MAE106: Mechanical Systems Laboratory
Spring Quarter 2019

Catalog Data: MAE106 Mechanical Systems Laboratory Units: 4
Experiments in linear systems, including RC circuits, vibrations, and motor control systems. Introduction to digital sampling concepts. Emphasis on mathematical models as useful tools for analysis and design of electromechanical systems.
Prerequisites: MAE60 or EECS 70A
Course Overlap: MAE170 covers control theory related to this course
Cross Listed Course(s): none
Restrictions: none
Lecture Location: HSLH 100A, MWF 3:00-3:50 Lab Location: ET549 and ET537

Textbook: Both textbooks are optional but would be helpful references; Any edition is OK
Control Systems Engineering, Norman S. Nise, Wiley, 2015
System Dynamics, William J. Palm III, McGraw Hill, 2009

References: **Course Web Site:** http://www.eng.uci.edu/~dreinken/MAE106/mae106home.htm

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Goals: This course covers theory and experiments on motor control systems, electrical filters, amplifiers, structural resonance and vibration. These topics are important for building robots, mechatronic devices, and structures. These systems will be described by linear, ordinary, differential equations. Key goals of the class are to use these equations to predict, understand, and control the behavior of machines, and to design, build, and test a robotic device as a final project.

Prerequisites by Topics: Electric Circuits (MAE 60) or Network Theory and Operational Amps (EECS72) Lecture

Topics:
Week 1: No Lab
4/1: Course Overview
4/3: Mechanical Design and 3D Printing
4/5: Review of Electrical Circuits
Week 2: Lab 1 - Laboratory tools
4/8: Circuit Analysis
4/10: Intro to Arduino Programming
4/12: TBD (to be determined)
Week 3: Project Role Trainings (in Engineering Tower and in Lab)
4/15: Data Acquisition
4/17: Filters and First-Order Systems
4/19: TBD
Week 4: Lab 2 - Introduction to data acquisition and filtering

4/22: DC Brushed Motors
4/24: Intro to Control Theory
4/26: TBD
Week 5: Verification 1 Design & Lab 3 - Open loop control of a motor
4/29: P-type feedback control of motor
5/1: Integral feedback control
5/3: Second-Order Systems: Time and Frequency Domain
Week 6: Lab 4 P-type feedback control of motor velocity
5/6: PD Motor Control
5/8: Midterm Review
5/10: Midterm I: Lecture Material & Labs 1, 2 and 3
Week 7: Lab 5 - PD feedback control of motor position
5/13: Vibration Analysis
5/15: Vibration of Two Beams
5/17: TBD
Week 8: Verification 2 Implementation
5/20: TBD
5/22: TBD
5/24: TBD
Week 9: Lab 6 - Vibrating Systems
5/27: Memorial Day
5/29: Midterm Review
5/31: Midterm II: Lecture Material & Labs 4, 5 and 6
Week 10: Final Project Section Competitions (in Lab)
6/3: No Lecture
6/5: No Lecture
6/7: No Lecture
Finals Week: Wildcard (6/10 @ 1pm) and Final Competition (6/10 @ 4pm)

Computer Usage: For laboratory write-ups, programming and data acquisition.

Laboratory Projects: **Laboratory Location:** Engineering Gateway 2102
Laboratory Times: See www.eee.uci.edu
Laboratory Exercises: Handouts that describe the experiments are available on the course web site. You can also ask the TA for help when you are confused. Be creative, explore (no penalties for in-lab mistakes!), and have fun in this hands-on lab.

Lab Pre-Quizzes: During the first ten minutes of lab, you will take a short online quiz to test whether you have read the lab beforehand. There will be no make-up if you miss your window.

Lab Practical Exams: You will have to demonstrate working experiments in lab to get credit for the lab.

Lab Write-Up: Students will rotate being their team's leader during lab. During their week as leader, students will be solely responsible for their team's write-up. You must use a computer graphing program (e.g. Microsoft Excel or Matlab) for all graphs (else no credit!).

Final Project: There will be a final project competition involving the design and head-to-head testing of a robotic device. The first round of competition will take place in lab during week 10, and a second round of competition on Monday 6/12 to determine the class champions.

Design Content Description: This course requires solution of design problems related to control and vibration, as well as design and construction of a robotic device for the final project.

Grading Criteria:

Lab Pre-Quiz: 7% (will drop lowest grade, i.e. one lab)
Lab Practical Exams: 24% (will drop lowest grade, i.e. one lab)
Lab Write-Ups: 10%
Midterms: 24%
Final project: 35% (includes verifications, competition grades, and final report).
No make ups without notification in advance and a valid reason
10% off for late assignments with a 1-week limit
Score on plagiarized assignment = 0 first time; fail course second time.

Prepared by: Dr. David Reinkensmeyer Date: 4/2/2019