Course: ME 33100 – System Dynamics

Type of Course: Required for ME program

Catalog Description: Introduction to mathematical modeling and response analysis of dynamic systems with mechanical, electrical, and fluid/thermal elements used in control systems. Concepts of analogous systems; transfer function and state space formulation; analysis in time-domain; analysis in frequency-domain; introduction to modern control theory.

Credits: 3

Contact Hours: 3

Prerequisite Courses: MA 36300 and ME 25100

Corequisite Courses: None

Prerequisites by Topics: Dynamics, Calculus, Linear algebra


Course Objectives: To introduce mathematical modeling and response analysis of dynamic systems with mechanical, electrical, and fluid/thermal elements used in control systems. Concepts of analogous systems; transfer function and state space formulation; analysis in time-domain; analysis in frequency-domain; introduction to modern control theory.

Course Outcomes: Students who successfully complete this course will be able to:

1. Model linear dynamic systems through understanding and practicing of (1, 7):
   - Fundamental physics laws
   - Mechanics laws
   - Simplifying/idealizing complex real world engineering problems
   - Deriving equations of motion that govern the physical behavior of mechanical, electrical, thermal/fluid, and combined systems

2. Predict and analyze the response of a system to a given input through understanding and practicing of (1, 7):
− Proper mathematical tools to solve differential equations of motion
− Time-domain analysis
− Frequency domain analysis
− State-space analysis

3. Analyze dynamic systems for controlled outputs through understanding and practicing of (1, 7):
   − Application of modern computing tools

4. Communicate effectively with other engineers through (3)
   − Presentation of technical reports

**Lecture Topics**

**Fundamentals of System Dynamics**

Introduction to System Dynamics
- Math review
- Terms and Definitions

The Laplace Transform
- Complex functions
- Laplace transforms of elementary function
- Final value theorem and initial value theorem
- Inverse Laplace transform
- Solving ODE’s with Laplace transform technique

**Modeling of Physical Systems and Equations of Motion**

Mechanical Systems
Electrical Systems and Electromechanical Systems
Fluid Systems and Thermal Systems

Transfer Function Approach to Modeling Dynamic Systems
State-Space Approach to Modeling Dynamic Systems

**System Response Analysis**

Time-Domain Analysis of Dynamic Systems
- transient response analysis of 1st and 2nd order systems
Frequency-Domain Analysis of Dynamic Systems
- Steady state (Frequency) response analysis of 1st and 2nd order systems

**Computer Usage**

Medium

**Laboratory Experience**

None

**Design Experience**

Low

**Coordinator**

Bongsu Kang, Ph.D.

**Date**

27 March 2018