ME 3017 System Dynamics (Required)

Catalog Description: ME 3017 System Dynamics (3-0-3)

Prerequisites: ME 2016 Computing Techniques, ME 2202 Dynamics of Rigid Bodies, MATH 2403 Differential Equations (C or better), and ECE 3710 Circuits and Electronics

Dynamic modeling and simulation of systems with mechanical, hydraulic, thermal, and/or electrical elements. Frequency response analysis, stability, and feedback control design of dynamic systems.

Textbook: William J. Palm III, *System Dynamics*, 3rd Edition, McGraw-Hill College, 2013.

Reference: K. Ogata, *System Dynamics*, 4th Edition, Prentice-Hall, 2004.

Topics Covered:

1. Laplace transforms
2. Modeling of mechanical systems
3. Transfer function models
4. Modeling of electrical and electromechanical systems
5. Modeling of fluid and thermal systems
6. Time response analysis of linear dynamic systems
7. Computer simulation of dynamic systems
8. Frequency response of linear dynamic systems
9. Free vibration of multi-degree of freedom systems
10. Input-output stability and transient response analysis
11. Introduction to feedback control systems

Course Outcomes:

Outcome 1: To introduce students to mathematical modeling of dynamic systems in various engineering disciplines.

1.1 Students will demonstrate understanding of various mathematical models such as differential equation and transfer function models for dynamic systems.

1.2 The students will demonstrate the ability to formulate mathematical models for mechanical, electrical, fluid, and thermal systems.

1.3 The students will demonstrate the ability to model mixed systems such as electro-mechanical and hydro-mechanical systems.

Outcome 2: To develop students' skills in analyzing, simulating, and identifying dynamic systems based upon their input-output responses.

2.1 Students will demonstrate that they can derive and analyze time response (transient and steady-state) of linear dynamic systems.

2.2 Students will demonstrate the ability to formulate the frequency response of linear dynamic systems.

2.3 Students will demonstrate understanding of free vibrations of multi degree of freedom systems.

2.4 Students will demonstrate the ability to perform computer simulation of various dynamic system responses.

2.5 Students will demonstrate that they can apply time and frequency response analyses to system identification and design modification.

Outcome 3: To introduce students to design and analysis of basic feedback control systems.

3.1 Students will demonstrate understanding of dynamic system stability and transient response specifications.

3.2 Students will demonstrate understanding of block diagrams and how to reduce them.

3.3 Students will be able to design and analyze basic automatic controllers using algebraic techniques in the transfer domain.

3.4 Students will demonstrate the ability to apply feedback control to real-world engineering systems.

Correlation between Course Outcomes and Student Outcomes:

ME 3017											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X				X						X
Course Outcome 1.2	X										X
Course Outcome 1.3	X				X					X	X
Course Outcome 2.1	X										X
Course Outcome 2.2	X				X						X
Course Outcome 2.3	X										X
Course Outcome 2.4	X										X
Course Outcome 2.5	X				X						X
Course Outcome 3.1	X										X
Course Outcome 3.2	X										X
Course Outcome 3.3	X				X						X
Course Outcome 3.4	X				X				X	X	X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Nader Sadegh