PURDUE UNIVERSITY FORT WAYNE | Department of Civil and Mechanical Engineering

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 with a minimum grade of C-
Corequisite Courses	None
Prerequisites by Topics	Dynamics, Calculus, Linear algebra
Textbook	Ogata, K., *System Dynamics*, Prentice Hall, current edition
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

<u>Fundamentals of System Dynamics</u>
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
<u>Modeling of Physical Systems and Equations of Motion</u>
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
<u>System Response Analysis</u>
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 12 October 2022