MECA 486

"Motion and Machine Automation"

Fall 2007

Instructor: Nick Repanich
Class times: Lecture MW 2-3; Lab MW 3-5
Final Exam Date and Time: Monday, Dec 17, 2-4
Office Hours: M 10:30-11:30 ; W 12:30-1:30 (OCNL 426)
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Textbook & Supplies:

Bolton, ***Mechatronics***, Pearson/Prentice Hall, 3rd Ed., 2003, ISBN 0-131-21633-3
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 multimeter. There are plenty 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. Labs will simulate application concepts such as point-to-point coordinated moves, registration, following, camming, and CAD-to-Motion.

Prerequisites:

Required: EECE 211L, either EECE 482 or MECA 482 (concurrent OK)
Recommended: MECH 340
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)

Application #1	20%
Application #2	25%
Mid-term Exam #1	5%
Mid-term Exam #2	5%
Applications #3	30%
Motor Sizings	8%
Final Exam	7%

Overall grades on the applications will be about 3/4-based on the degree that the application is completed in the time allotted and 1/4 on the lab notes.

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 some motor sizing problems. There will be plenty of out-of-class work you will need to do with your lab partner to accomplish each application.

Lab Notebooks:

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

Spiral bound, 5x5quad-ruled, 80-page lab notebooks should be kept to document all work on the applications, and will be collected for review after each major section. Before starting your notes, put your name on the front cover, pre-number all the pages in the notebook, and include a Table of Contents. Date the start of each session's entry and be neat. Draw a line after each session, and initial your work. Use the right hand pages for lab notes, and you may use the left hand pages for lecture notes. Paste/Gluestik/tape in any other useful items such as pictures of your setup, printed programs, Excel/MATLAB calc's etc. Please do homework separately so that my collection of your lab notebook does not hinder your project work.

Exams:

The Mid-term exams will be in-class. The final exam will likely be take-home and given out a week before the exam is due. If so, exam time will be used to, review the answers and discuss any other industry issues you may face, or perhaps a tour of a local manufacturing facility.

Segment 1 – Open-Loop Systems

Week # (approximate)

1-4 Applications #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 Application #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