

EML 4312 - Spring 2009

Control of Mechanical Engineering Systems

Instructor: Dr. Prabir Barooah Class time: period 8 (3:00-3:50 pm) MWF
Office: MAE-A 322 Class location: WEIL 270
E-mail: pbarooah at ufl.edu Office Hours: 5 - 6 pm, MW
Office Phone: 352.392.0614

Course website

Please check the course website regularly for updates and announcements:

<http://humdoi.mae.ufl.edu/~prabirbarooah/EML4312S09.html>

Textbook

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

Teaching Assistants

Siddharth Mehta (siddhart at ufl.edu), office hours: Tuesday, period 8 (3-4 pm)

Chenda Liao (cdliao at ufl.edu), office hours: Tuesday, period 8 (3-4 pm)

He Hao (hehao at ufl.edu), office hours: Thursday, period 8 (3-4 pm)

Course Outline

Overview of feedback control, advantages of feedback control, control system architecture.

Mathematical models of physical processes, dynamical systems, ordinary differential equations (ODEs), trajectories, stability notions.

Linear ODEs and linearization, Linear time invariant (LTI) systems, first order systems and their trajectories.

Laplace transforms of signals, properties of Laplace transforms, trajectories of second order systems using Laplace transforms,

Higher order systems, transfer functions, partial fraction expansion, trajectories of higher order systems using Laplace transform and partial fraction expansion.

Stability of linear systems, poles and zeros of transfer functions.

Root locus.

Nyquist plot and Bode plot (frequency response), response to sinusoidal signals, experimental identification of transfer functions. Nyquist stability criteria.

Control design objectives, sensitivity and complimentary sensitivity.

Classical controller structures: P, PI, and PID controller, lead, lag and lead-lag controller.

State-space representation of LTI systems, realization, controllability and observability, state feedback control.

(time permitting) Discrete-time systems, Z -transforms, digital control.

Course prerequisites

MAP 2302, EGM 3400 or EGM 3401. (MAP 4403 is encouraged, though not a prerequisite)

Evaluation criteria

Grading will be based on three exams (25%, 25%, 40%) and two mini-projects ($5 + 5 = 10\%$).

The first exam is *tentatively* scheduled on Feb 18, 2009, in class.

The second exam is *tentatively* scheduled on March 27, 2009, in class.

The third exam will be given during the final exam time determined by the university, which is 3:00 - 5:00 p.m. on Tuesday, April 28, 2009.

The first two in-class exams are budgeted at 45 minutes each. The third exam is budgeted for 1 hr 50 minutes.

homeworks

Homeworks will be assigned (through the course website) at regular intervals throughout the semester. Homeworks will not be graded and *will not count* towards your grade. However, you are strongly encouraged to do all the assigned homeworks problems, for several reasons. First, without doing the homework problems, you'll get very little out of this class. Second, approximately 20% of the test problems will come from the homeworks (either directly or with minimal changes).

Make up exams etc.

If you have to miss an exam, you must see the instructor and make arrangements in advance unless an emergency makes this impossible.

Computers, Calculators etc.

MATLAB, with the "Control Systems Toolbox" is required to solve some homework problems as well as the mini-projects. You may want to purchase the student version of MATLAB. The full version (including many toolboxes) is available in the MAE Undergraduate Computer Lab in NEB 109, and at CIRCA computer clusters campuswide (labs.circa.ufl.edu).

You should bring a calculator to class and to the exams. Cellular phones, PDAs, etc. will NOT be allowed in place of calculators.

Class Conduct

Although you are expected to know all the material covered in class, attendance in class is not mandatory. In case you decide to come to class, please follow these guidelines:

- Arrive on time.
- Again, arrive on time. Arriving a few minutes late is tolerated as long as you make an effort to minimize the disturbance to other students.
- Keep eating and drinking in class to a minimum.
- Avoid dozing off in class. At the minimum, be sure not to make a spectacle of yourself.
- Turn off your cell phone, or better, don't even bring them.
- If you have to leave a class early (or temporarily), try not to stomp on your way out (or in).

Students with Disabilities

The University of Florida provides high-quality services to students with disabilities, and we encourage

you to take advantage of them. Students with disabilities needing academic accommodations should 1) Register with and provide documentation to Disability Resources (392-1261), and 2) Bring a letter to the instructor from this office indicating that you need academic accommodations. Please do this as soon as possible, preferably within the first week of class.

Academic Integrity

All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action.

For this class, my policies with regards to cheating are as follows:

- If you talk to anyone other than the proctors during an exam, you will get a 0 in that exam. If you repeat the offense, I will give you a fail grade *E* in the class.
- If you turn in someone else's work as your own in the mini-projects, you'll get zero in that project. If you repeat this offense, you'll get a fail grade in the class.

If you are accused of academic dishonesty in this class that you don't agree with, you can seek resolution through UF's Office of Student Conduct and Conflict Resolution. Their phone number is 392 – 1261.