MAE 143B (4 units)
Linear Control

Class/Laboratory Schedule: four hours of lecture, eight hours outside preparation.
12 hours/week total

Course Coordinator(s): Mauricio de Oliveira

Textbooks/Materials:
1. Feedback Control of Dynamic Systems, by Franklin, Powell, and Emami-Naeini
2. Feedback Systems: An Introduction for Scientists and Engineers, by Astrom and Murray.

Catalog Description: Analysis and design of feedback systems in the frequency domain. Transfer functions. Time response specifications. PID controllers and Ziegler-Nichols tuning. Stability via Routh-Hurwitz test. Root locus method. Frequence response: Bode and Nyquist diagrams. Dynamic compensators, phase-lead and phaselag. Actuator saturation and integrator windup.

Prerequisites: MAE 143A or CENG 100 (Grade C- or higher).

- ■ Required Course
- □ Technical Elective Course
- □ Other: _____

Performance Criteria:

Objective 1:
1.1 Students will demonstrate understand of how to find a closed loop transfer function of a complex block diagram involving feedback interconnections
1.2 Students will demonstrate the ability to select system parameters to meet performance specifications in time domain and to achieve closed-loop stability

Objective 2:
2.1 Students will demonstrate understanding of how to select the controller gain, as well as the poles and zeros of phase-lead and phase-lag compensators, to place closed-loop poles in a desired region in the complex plane
2.2 Students will demonstrate the ability to determine phase and gain margins in Bode and Nyquist plots
2.3 Students will demonstrate the understanding of how to obtain the information needed to apply the Ziegler-Nichols tuning rules for PID controllers

Objective 3:
3.1 Students will demonstrate the ability to relate examples from basic control applications to control objectives, choices of control inputs and outputs, and choices of compensator types for particular applications

Course Objectives:
(Numbers in parentheses refer to MAE Program Outcomes)

Objective 1: To teach the students the mathematical methods for analysis of performance and stability of feedback systems (1a, 5e, 11k)

Objective 2: To introduce the students to the basics of design of feedback control systems (1a, 3c, 5e, 11k)

Objective 3: To introduce the students to elementary applications of control systems from a broad array of problems in aerospace and mechanical engineering (1a, 3c, 5e, 11k)

Course Topics:

1. Transfer functions and block diagram algebra.
2. Time response specifications.
3. PID controllers and Ziegler-Nichols tuning.
4. Steady-state response and system types.
5. Stability via Routh-Hurwitz test.
6. Root locus method.
7. Frequency response: Bode and Nyquist diagrams.
8. Dynamic compensators, phase-lead and phase-lag.
9. Actuator saturation and integrator wind-up.

Prepared by: Miroslav Krstic, July 2007
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