MCHE 474: Control Systems

Mid-Term Exam – Thursday, November 9th

Covers Chapter 2 through Chapter 7, with focus on Chapters 5 – 7, including (but not limited to):

Chapter 2

- Modeling and linearization of physical systems
- The Laplace Transform & Inverse Lapace Transform
  - Use to solve ODEs
  - Use to write the transfer function of linear systems
  - Use for systems with nonzero initial conditions
- Block diagram models
  - Block diagram algebra and reduction
  - Be able to draw a representative block diagram for a system (like the DC motor example we worked in class)
  - Know common block diagram forms

Chapter 3

- State variable representation of systems
- The state differential equations and state-space form
  - Be able to write system equations in this form
  - Know the general matrix form and functions of each matrix
- State Transition matrix

Chapter 4

- Differences between open and closed-loop systems
- Error signal analysis
  - Sensitivity function
  - Complementary loop function
  - The relationship between these two functions
  - What we need from the controller to limit the effects of:
    - ✦ disturbances,
    - ✦ measurement noise, or
    - ✦ reference inputs
- Sensitivity to parmeter variations
- Analysis of steady-state error (Know the Final-value Theorem)

Chapter 5

- Know the test inputs
- Know of the effects of changing natural frequency and damping on:
  - Rise time
  - Settling time
  - Overshoot
- System Types and their relationship to steady-state error
- Sketching system responses based on natural frequency and damping ratio

Chapter 6

- System stability
- Determine stability from pole locations

Chapter 7

- The magnitude and angle conditions of the Root Locus
- Sketching Root Loci
- Meaning of pole locations on the Root Loci
- Selection of parameters using the Root Locus
- PID Controller
  - Equations
  - Effects of each gain
  - Tuning methods
    - "Manual"
    - Ziegler-Nichols (Open-loop and Closed-loop methods)
  - Tuning methods