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 (a, c, e):
   - Fundamental physics laws
   - Mechanics laws
   - Simplifying/idealizing complex real world engineering problems
2. Predict and analyze the response of a system to a given input through understanding and practicing of (a, c, e):
   - 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 (a, c, e, k):
   - Application of modern computing tools

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

30 September 2015