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:  

Other References:  

Grading Policy:  
Homeworks: 30%  
Midterm I: 35%  
Midterm II: 35%
## Tentative Schedule (please note that the order might change):

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Reading</th>
<th>Topic</th>
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| 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 |