University of California at Berkeley
Department of Mechanical Engineering

ME C232/EE C220A Advanced Control Systems I **Fall 2017**

Instructor: Masayoshi Tomizuka
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Tentative Office Hours in 5100B E.H.: W and F 9:00 – 10:30 pm

Teaching Assistant: Liting Sun, Room 2103 Etch Hall,
(510) 664-9957, litingsun@berkeley.edu
Tentative Office Hours: Tu 3:30 – 5:00 pm and F2:30 – 4:00 pm

Lectures: Tu, Th 11:00 – 12:30 in Room 3108 Etcheverry Hall

Discussion: Tentatively W2:00 – 3:00 pm in Room 3108 Etcheverry Hall

Class Notes: ME232 Class Notes by M. Tomizuka
Will be made available at the class website.

References (not required to purchase):

1. Joao P. Hespanha, Linear Systems Theory, Princeton, 2009
2. W. L. Brogan, Modern Control Theory, 3rd Ed., Prentice Hall.
3. Panos J. Antsaklis & Anthony N. Michael, Linear Systems, Birkhauser.
4. N. Nise, Control Systems Engineering, Wiley.

ME C232 Overview:

ME C232 is the first graduate course offered by the Department of Mechanical Engineering on dynamic systems and control. It is cross listed in the Department of Electrical Engineering and Computer Science as EE C220A. It is a pre-requisite to most of the other graduate courses offered by the College of Engineering in this area. ME C232 deals with analysis and design techniques for linear control systems.

It is assumed that you have taken or are taking concurrently one junior/senior level control course. If you have not taken any control course before, you can still take ME C232 but you need to take ME C134 (EE C128) Feedback Control Systems concurrently. It is recommended that you also take concurrently with ME C232 E 231, which will be taught this semester by Professor Kameshwar Poolla. It covers three topics essential to modern engineering such as controls: linear algebra, random processes, and optimization.

Grading:

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

Tentative Schedule (Subject to change)

Week	Dates	Material
1	8/24	Introduction, Laplace transformation and z-transformation (Continuous time function vs. Discrete time sequence)
2	8/29, 31	z-transformation (continuation); Models of linear dynamical systems: transfer functions, state space models, various canonical forms
3	9/5, 7	Mathematical preliminaries (notation, functions); Vector spaces (Basis and change of coordinates, norms); Linear operators and matrices (Range and null space)
4	9/12, 14	
5	9/19, 21	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.
6	9/26, 28	
7	10/3, 5	Stability, Lyapunov stability, Lyapunov function.
8	10/10, 12	Controllability and observability, **Midterm I**
9	10/17, 19	Controllability and observability, Singular value decomposition and balanced realization
10	10/24, 26	State feedback and output feedback, pole assignment via state feedback
11	10/31, 11/2	State estimation and observer, observer state feedback control
12	11/7, 9	Linear Quadratic (LQ) Optimal Control, Linear Quadratic Regulator (LQR), Riccati equation, Solution of Riccati equation
13	11/14, 16	Properties of LQR, gain margin/phase margin, Symmetric root locus
14	11/21, 23*	**Midterm II**
15	11/28, 30	Properties of LQR; Review
16	12/4-8	Reading/Review/Recitation Week
17	12/11-15	Final examination week

The first midterm examination on October 12.
The second midterm examination on November 21.
*Thanksgiving holiday (November 23)
**The last lecture on November 30.
Final examination: