarity</td>
<td>No organization, unclear what or where the solution is</td>
<td>Little organization and incorrect process or explanation of solution process, answer is not clearly identified or if identified not clear how it was determined</td>
<td>Some organization but does not emphasize process with clear, meaningful content at each step. Answer is identified but sometimes unclear how it was determined</td>
<td>Mostly organized with statements at each step explaining solution process; answer is clearly identified</td>
<td>Clear organization including identification of problem statement, goal, solution, and review; neat orderly; answer is clearly marked, identified and discussed</td>
</tr>
<tr>
<td>Written communication</td>
<td>Illegible and confusing, misspelled words and incorrect grammar and punctuation</td>
<td>Mostly incomplete sentences with no paragraph structure and misspellings</td>
<td>Mostly complete sentences but paragraph and sentence structure is awkward and difficult to follow.</td>
<td>Complete sentences and some paragraph organization but sometimes difficult to follow</td>
<td>Writes in complete sentences, uses clear opening sentences in paragraphs, and organizes subjects comprehensibly and clearly</td>
</tr>
<tr>
<td>Review</td>
<td>Provides no review or justification for results</td>
<td>Little review, justifies with, “seems right”, “looks good”, “seems reasonable”, or etc.</td>
<td>Some review of answer and supports with data or logic/reason, Sometimes justifies results with “seems right”, “looks good”, etc.</td>
<td>Provides a review and supports results with data or logic/reason</td>
<td>Provides a clear and succinct review to the solution, results justified by data and/or logic/reason and/or basic principles</td>
</tr>
</tbody>
</table>
Appendix B

Late Assignment Policy Agreement

The following policy and agreement pertains to all assignments, which includes submitted artifacts, e.g. homework, reports, or exams, or attendance in class or outside of class that are assessed and become the bases for receiving credit toward a course grade. Assignments are not accepted for credit if submitted after their due date and time. Exams are not accepted for credit if rescheduled after the date and time that they are administered in class.

If assignments are not turned in on or before their due date or a student is absent from class (lecture or laboratory), then the following conditions will determine whether or not and how much credit will be given for the assignment or attendance. This agreement is non-negotiable and must be completed by each student requesting credit for any late assignment, exam or absence. If this agreement and supporting documentation is not provided, there will be no credit given, and there will be no discussion about the particular circumstances that resulted in the late assignment.

1. Was the student involved in an accident, admitted to the hospital or seen by a medical professional on or within 24 hours of the assignment or exam due date?
   Yes  No

2. Is it 48 hours in advance of the exam or homework due date?
   Yes  No

3. Is the need to reschedule an assignment or exam due to a job interview, work schedule conflict, family emergency, childcare issue, or other related circumstance?
   Yes  No

If you answered Yes to question (1) or Yes to both questions (2) and (3), your situation will be considered for appropriate accommodations. Provide documented evidence, e.g. physician’s note, admission to a medical facility for care, or other evidence of accident, event, or circumstance, that includes the date and time of services or event and submit with this signed agreement to instructor.

For which assignment are you seeking credit: _______________________________________

If you did not answer Yes to question (1) or Yes to both questions (2) and (3), you will not receive credit for the late or missed assignment or exam. Do not turn in this agreement.

Name: ____________________________________________________________

Signature: _______________________________________________________