MECA 486
"Motion and Machine Automation"

SPRING Semester

Instructor: Nick Repanich
Class times: Lecture TTh 2-3; Labs TTh 3-5
Final Exam Time: Thursday 12-1:50 PM
Office Hours: T 12:30 -1:20 PM ; Th 11:30 AM -12:20 PM (OCNL 347A)
Classroom: OCNL 431
Units: 4
E-mail: nrepanich@csuchico.edu
Phone /Text - (530) 520-2548 (announce name in text)

Assignments
Engine Boring Requirements
G4143-3020-BST Label Reference
DMC 1460 Digital IO
MCG Servo Motor Specs
PS430 Documentation
AMP NEMA23 Torque Curves
IDC Positioning Tables Manual
Expanded Metal Specs
Motor Sizing Workshop
AMC Analog Amp Hardware Manual
AMC 12A8 Datasheet
AMC BE12A6 Datasheet
AMC App Note - Brushed Motor w/ Brushless Amp
AMC App Note - Troubleshooting the red LED

Textbook & Supplies:

Required: None
Recommended: Bolton, ***Mechatronics***, Pearson/Prentice Hall, 4th Ed., 2008, ISBN 978-0-13-240763-2
Also, books from EECE 211 & PHYS 204B&C will be a good reference. Industry catalogs/CD's will be used to provide information about components used in machine automation. Also, each lab group may want to bring their own tools and multi-meter. There are some in the lab, but they are just a bit cumbersome.

Course Description:

This course will combine and apply machine automation concepts in motion control, electrical circuits, fundamental mechanics, control systems and programming. Our goal is to draw these once-learned concepts back out, but this time draw them out in a way that those concepts *have context and are retained.* Lectures will address specific technical topics such as motor sizing, gearing, couplings, ground loops, servo control loops, regeneration, networking, I/O, power supplies, vibration and resonance, and troubleshooting. Projects will simulate application concepts such as point-to-point coordinated moves, registration, following, camming, and CAD-to-Motion.

Prerequisites:

Required: EECE 211L, MECH 340, and either EECE 482 or MECA 482 (concurrent OK)
Recommended Topics: ME's will need knowledge of diodes and transistors. EE's and CENG's will need knowledge of mechanical transmission devices (Ch. 9 to 12, 14 & 15 of MECH 340 text), in addition to working knowledge of Newton's Laws.

If you are interested in taking this class, and do not have the required prerequisites, but feel you may be able to overcome those, please talk to me. Instructors always have the option to make exceptions to the prerequisites.

Grading: (%'s are approximate)

Project #1	10%
Project #2	10%
Project #3	10%
Mechanics Selection & Motor Sizings	25%
Mid-term Exam #1	15%
Mid-term Exam #2	15%
Final Exam	15%

Overall grades on the projects will be about 3/4-based on the degree that the project is completed in the time allotted. Even though projects are done in groups, your individual grade will additionally be based on factors such as individual contribution to your team, your teamwork, individual assignments within the project, and your individual knowledge of the system.

Homework:

Since this is a more project/lab-oriented course, there is reading assignments to prepare for lectures, but limited homework to be turned in except the mechanics selections and motor sizings. There will be plenty of out-of-class work you will need to do with your lab partner to finish each project.

Projects:

All applications will adhere to the following procedure:

1. Ask questions of the "client" (instructor)
2. Size all motors
3. Wire
4. Program
5. Attach mechanics, if possible
6. Test
7. Analyze results and give a "proof-of-concept" presentation

Exams:

The Mid-term exams will be in-class. The final exam will be comprehensive. Study for tests by explaining things out loud, writing out the answers, and study until you understand every single component, including wires, signals in wires, connections, setup and programming of the systems. Numerical grading is on a grade-point scale.

Segment 1 – Open-Loop Systems

Week # (approximate)

1-4 Projects #1 & #2

Each two-person group will meet with a "client" to gather the technical details of a simple application. As you ask questions, constraints arise that lead to a simple stepper system. You will make a brief verbal proposal. Upon acceptance, you receive the equipment needed to do a proof-of-concept. Your and your partner must wire it and demonstrate the application.

As you solve the application, you are presented with either application changes or problems. These changes allow you to discover different properties and options available with steppers, including:

- Vibration and Resonance
- Microstepping
- Effects of Inertia
- Parallel vs. Series Wiring
- Effects of Inductance

- Drive Technologies
- Simple Controller Programming
- Interface Programming

5 Motor Sizing

Students learn how to properly size motors without software. You solve many fundamental sizing problems and learn how to put those together to solve complex mechanical systems. A difficult, multi-axis sizing is given as homework.

Segment 2 – Closed-Loop Systems

Week # (approximate)

6 Servo System Basics

To start servo training, each student participates in a discussion and application of servo loops, modern servo control, feedback, and tuning.

7 - 13 Project #3
14-15 Mechanics Systems

Lectures:

Lectures have been developed to address specific technical issues engineers face in industry. 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:

- Electrical Safety
- Power Supplies
- I/O Circuits
- Troubleshooting Electromechanical Systems
- Amplifier Enable Circuits
- Controlling Vertical Loads
- Ground Loops and Electrical Noise
- Fun with Brushed Motors
- Regeneration
- Mechanical Gearing
- Coupler Technology
- Building Mechanical Systems
- Things That Hurt Servo Performance
- Connectivity and Networking
- Matching Mechanical Power to Electrical Power
- Resolvers vs. Encoders

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. Review this policy and especially review the examples provided by the Office of Judicial Affairs of using previous work (plagiarism) and unauthorized collaboration, www.csuchico.edu/sjd/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 Learning Outcomes:

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