ME 621: Introduction to Modern Control Engineering

Department of Mechanical Engineering
Stevens Institute of Technology
Spring 2012

Course Description: This graduate level course focuses on linear system theory in time domain. The course introduces the fundamental mathematics of linear spaces, linear operator theory, and then proceeds with existence and uniqueness of solutions of differential equations. Topics covered include

- Linear algebra review, solutions of linear differential equations, state space representations
- State transition matrix, time varying systems, the fundamental matrix.
- Structural properties of linear systems: controllability, observability and stability, realizations and minimality.
- Synthesis of linear controllers, pole placement, state feedback, observer design.

Requirements: linear algebra, differential equations, and signals and systems. Undergraduates need permission.

Instructor:
Michael M. Zavlanos, michael.zavlanos@stevens.edu

Lectures: Tuesday 6:15-8 :45pm, E. A. Stevens 130

Office Hours: TBA

Textbook:
Wilson J. Rugh. *Linear System Theory*, 2nd Edition, Prentice Hall, 1996.

Other References:

- Panos J. Antsaklis and Anthony N. Michel. *A Linear Systems Primer*, 1st Edition, Birkhauser Boston, 2007.
- Joao Hespanha. *Linear Systems Theory*, Princeton University Press, 2009.
- C.T. Chen. *Linear Systems Theory and Design*, 3rd Edition, Oxford University Press, 1999.
- G. Strang. *Linear Algebra and its Applications*, 3rd edition, 1988 (Linear Algebra Reference).

Grading Policy:
Homeworks: 30%
Midterm I: 35%
Midterm II: 35%

Tentative Schedule (please note that the order might change):

Week	Date	Reading	Topic
1	January 17	Chapter 2	• State-space representation • Linearization
2	January 24	Chapter 3 & Linear Algebra	• Existence & Uniqueness • Linear spaces, eigenvalues, eigenvectors • Change of basis
3	January 31	Linear Algebra	• Diagonalization, Jordan forms • Cayley-Hamilton theorem • Functions of a square matrix • Matrix exponential
4	February 7	Chapters 4 & 5	• State-space solutions: Time varying & time invariant cases • Properties of the state transition matrix
5	February 14	Chapters 20 & 21	• Discretization of continuous systems • Discrete-time state-space solutions
6	February 21	Chapter 6	• Uniform exponential stability and asymptotic stability: Time varying & time invariant cases
7	February 28	Chapters 7 & 23	• Lyapunov stability theorems: Time varying & time invariant cases • Midterm I
8	March 6	Chapter 9	• Controllability & Observability • Kalman rank tests • PBH tests
9	March 13	Spring Break – No Classes	
10	March 20	Chapter 9	• Controllability & Observability (contd') • Kalman rank tests • PBH tests
11	March 27	Chapter 13	• Canonical forms
12	April 3	Chapter 14	• State feedback: Pole placement
13	April 10	Chapter 15	• Estimator design • Observers
14	April 17	Chapter 15	• Estimator design (contd') • Observers
15	April 24		• Midterm II
16	May 1		TBD