

MAE106: Mechanical Systems Laboratory Spring Quarter 2017

Catalog Data:	<p>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: EH1200, MWF 3:00-3:50 Lab Location: EG2102</p>
Textbook:	<p>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</p>
References:	<p>Course Web Site: http://www.eng.uci.edu/~dreinken/MAE106/mae106home.htm Coordinator and Instructor: Professor David J. Reinkensmeyer (MAE) Office: EG3225, 824-5218, dreinken@uci.edu Office Hours: Monday 4-5 PM or by appointment Instructor: Professor Brendan W. Smith (ME, LMU) Office Hours: 3-4 PM in EG2102 or by appointment, smithbw@uci.edu Teaching Assistants: Sumner Norman snorman@uci.edu Diogo Schwerz de Lucena, diogo.lucena90@gmail.com Kimia Montazeri montazeri.kimia@gmail.com Jingtian Wu jingtiw@uci.edu Omkar Vaishampayan ovaisham@uci.edu</p>
Goals:	<p>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.</p>
Prerequisites by Topics:	<p>Electric Circuits (MAE 60) or Network Theory and Operational Amps (EECS72) Lecture</p>
Topics:	<p>Week 1: No Lab 4/3: Course Overview 4/5: Review of Electrical Circuits 4/7: Mechanical Design and 3D Printing Week 2: Lab 1 (Laboratory tools) 4/10: Circuit Analysis 4/12: Intro to Arduino Programming 4/14: TBD (to be determined) Week 3: Project Role Trainings (in Lab) 4/17: Data Acquisition 4/19: Filters and First-Order Systems 4/21: TBD Week 4: Lab 2 (Introduction to data acquisition and filtering) 4/24: DC Brushed Motors 4/26: Intro to Control Theory 4/28: TBD Week 5: Lab 3 (Open loop control of a motor) & Mechanical Verification (in Lab) 5/1: P-type feedback control of motor</p>

5/3: Integral feedback control

5/5: Second-Order Systems: Time and Frequency Domain

**Week 6: Lab 4 (P-type feedback control of motor velocity)
& Connections Verification (in Lab)**

5/8: PD Motor Control

5/10: Midterm Review

5/12: **Midterm I:** Labs 1, 2 and 3

**Week 7: Lab 5 (PD feedback control of motor position)
& Controls Verification (in Lab)**

5/15: Vibration Analysis

5/17: Vibration of Two Beams

5/19: TBD

Week 8: Lab 6 (Vibrating Systems)

5/22: Experimental Design

5/24: Mathematical Modelling

5/26: TBD

Week 9: Experimental Verification (in Lab)

5/29: Memorial Day

5/31: Midterm Review

6/2: **Midterm II:** Labs 4, 5 and 6

Week 10: Final Project Section Competitions (in Lab)

6/5: Memorial Day

6/7: No Lecture

6/9: No Lecture

Finals Week: Wildcard (6/12 @ 1pm) and Final Competition (6/12 @ 4pm)

For laboratory write-ups and data acquisition.

Computer Usage:

Laboratory Projects:

Laboratory Location: Engineering Gateway 2102

Laboratory Times: See 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

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.

Description:

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%

No make ups without notification in advance and a valid reason

10% off for late assignments.

Score on plagiarized assignment = 0 first time; fail course second time.