University of Dayton
Dept. Electrical and Computer Engineering

ECE 415 Control Systems – Fall 2008

Instructor: Prof. Raúl Ordóñez, KL341-E, raul.ordonez@notes.udayton.edu
Office Hours: You can come almost any time I am there, but please try to make an appointment. Official office hours are M, W, 14h00-15h30.

Text: *Modern Control Systems*, R. C. Dorf, R. H. Bishop, 10th edition, Prentice Hall, 2005.

Objective: In this class you will learn, and understand how to use, the fundamental concept of feedback. You will become able to quantitatively describe electro-mechanical and other types of systems as mathematical models using differential equations. You will be intimately acquainted with the Laplace transform and will learn to analyze, design and simulate control systems that take advantage of feedback to make devices do what you want them to do.

Grading:	Homework	10%
(Tentative)	Quizzes (two or three)	15%
	Midterm	25%
	Computer Projects	25%
	Final Exam	25%

Miscellaneous:

- Homework will be assigned regularly (possibly every Wednesday) and a 0/100% grading scheme will be used (you get full credit for turning the homework in and attempting all problems assigned; you get zero credit in all other instances).
- All assignments must be completed as a course requirement; penalty for late work will be severe – however, talk to me if you have special circumstances.
- You are responsible for any and all alterations in homework assignments, exam and quiz dates, and course announcements in general which occur in the lecture. In other words, come to class!
- All tests are closed book.
- There will be several design problems where you will be expected to use the theoretical concepts from the course and the CAD package MATLAB to design controllers for various physical systems (e.g., motors, aircraft, robots, etc.).

Course homepage: http://homepages.udayton.edu/~ordonez/courses.html
Click on 415 for the syllabus and 'quickplace' for a link to the quickplace page, where additional course material will be located. You can access the page using the '415student' account. If you would like to add content to this page (e.g., to upload documents, simulations, start discussions, etc., send me an email.)

Outline of topics

1. Introduction: the control problem.
2. General system concepts.
3. Mathematical models of systems (Ch. 2).
   - 3.1. Differential equations of physical systems.
   - 3.2. The Laplace transform.
   - 3.3. Convolution.
   - 3.4. Transfer function and block diagrams.
4. Feedback control (Ch. 4)
   - 4.1. Disturbance rejection: a case study of speed control.
   - 4.2. Sensitivity to variation in parameters.
   - 4.3. Steady-state error and transient response of control systems.

5. Performance of feedback control systems (Ch. 5)
    5.1. Steady-state tracking and system type - test signals.
    5.2. Time-domain specifications: second order systems.
    5.3. Effects of zeros and additional poles.
6. Stability of linear systems (Ch. 6)
    6.1. Bounded-input, bounded-output stability.
    6.2. Routh-Hurwitz's stability criterion.
    6.3. Kharitanov's stability criterion (time permitting).
7. The root-locus design method (Chs. 7 and 10).
    7.1. Root-locus of a basic feedback system: the concept.
    7.2. Guidelines for sketching a root-locus.
    7.3. Selecting gain from the root-locus.
    7.4. Lead, lag and PID controller design.
    7.5. Systems with delay (time permitting).
8. Frequency response design methods (Chs. 8 and 9).
    8.1. Bode plots of magnitude and phase.
    8.2. Guidelines for drawing Bode plots.
    8.3. Stability.
    8.4. The Nyquist stability criterion.
    8.5. Relationship between Bode and Nyquist plots – how to draw Nyquist plots.
    8.6. Stability margins.
    8.7. Bode's gain-phase relationship.
9. Feedback control system design in-depth (Ch. 10)
    9.1. PD compensation.
    9.2. Lead compensation.
    9.3. PI compensation.
    9.4. Lag compensation.
    9.5. PID compensation.
    9.6. Sensitivity.