

EE 4136 Control Systems Analysis

University of Colorado, Denver
College of Engineering and Applied Science

Term: Fall 2009
Course date/time: Friday, 06:15-09:00PM
Course location: NC 1511

Instructor: Dr. Tzung-Sz Shen
Email address: Tzung-Sz.Shen@cudenver.edu
Grader: Xinyue Niu (niu821213@gmail.com)

Course Design

Course Description: Introduce students to the fundamentals of analysis and design of feedback control systems. (Prereq: EE 3316, Linear Systems Theory; and prereq or coreq: EE 3817, Engineering Probability and Statistics).

Course Objectives: The students will learn the mathematical knowledge as well as computer skill for the analysis and design of feedback control systems. They will be applied to complete a project assignment.

Requirements

Required Texts: Gene F. Franklin, David Powell, and Abbas Emami-Naeini, Feedback and Control of Dynamic Systems, Pearson Prentice Hall, 5th Ed., 2006 (ISBN: 0-13-149930-0).

Lecture Notes (will be prepared by the instructor and distributed before the lecture)

Recommended Texts: Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 4th Edition, 2001 (ISBN: 0-13-060907-2).

Required Software: Matlab/Simulink software is used throughout this class. Students are required to learn and apply the software tool for assignments. The following is a list of references and useful links:

- Katsuhiko Ogata, Matlab for Control Engineers, Pearson Prentice Hall, 2008 (ISBN: 0-13-615077-2).
- CMU Control Tutorial for Matlab & Simulink, <http://www.library.cmu.edu/ctms/ctms/index.htm>
- Matlab Primer by K. Sigmon, <http://math.ucsd.edu/~driver/21d-s99/matlab-primer.html#toc>
- Matlab online documentation, <http://www.mathworks.com/access/helpdesk/help/helpdesk.html>

Assignments and Examinations:

Homeworks – Assigned weekly except midterm/final exams and report due dates. Homework must be turned in before the lecture of the following week, emailed, or dropped in the instructor's mailbox inside EE department office. **No credit for late assignment!**

Project – A team of two students will work on a project to analyze and design a computer-control system by software simulation. *The reports must be able to demonstrate your project work within the constrained length.* Points will be deducted for excessive report pages. A list of references is required in the reports.

- (1) Project definition (half page, due on Sep. 11): include project title, team members, objectives, and a brief project description.
- (2) Progress report (up to 3 pages, due on Oct. 09): describe system configuration/dynamics, issues, design requirements, and/or current results.
- (3) Final report (up to 6 pages, excluding Appendix, due on Nov. 20).

Examinations – Midterm (Oct. 16) and final (Dec. 11) are closed-book in-class written examinations. A one-page letter-size sheet of notes is allowed.

Assessment Design

Grades:

The weights of the assignments and examinations are listed below. The final grade will be graded on a curve.

Homework	20%
Project	20% (2% project definition, 6% progress report, 12% final report)
Examinations	50% (25% Midterm, 25% Final)
Class/Workshop Participation	10% (In-class workshop exercises won't be graded but must be turned in.)

The homework solution is given and discussed in the class on the due day. Graded assignments and exams (with solutions) will be returned in class in the following week.

Course Policies:

- **Late homework or project assignments will be given no credit. No make-up exams will be given.** In case of illnesses or family emergency, you must contact (email) the instructor prior to the due date for an extension or exception. Contact Janiece Hockaday, EE Administrative Assistant, at (303) 556-4718 or 556-2872, to reach the instructor for urgent matters.
- Class participation is graded based on workshop exercise returns.
- Group discussions on homeworks and the project are encouraged, but plagiarism is prohibited.

Course Schedule

Date	Topic	Reading Assignment [Lecture Note]	Homework Due Date
Aug. 21	Introduction, Linear system review	Ch.1, 3.1 [LN1]	
Aug. 28	Review: Dynamic models	Ch.2, 3.2 [LN2]	#1 (8/28)
Aug. 28, Sep. 04	Dynamic response (Matlab/Simulink Tutorial 1)	3.3-3.7 [LN3]	#2 (9/04)
Sep. 11, Sep. 18	Basic properties of feedback (Matlab/Simulink Tutorial 2)	Ch. 4 [LN4]	#4(9/11) #5(9/18)
	<i>Project definition due on Sep. 11</i>		
Sep. 25	Root locus of a feedback system	5.1-5.3 [LN5]	#6 (9/25)
Oct. 02, Oct. 09	Root locus design (Midterm review)	5.4-5.7 [LN6]	#7 (10/02)
	<i>Progress report due on Oct. 09</i>		
Oct. 16	Midterm exam		
Oct. 23, Oct. 30	Frequency-response and stability	6.1-6.6 [LN7]	#8 (10/30)
Oct. 30, Nov. 06	Frequency-response design method	6.7 [LN8]	#9 (11/06)
Nov. 13	Control system analysis in state space	7.1-7.4 [LN9]	#10 (11/13)
Nov. 20	Control law design	7.5-7.6 [LN10]	
	<i>Final report due on Nov. 20</i>		
Nov. 27	Fall break, No class		
Dec. 04	Estimator design (Final review)	7.7 [LN10]	#11 (12/04)
Dec. 11	Final exam		

Course Communication

- Office Hours: Friday 5:45-6:15PM, 9:00-10:00PM (EE Conference Room)
- E-mail communication with the instructor is preferred besides the office hours.
- Any updates or changes of the syllabus, dates, or assignments will be announced in class and/or communicated by email. You are required to provide an email address, and responsible to inform the instructor promptly for any change.

Students Called for Military Duty

- If you are a student in the military with the potential of being called to military service and /or training during the course of the semester, you are encouraged to contact Paul Rakowski.

Project Work Suggestions

- Team work!
- Understand the dynamics of the system. Identify issues and challenges of the system.
- Define appropriate design specifications based on system performance requirement.
- Design controllers and implement them in the simulation.
- Have the goals been achieved? If not, why? What else can you do for improvement?
- Literature review resource: CU Library Article Databases Indexes (“Engineering Village” & “IEEE Xplore” are highly recommended), <http://library.auraria.edu/findit/databasesindexes/dbaseindex.php>