Current Catalog Data: Analysis and implementation of linear closed-loop motion control systems containing electrical, hydraulic, pneumatic and mechanical components. Analytical and experimental development of models for components and systems.
3 credit hours (2 hours lecture, 3 hours laboratory)

Prerequisite Courses: ME 3600 or ECE 3710


Course Coordinator: Koorosh Naghshineh

Course Objectives: -To teach students about basic components of hydraulic actuation systems and simple hydraulic circuits
-To teach students analytical techniques for developing continuous transfer function models of motion control systems
-To teach students to design phase-lead, phase-lag, and PID compensators
-To advance students knowledge of concepts of data acquisition
-To teach students experimental techniques for developing continuous transfer function models of motion control systems
-To teach students analytical techniques for developing digital transfer function models of motion and control systems
-To teach students to implement a closed-loop motion control system
-To advance students knowledge of existing software tools for system dynamics and linear control system design

Topics: Hydraulic actuation system components (4 hours)
Simple hydraulic circuits (3 hours)
Modeling of component and system response (4 hours)
Measurement of component and system response (3 hours)
Transient and steady-state response (1 hour)
Root locus design of phase-lead, phase-lag, and PID compensators (4 hours)
Freq. response design of phase-lead and phase-lag compensators (4 hours)
Pre-filters (1 hour)
Design of PID compensators for ITAE Optimal Response (1 hour)
Control Effort (1 hour)
Data acquisition (2 hours)
System identification analysis software (2 hour)
Closed loop control implementation (3 hours)
Digital control methods (2 hours)

Class/Laboratory Schedule: Two 50-minute lecture classes and one 3-hour laboratory per week each semester.

Professional Component: This course is a Group 3 elective laboratory course for senior level students in the mechanical and electrical engineering programs. It builds on students knowledge of dynamics, differential equations, circuit analysis, and control systems. The course content is 100% engineering science.

Relationship to Student Outcomes: No student outcomes are assessed in this course; however the course content is related to the following ME outcomes.

**Mechanical Engineering (Outcome a1)**

(Outcome a1) An ability to apply knowledge of advanced mathematics through multivariate calculus and differential equations

(Outcome b) An ability to design and conduct experiments, as well as to analyze and interpret data

(Outcome e) An ability to identify, formulate, and solve engineering problems

(Outcome g1) An ability to write effectively

(Outcome k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared By: James W. Kamman, July 6, 2017