EE 302 - Spring 2019

Midterm 1 – Study Guide

1. **Basic Concepts**
   You should be able to
   a. Understand the feedback concept and its purpose,
   b. Give real-life examples of feedback systems,
   c. Be able to draw the block diagram of a system in feedback configuration

2. **Mathematical modeling of Physical Systems.**
   You should be able to
   a. Understand the relationship and difference between a physical system itself and its mathematical model,
   b. Understand the assumptions in deriving a given mathematical model,
   c. write the differential equations model describing the behavior of simple mechanical and electrical systems from first principles,
   d. Use the Laplace-Transform to write the s-domain models of components and constructively draw the block diagram representation,
   e. Manipulate block diagrams to find mathematically equivalent representations,
   f. Derive the transfer function representation of simple mechanical and electrical systems.
   g. Understand the concept of closed-loop poles (and zeros) and be able to determine them,
   h. Define appropriate states and derive the state-space representation of simple mechanical and electrical systems.
   i. Understand the relationships between different system representations for a single system.

3. **Time-Domain behavior of System Models.**
   You should be able to
   a. understand the relationship between the response of a system and its mathematical model,
   b. Understand the basic stability criteria (convergent behavior) based on the location of the closed-loop poles in the s-plane.
   c. know the typical input types and resulting responses used to characterize control systems,
   d. analyze the behavior of first, second systems given or assumed in standard form,
   e. understand the dominant pole(s) concept and its use in analyzing higher order systems,
   f. know important performance measures (design criteria) used to characterize control systems,
   g. know the relationship between the performance measures and the location of the closed-loop poles of the system in s-plane,
   h. compare different systems in terms of performance measures from the location of the closed-loop poles,

i. Understand the relationship between the parameters of a system and its transient response,
j. Understand the relationship between the parameters of a system and its steady-state behavior.
k. Understand when and how Final-Value Theorem can be applied to determine the limiting (steady-state) behavior from Laplace Transform,
l. Know how to determine the Type of an open-loop system and its relationship with the closed-loop steady-state error behavior.
m. Draw the block diagram of a system with proportional (P), Integral (I) and Derivative (D) control actions and their combinations,
n. For simple cases, predict the effect of these control actions on system transient and steady-state behavior.