MECH/MECA 140: Introduction to Engineering Design and Automation

Section 03/04  T/Th 11:00 – 12:50pm
Instructor:  Daisuke Aoyagi, daoyagi@csuchico.edu, OCNL 428, (530) 898-4619
Office Hour:  MTWR 9-10am, F 4-5pm

Section 01/02  M/W 9:00 – 10:50am
Instructor:  Scott Vanni, svanni@csuchico.edu, LANG 114, (530) 898-5129
Office Hour:  TBA

(Not teaching this semester: Nick Repanich, nrepanich@csuchico.edu)

Course Description:
Through the process of designing and building a machine, you will learn a process for designing and essential project management skills. You will learn the basic systems used in most every machine such as sensors, pneumatics, hydraulics, bearings, bushings, gears, belts and pulleys, clutches and brakes, and framing materials. You will also get introduced to ac and dc motor control, simple electrical circuits, machine controllers, programming, testing and analysis of results. The class has an economic overlay in that the project(s) will include budgeting and feature justification. Labs are not recipe-type activities. They demand the student simulate the actions an engineer might take in considering automation of a machine or process, and then complete a proof-of-concept system to verify those decisions. Many of the project skills introduced here will be used in other projects in and out of classes, and especially in your capstone senior design project.

Prerequisites:
Co-requisite: PHYS 204A.

Course Usage of Blackboard Learn
Copies of the course syllabus and major assignments may be found on Blackboard Learn. You are responsible for regularly checking the online resources, which is accessed through the Chico State Portal.

Attendance:
You are allowed one class period of excused "sick leave" and one "wander in late". Otherwise attendance is required at all class meetings including during the scheduled final exam period. Your course grade will be lowered 1/3 grade point for each additional unexcused absence from class. Also, please get to class on time. Each additional "wander in late" = 1/2 of an absence.

Textbook and other supplies:
Required textbook: Moaveni, Engineering Fundamentals, Thomson/Cengage, 5th Ed.
Your high school Physics book will also be a useful reference.
You will also need a USB flash drive to store many of the assignments and exercises. Safety glasses are required when you enter OCNL 432 (design workshop).
**Grading:**
Homework 20%
Project Scale Model & Presentation 15%
Final Project - Amount Completed 35%
Project Knowledge 10%
Individual Contribution & Teamwork 15%
Design Notebook 5%

**Exams:**
None planned.

**Homework:**
Homework should be typed (except sketches) and proofread. It will be graded on effort, content, spelling and grammar. Each spelling error will deduct one letter grade from that assignment.

Since this is a more project/lab-oriented course there will be plenty of out-of-class work you will need to do with your project team to accomplish each project. Generally, an average student during an average week should spend four hours per unit on a class. This includes time in class and time spent out of class doing homework and studying. Since this is a 2-unit class which meets four hours per week, on average you should devote at least 4 hours outside of class each week to this course.

**Design Notebooks:**
Each student needs to keep a design notebook. It is a collection of your work for the semester, including items such as sketches, wiring diagrams, pictures of your setup, programs, spreadsheets, etc.

The instructor will specify format, requirements, and recommendation for the Notebook.

**Safety:**
You will be working with tools which have the potential of causing injury. The Department's Lab Safety Policies and Procedures are available to read on the department web site. There is also a form to sign before you can enter and use OCNL 432 for the semester. When you submit this form, you will receive a special sticker to put on your student ID card. Be prepared to show your ID card with the sticker whenever you are in OCNL 432.

Everyone in OCNL 432 must wear eye protection at all times. You may NEVER work alone in OCNL 432. Anyone failing to comply with all lab safety rules will be told to leave the lab immediately and not be allowed to return to the lab that day. Repeated offenses will result in failing the course.

Note that OCNL 436 may be available as additional workspace when it is not used for another scheduled class/meeting. However, you may NEVER work alone in there.

You are to bring your own eye protection (safety glasses). The instructors will try to maintain several pairs of safety glasses at the door to OCNL 432 as backup. However, the numbers are limited and the quality/condition may not be ideal. You are strongly urged to bring your own, and should not depend on the provided backup safety glasses.

**Project Expenses:**
During the project if you have minor expenses for parts necessary to your design, you may buy them yourself and then get reimbursed, depending on the availability of MMEM department funding. Instructor
will need to pre-approve the expense based on seeing your design need, and you must pay cash or use a debit card (not credit card) to get reimbursed.

**Courtesy:**
To keep the facilities a pleasant place for you and other students to work in, please:

1. Always cover your table in OCNL 436 or 431 with a sheet of masonite when working with any tools. Do not use hot glue in OCNL 436 or 431; keep it in OCNL 432.
2. When finished working, clean up your table, any tool you used and any other area in which you worked. Return tools to proper locations and sweep up the area if necessary.
3. No food or drink in OCNL 431

**Course Outline:**
Week # (approximate)

1-2  Introduction to the design process
- Project Justification (Why spend time or money on this project?)
- Problem Definition - (What it must accomplish - define the specs)
- Project Planning
- Conceptualization
- Evaluation of Alternatives
- Detail Design and Analysis
- Construction and Programming
- Testing and Analysis of results
- Communication of solution and give a "proof-of-concept" presentation
- Iterative!

The groups will meet with a 'customer' to gather the technical details of a simple project. As you ask questions, constraints arise that lead to a simple system. Upon acceptance of your design, you receive the materials needed to build a proof-of-concept. Your and your partner(s) must build it and demonstrate the project.

3-5  Design Project Mockup
6-7  Computer Control of Machines
8-15 Final Design Project

**Lectures:**
Lectures have been developed to address specific technical and economic issues. Interaction between the instructor and students is encouraged and expected. Lectures are scattered throughout the semester, as they become needed. The lectures are, in no particular order:

- Framing Material Choices
- Electrical Safety
- Machine Control Topologies
- Power Supplies
- I/O Circuits and Devices (Sensors)
- AC and DC Motors
- Gearing
- Belts and Pulleys
• Solenoids
• Bearings and Bushings
• Energy Sources
• Clutches and Brakes
• Couplers
• Motor Control (VFD’s, Vector Drives)
• Asking Project Questions
• Pneumatics and Hydraulics in Machines
• Machine Controllers
• plus more...

**Academic Integrity:**
The students, faculty, administrators, and staff of CSU, Chico are committed to a culture of honesty in which members of the community accept responsibility to uphold academic integrity in all they say, write, and create. The complete CSU, Chico policy is available at: [www.csuchico.edu/prs/EMs/2004/04-036.shtml](http://www.csuchico.edu/prs/EMs/2004/04-036.shtml). Review this policy and especially review the examples provided by the Office of Judicial Affairs of using previous work (plagiarism) and unauthorized collaboration, [http://www.csuchico.edu/scrr/integrity.shtml](http://www.csuchico.edu/scrr/integrity.shtml). You can feel confident your instructor will protect the integrity of the class by taking appropriate action for any deviations from this policy of academic integrity.

**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**, 530-898-5959, Student Services Center 170, arcdept@csuchico.edu

**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 on the current students page of the CSU Chico web site.

**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 University Writing Center has been combined with the Student Learning Center. You can also visit the Student Learning Center web site: [http://www.csuchico.edu/slc/index.shtml](http://www.csuchico.edu/slc/index.shtml).