

CALIFORNIA INSTITUTE OF TECHNOLOGY
Control and Dynamical Systems

CDS 101 - Analysis and Design of Feedback Systems
CDS 110 - Introduction to Control Theory
Fall 2007

Instructor

R. Murray, 109 Steele
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Office hours: Fri, 3–4 pm (by appt)

Teaching Assistants

Julia Braman, Elisa Franco, Sawyer Fuller
George Hines, Luis Soto (cds101-tas@cds)
Office hours: Sun 4–6 pm, 110 STL

Lectures: MW 2-3 pm, 74 Jorgensen

Recitations: Fri 2-3 pm, rooms TBD

Course Overview CDS 101/110 provides an introduction to feedback and control in physical, biological, engineering, and information sciences. Basic principles of feedback and its use as a tool for altering the dynamics of systems and managing uncertainty. Key themes throughout the course will include input/output response, modeling and model reduction, linear versus nonlinear models, and local versus global behavior.

CDS 101 is a 6 unit (2-0-4) class intended for advanced students in science and engineering who are interested in the principles and tools of feedback control, but not the analytical techniques for design and synthesis of control systems. CDS 110 is a 9 unit class (3-0-6) that provides a traditional first course in control for engineers and applied scientists. It assumes a stronger mathematical background, including working knowledge of linear algebra and ODEs. Familiarity with complex variables (Laplace transforms, residue theory) is helpful but not required.

Class homepage Information on the class is available via the class homepage: <http://www.cds.caltech.edu/~murray/cds101>. All course handouts and other administrative data about the course are available via the class homepage.

Lectures, Recitation Sections and Office Hours The main course lectures are on MW from 2–3 pm in 74 Jorgansen. CDS 101 students are not required to attend the Wednesday lectures, although they are welcome to do so. In addition to the main lectures, a series of problem solving (recitation) sessions are run by the course teaching assistants and given on Fridays from 2–3 p m. The recitation session locations will be determined in the first week of classes and will be posted on the course web page.

The TAs will hold office hours on Sundays from 4-6 pm in 112 Steele (CDS library). *All students must show up for office hours or recitation at least once in the first three weeks of the course (even if you just stop in and introduce yourself to the TAs at office hours).*

Grading The final grade will be based on homework sets, a midterm exam, and a final exam:

Homework (50%): Homework sets will be handed out weekly and due on Mondays by 5 pm to the box outside of 109 Steele. A grace period of two days is allowed in turning in your homework. *Late homework beyond the grace period will not be accepted without a medical excuse and/or the approval of the Dean.*

Midterm exam (20%): A midterm exam will be handed out at the beginning of midterms week (25 Oct) and due at the end of the midterm examination period (31 Oct). The midterm exam will be open book and computers will be allowed (though not required).

Final exam (30%): The final exam will be handed out on the last day of class (1 Dec) and due at the end of finals week. It will be an open book exam and computers will be allowed (though not required).

Homework policy Collaboration on homework assignments is encouraged. You may consult outside reference materials, other students, the TA, or the instructor, but you cannot consult homework solutions from prior years and you must cite any use of material from outside references. All solutions that are handed in should be written up individually and should reflect your own understanding of the subject matter at

the time of writing. MATLAB scripts and plots are considered part of your writeup and should be done individually (you can share ideas, but not code).

Software Computer exercises will be assigned as part of the regular homeworks. The exercises are designed to be done in MATLAB, using the Control Toolbox and SIMULINK. Caltech has a site license for this software and it may be obtained from ITS (Caltech students only):

<http://software.caltech.edu>

An online tutorial is available at

<http://www.engin.umich.edu/group/ctm/basic/basic.html>

Course Text The primary course text is

- K. J. Åström and R. M. Murray, *Analysis and Design of Feedback Systems*, Preprint, 2007.

This book is available in the bookstore and can also be obtained online (as PDF files). Additional online references may be found on the course homepage or in the Sherman Fairchild Library.

Course outline

Week	Topic
1	Intro to feedback and control (Fri: MATLAB tutorial)
2	Dynamics and modeling (Fri: SIMULINK tutorial)
3	Stability and performance
4	Linear control systems
5	Reachability and state feedback (Fri: Midterm review)
6	Transfer functions
7	Loop analysis of feedback systems
8	PID control (Fri: no class)
9	Frequency domain design
10	Robust performance (Fri: Final review)