ME 348: Dynamics Systems

Course description: Fundamentals of vibration analysis, control systems, system modeling and dynamics analysis.

Number of credits: 3. This course is required.

Course Coordinator: J Swensen

Prerequisites by course: ME 212; ME 313; certified major in Mechanical Engineering

Prerequisites by topic:

1. Dynamics
2. Differential Equations
3. Linear Algebra

Postrequisites: ME 401, ME 416, ME 449, ME 470, ME 475, ME 481

Textbooks/other required materials:

1. Ogata, K. *System Dynamics*. Pearson Prentice Hall, 2004, 4/e.

Course objectives:

1. To provide students with a review of dynamics.
2. To instruct students in the use of modeling mechanical, electrical, thermal, and fluid engineering systems.
3. To introduce students to the analysis of linear dynamical systems, vibrations, and control systems.

Topics covered:

1. Dynamics (review)
   a. Newtonian Mechanics, Translation, Rotation
2. Modeling Engineering Systems
   a. Laplace Transforms and Block Diagrams
   b. Mechanical, electrical, thermal, and fluid systems
3. Analysis of Linear Dynamical Systems
   a. Equilibrium solutions
   b. Linearization of nonlinear systems
   c. Solution of linear differential equations
   d. State space systems
   e. n-th order Input-Output ODEs
   f. Free response
   g. Forced response
   h. Eigenvalues and stability
   i. Eigenvectors, diagnolization, state transition matrix
4. Introduction to Vibrations
   a. Free vibrations
   b. Forced vibrations
   c. Frequency response (Sinusoidal inputs)
5. Introduction to Control Systems
   a. Feedback control systems

b. PID control
c. Transient response specifications

Expected learning outcomes:

1. Develop differential equations models for mechanical, electrical, and hydraulic systems.
2. Determine equilibrium solutions for nonlinear systems.
3. Develop linearized ODE models describing the motion of a dynamic system near equilibrium.
4. Solve the linearized ODE models for both free and forced responses.
5. Determine natural frequencies and mode shapes for n degree-of-freedom undamped vibrations.
6. Design simple feedback control systems to meet various performance specifications.

Class schedule: Three 50-minute lecture sessions per week, for one semester.

Laboratory schedule: None

Contribution to meeting the professional component: Engineering Topics

Relationship of course to student outcomes:
3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018 (ABET EC2000)

a	b	c	d	e	f	g	h	i	j	k
3										

Student Outcomes Fall 2018 forward (ABET EC2019)

1	2	3	4	5	6	7
3						

Prepared by: Andrea Butcherite and J. Swensen *Date:* May 30, 2018