

CONTROL SYSTEMS DESIGN PROJECT – ECE147C
ADVANCED MECHANICAL ENGINEERING LAB – ME 106

TU TH 9:30-10:45PM, GIRV 1108

The objective of this course is to provide students with the necessary knowledge to design, implement, and document a control engineering project.

The course has three components: lectures, prepared laboratories (in the form of a project that is the same for all students), and a design project (specific to each group of students).

The lectures and laboratories cover a range of special topics related to the practical implementation of control systems that are not covered in introductory control courses but that are likely to arise in the professional career of controls engineers.

The course is heavily project-oriented and the students will be required to design, implement, document, and present a significant control systems project, which requires them to address the issues covered in the lectures.

Prerequisites: ECE147A or ME155A or ME173 or equivalent. Open to all engineering majors.

Instructor

João P. Hespanha (hespanha@ece.ucsb.edu)

Course Web page:

<http://www.ece.ucsb.edu/~hespanha/ece147c/>

Textbook

No textbook. The course will be based on a collection of modules and papers provided by the instructor.

Assessment format:

3 units (ME106)

- 1-2 homework assignments (*individual*, needed for the laboratory) – 5 %
- Laboratories (*group* mid-term report) – 40%;
- Final Project (includes a *group* end-of-term report and a *group* in-class presentation) – 55%

5 units (ECE147C)

- 5-6 homework assignments (*individual*) – 25 %
- Laboratories (*group* mid-term report) – 35%;
- Final Project (includes a *group* end-of-term report and a *group* in-class presentation) – 40%

Projects

The second half of the laboratory time is devoted to the final project. Possible projects include

- Identification and control of the seesaw system [in hardware]
- Identification and control of an inverted pendulum [in hardware]
- Identification and control of a flexible beam [in simulation]
- Identification and control of an F-16 [in simulation]
- other ... [in hardware or simulation]

Detailed Syllabus

The following is a tentative schedule for the course. As revisions are needed, they will be posted on the course's web page.

Class	Lecture content	Laboratory
Mar 30	<i>no class</i>	Laboratory session enrollment
Apr 1	<i>no class</i>	
#1, Apr 6	Course overview Computer-controlled systems (review)	Introduction to laboratory
#2, Apr 8	Part I—Model identification and parameter estimation <ul style="list-style-type: none"> Least-squares parametric identification 	
#3, Apr 13	<ul style="list-style-type: none"> ARX model identification 	Parametric identification of the two-cart system
#4, Apr 15	<ul style="list-style-type: none"> Partial identification (known parameters) Choice of inputs, model order and sampling frequency 	
#7, Apr 20	Nonparametric identification	Closed-loop control of the identified model
#8, Apr 22	Nonparametric identification (cont.)	
# 9, Apr 27	Part II—Loop shaping control design	Closed-loop control of the identified model (cont.)
#10, Apr 29	Loop shaping control design (cont.)	
#11, May 4	Part III—Robust Control <ul style="list-style-type: none"> Frequency domain uncertainty 	Final project
#12, May 6	<ul style="list-style-type: none"> Loop-shaping control design 	
#13, May 11	Part IV—Optimal control: LQR/LQG <ul style="list-style-type: none"> LQR problem 	Final project
#14, May 13	<ul style="list-style-type: none"> Loop-shaping using LQR 	
#15, May 18	<ul style="list-style-type: none"> LQG/LQR output-feedback 	Final project
#16, May 20	<ul style="list-style-type: none"> Loop-gain recovery 	
#17, May 25	Part V—Control of Nonlinear systems <ul style="list-style-type: none"> Feedback linearization 	<i>Project presentations</i>
#18, May 27	<ul style="list-style-type: none"> Lyapunov stability theorem 	
#19, Jun 1	<ul style="list-style-type: none"> Lyapunov-based control design 	
#20, Jun 3	<i>TBA</i>	