

ECE 317: Feedback and Control Systems

Catalog Description

Control of continuous single-input/single-output linear systems using classical feedback techniques. Time and frequency domain analysis. Design in the s-plane and frequency domain. Use of time and frequency system identification techniques for developing plant models. Design of feedback compensators for steady-state error reduction, disturbance rejection, transient stability, and dynamic response.

Credit hours: 4

Goals

This course introduces classical control theory for the feedback design of continuous time single-input single-output (SISO) systems. Students will learn to apply classical control principles to the design of continuous time control system and operate software that aids in the design process.

Prerequisites

ECE 316

Course Coordinator and Committee

James McNames (coordinator)

Fu Li

John Lipor

Mark Martin

Textbook

Feedback Control of Dynamic Systems, eighth edition, G. F. Franklin, J. D. Powell, and A. Emami-Naeini, Pearson, 2019.

The course instructor may choose to use a different textbook. Please check with your instructor before purchasing.

Learning Outcomes

At the end of this course, students will be able to:

1. Derive mathematical models for physical systems using differential equations, transfer functions, and empirical system identification.
2. Analyze transient response and steady-state error of first- and second-order feedback systems.
3. Design PID, lead, lag, and lead-lag compensators to meet time-domain and frequency-domain specifications.
4. Assess absolute and relative stability using root locus, Bode plots, and Nyquist criteria.
5. Use computational tools to simulate, analyze, and tune closed-loop control systems.
6. Implement digital controllers by discretizing continuous-time designs using standard methods.

Topical Outline

- Overview of feedback control and closed-loop architectures.
- Dynamic modeling of electrical and mechanical systems in the s-domain.
- Linearization of nonlinear systems around operating points.
- Transient response of first- and second-order systems; Routh-Hurwitz stability criterion.
- Steady-state error analysis and system type.
- Design and tuning of PID controllers.
- Root locus analysis and design of lead, lag, and lead-lag compensators.
- Frequency response analysis: Bode and Nyquist plots, gain and phase margins.
- Digital control: controller discretization and implementation.

Course Structure and Grading Criteria

Teaching method will primarily be hundred-minute lectures twice each week. The grade is based on in-class exams, in-class quizzes, a final exam, and a project. For details of the grading criteria, please see the syllabus provided by your instructor.

Relevant Program Outcomes

The following program outcomes are supported by this course:

(1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(5) An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives

Prepared By: James McNames

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