BAKER COLLEGE
STUDENT LEARNING OUTCOMES

ME4610 DYNAMIC SYSTEMS AND CONTROL

3 Semester Hours

Student Learning Outcomes and Enabling Objectives

1. Illustrate the conceptual design and build of control systems in modern engineering applications
    a. Introduce the basic history of control theory and practice
    b. Outline the elements of control system design in context of engineering design
    c. Distinguish between open-loop and closed loop control systems
2. Produce mathematical models of engineering systems to enable their control
    a. Construct mathematical models of physical systems using differential equations and linear approximations
    b. Apply Laplace transforms to obtain transfer functions
    c. Implement transfer functions and impulse response functions in modeling control systems.
    d. Use block diagram models to represent a control system.
3. Adapt basic state-space theory to control systems
    a. Employ block diagrams and signal flow graphs to create state variable models
    b. Apply mathematical models to solve problems involving the control of the following systems
        i. Mechanical Systems
        ii. Electrical Systems
        iii. Fluid Systems
4. Examine feedback control system characteristics
    a. Demonstrate the role error signals in analysis of control systems
    b. Relate the improvements afforded by feedback control in reducing system sensitivity to parameter changes.
    c. Apply transient-response analysis with and without computational software to solve problems involving the control of first order dynamic systems.
5. Illustrate the performance of feedback control systems
    a. Use test signals to observe resulting transient response characteristics of second-order systems
    b. Show relationship between pole locations of second order pole locations and transient response as defined by percent overshoot, settling time, rise time and time to peak.
    c. Apply transient response analysis to with and without computational software to solve problems involving the control of second order dynamic systems.
6. Assess stability of linear feedback systems

   a. Compare concepts of absolute and relative stability
   b. Show the relationship of the s-plane pole locations (for transfer function models) and of the eigenvalue locations (for state variable models) to system stability
   c. Construct a Routh array and employ the Routh-Hurwitz stability criterion to determine and optimize stability.
7. Adapt the Root Locus Method
   a. Demonstrate the concept of the root locus and its role in control system design
   b. Design a controller to meet desired specifications using the root locus methods
   c. Compare characteristics of PI, PD and PID controllers and discuss choice of controller vs application.

Project Student Learning Outcomes and Enabling Objectives

8. Complete a course project involving topics of the course integrating both transient and steady state response analysis of the system.
   a. Formulate mathematically the description of an engineering system with its controller and quantitatively describe system variables and desired performance specifications.
   b. Evaluate close loop control system response to variable inputs using Matlab and Simulink software.
   c. Validate controller design performance and system stability through computational software.
   d. Deliver a comprehensive technical presentation.

These SLOs are not approved for experiential credit.

Effective: Fall 2017