University Of California, Berkeley
Department of Mechanical Engineering

ME C232: Advanced Control Systems I (3 units)
EECS C220A: Advanced Control Systems I (3 units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

Input-output and state space representation of linear continuous and discrete time dynamic systems. Controllability, observability, and stability. Modeling and identification. Design and analysis of single and multi-variable feedback control systems in transform and time domain. State observer. Feedforward/preview control. Application to engineering systems.

COURSE PREREQUISITES

At least one undergraduate level Controls course is recommended. A background in linear algebra is also recommended.

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Course will have a reader or class notes.

COURSE OBJECTIVES

DESIRED COURSE OUTCOMES

TOPICS COVERED

Please see tentative schedule attached.

CLASS/LABORATORY SCHEDULE

Three hours of lecture and one hour of discussion per week.

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

40 % from 2 midterms, 40 % from final and 20 % from assigned homework.

PERSON(S) WHO PREPARED THIS DESCRIPTION

Professor Roberto Horowitz
March 9, 2011.

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): ADV CONTRL SYS I
TIE CODE: LECS
GRADING: Letter
SEMESTER OFFERED: Fall
COURSES THAT WILL RESTRICT CREDIT: ME 232
INSTRUCTORS: Horowitz, Tomlin
DURATION OF COURSE: 14 Weeks
EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9
IS COURSE REPEATABLE FOR CREDIT? No
CROSSLIST: EECS C220A

Tentative Schedule (Subject to change)

Week	Material
1	Introduction, Mathematical Preliminaries: Functions, Transformations and Mapping, (Discussion session will immediately start covering Linear Algebra), Laplace transformation and z-transformation (Continuous time function vs. Discrete time sequence)
2	State variables and state space models of dynamical systems, Relations between state space models and transfer function models (Controllable Canonical Form, Observable Canonical Form, Diagonal Form)
3-4	Solutions of unforced linear state equations, matrix exponential, eigenvalues and eigenvectors, Jordan form. Solutions of linear state equations, transition matrix, discrete time models of continuous time systems.
5-6	Modeling of physical systems: power, energy, sources, passive elements (C-, I-, R-, transformer, and Gyrator), through and across variables, linear graph, modeling examples for typical mechanical systems such as vehicle suspension, electrical motor, etc.
7	Stability, Lyapunov stability, Lyapunov function
8-9	Controllability and observability, definition and criteria, stabilizability and detectability, balanced realization and model reduction
10	State feedback and output feedback, pole assignment via state feedback
11	State estimation and observer, observer state feedback control
12-14	Linear quadratic regulator (LQR), Riccati equation, Properties of LQR systems

Examples will be drawn from mechanical, electrical and fluid systems, including motion control systems, vibration analysis and control problems, vehicles, mechatronics systems, etc.