AME 451: Linear Control Systems I

Time: MW 5-6:20
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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 7): 30%
   Final (December 9): 50%


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
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.