

AME 451: Linear Control Systems I

Lecture: MW 5-6:20
Discussion F 11-11:50
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Homework: Will be assigned *every* Wednesday and will be due *the following* Wednesday

Grading: The final grade will be according to the following formula:

Homework:	20%
Midterm (October 5):	30%
Final (December 7):	50%

Textbook: R. Dorf and R. H. Bishop, *Modern Control Systems* , 12th Edition, Prentice-Hall, 2011.

Course Outline

1. *Introduction (Chapter 1)*

- (a) Input-output relations
- (b) Dynamic systems, actuators, sensors, and controllers
- (c) Flow of information and functional diagrams
- (d) Open-loop and closed-loop (feedback) control systems

2. *Review: Modeling of Dynamic Systems (Chapter 2)*

- (a) Modeling of dynamic systems in time domain
 - i. Mechanical systems
 - ii. Fluid- and heat- flow systems
 - iii. Electrical circuits
 - iv. Electromechanical systems
- (b) Modeling in Laplace Domain
 - i. Laplace transforms of elementary functions
 - ii. Inverse Laplace transform
- (c) Transfer function representation of dynamical systems
- (d) Block diagram manipulations
- (e) Simulation of control systems using *MATLAB*

3. *Performance of Control Systems (Chapters 4 and 5)*

- (a) Characteristics of feedback systems
 - i. Error signal analysis
 - ii. Sensitivity to parameter variations
- (b) Transient response specifications
- (c) First-order systems
- (d) Second-order systems
- (e) Root location and transient response
- (f) Steady-state errors and system type
- (g) Simplification of linear systems
- (h) Control system characteristics using *MATLAB*

4. *Stability of Linear Systems (Chapter 6)*

- (a) Definition of stability
- (b) Routh-Hurwitz stability criterion
- (c) Application of Routh-Hurwitz criterion to system synthesis
- (d) System stability using *MATLAB*

5. *Root-Locus Analysis (Chapter 7)*

- (a) The root-locus concept
- (b) Rules for the construction root-locus plots
- (c) Root-locus analysis using *MATLAB*

- (d) Control actions
- (e) Control design

6. *Frequency Domain Analysis (Chapters 8)*

- (a) Frequency response of linear systems
- (b) Log Magnitude and phase (Bode) diagrams
- (c) Polar (Nyquist) plots (notes)
- (d) Nichols plots
- (e) Frequency response using *MATLAB*

7. *Stability in Frequency Domain (Chapter 9)*

- (a) Nyquist stability criterion
- (b) Relative stability measures
- (c) Stability in frequency domain using *MATLAB*
- (d) Performance measures in frequency domain
- (e) Stability of systems with time delays

8. *Design and Compensation Techniques (Chapter 10, Notes)*

- (a) Lead compensation
- (b) Lag compensation
- (c) Lead-lag compensation
- (d) Tuning of commercial controllers
- (e) System design using the *MATLAB* program *SISOTOOL*.