MECH 466: AUTOMATIC CONTROL

4 Credits, First Semester (MWF 12:00-12:50 hours)

Room: West Mall Swing Space (SWNG) Room 122

Instructor
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Prerequisite: One of EECE 251, EECE 263, PHYS 209 [3-2*-0]

Course Objectives

This introductory course in control systems deals with modeling, response analysis, and control of dynamic systems, and the analysis and design of control systems. The objective of control is to make a ***dynamic system*** (***plant*** or ***process***) behave in a desired manner, according some ***performance specifications***. The system can be quite complex and may be subjected to known and unknown excitations (***inputs***), as in the case of an aircraft. The system may have many responses (***outputs***) as well. The device or means that generates the control signal (or, control command) according to some scheme (or, ***control law***) and that controls the response of the plant, is called the ***controller***. To determine a control action in ***feedback control***, the controller compares the measured response signals with their desired values. The plant and the controller are the two essential components of a ***control system***. A ***compensator*** (analog or digital; hardware or software) may be employed as well to improve the system performance or to enhance the controller. Modern control techniques are applicable in every branch of engineering, particularly in mechanical engineering and mechatronic systems. In ***time-domain*** techniques, the system is represented as a set of differential equations whose independent variable is time (t). In ***frequency-domain*** techniques, the system is represented as a set of input-output relations called transfer functions whose independent variable is frequency (ω). Topics covered in the course include analytical models, model linearization, response analysis, performance specification, stability analysis, root locus method, Bode plots, Nyquist criterion, system compensation, controller design, and digital computer control. Laboratory experiments will complement the lecture content.

Textbook:
De Silva, C.W., *Modeling and Control of Engineering Systems*, CRC Press/Taylor&Francis, Boca Raton, FL, 2009.

Further Reading:
De Silva, C.W., *Sensors and Actuators—Control System Instrumentation*, CRC Press/Taylor&Francis, Boca Raton, FL, 2007.

MECH 466 -- COURSE LAYOUT

Week	Starts	Topics	Read
1	Sep 06	Introduction; Control Engineering	Chapter 1
2	Sep 11	Performance Specification; Analytical Modeling	Chapter 2
3	Sep 18	Analogies; State Space Models	Chapters 2, 4
4	Sep 25	DC Motor; Model Linearization	Chapter 3
5	Oct 02	Transfer Functions; DC Motor Control	Chapter 5
6	Oct 11	Time Response Analysis	Chapter 6
7	Oct 16	Control Methods; Error Constants; Sensitivity	Chapter 7
8	Oct 23	Control Methods; Error Constants; Sensitivity	Chapter 7
9	Oct 30	Stability Analysis; Routh-Hurwitz Criterion	Chapter 8
(Mid-term examination will be held on Monday, October 30, in class)			
10	Nov 06	Root Locus Method	Chapter 8
11	Nov 13	Frequency Domain Analysis; Bode and Nyquist Diagrams; Nyquist Criterion	Chapter 8
12	Nov 20	Lead and Lag Compensator Design	Chapter 9
13	Nov 27	Digital Control; Review	Chapter 10

Grade Composition

Laboratory Exercises (Five)	10%
Mid-Term Examination	20%
Final Examination	70%
Total	100%

Student Help: Office Hours: M, W, 3:00-4:00 p.m. Also, you may send me e-mail with your questions. Other face-to-face meetings can be scheduled if needed.