Syllabus

Lecture Hudson Hall 208, MF 1:25 pm–2:40 pm

Laboratory Hudson Hall 149

Tu	10:05 am–1:00 pm	W	10:05 am–1:00 pm
Tu	1:25 pm–4:20 pm	W	1:25 pm–4:20 pm

Instructor Dr. Genevieve Lipp, *Office:* Hudson 226, *Email:* genevieve.lipp@duke.edu
Office hours are Wednesday 9:00 am–11:00 am or by appointment.

Teaching assistants

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Course description Control systems, both human-made and natural, are an integral part of modern life. Space shuttles, machining processes, and hormonal regulation all rely on automatically controlled systems. Throughout this course, you will build the fundamental skills to analyze and design feedback systems that have the desired behavior, which you can use in a career as a control systems engineer—or in your senior design project.

Learning objectives By the end of this course, you will be able to:

- Identify design objectives for control systems, and choose appropriate analysis techniques to meet each one;
- Model electrical, mechanical, and electromechanical systems using block diagrams and signal-flow graphs;
- Represent systems in the frequency domain by finding the transfer function, or in the time domain using a state-space approach;
- Investigate the stability of a system;
- Analyze and design elements of a system's transient response;
- Analyze the steady-state error of a system for different input forms; and
- Use root-locus techniques to design for stability and desired transient response.

Textbook *Control Systems Engineering*, seventh edition, by Norman S. Nise
Ask instructor if you would like to use a different edition.

Sakai Assignments and other important course information is available on Sakai: log in to `https://sakai.duke.edu/portal/site/controlsf17`, or `sakai.duke.edu` and this course will be listed under your Sites. Most of the course content will be under the Lessons tab, where you can find each week's assignments.

Grading scheme

Homework	10%
Participation	10%
Laboratories	30%
Test 1	10%
Test 2	20%
Test 3	20%

Much of your learning in this course will happen as you work through ten **homework** assignments. These will be graded for completion, since the primary purpose is to give you a chance to practice the skills introduced in your reading and in lecture. You are welcome to work with classmates, but be mindful of whether *you* are developing each skill. You will turn in your homework assignments by scanning an image of your work and attaching it to the corresponding assignment in Sakai.

Participation in the course is paramount. This can take many forms, but some expectations are that you come to class prepared, ask and answer questions on Piazza, and make use of instructor and TA office hours. Your grade for participation will be based on reading quizzes due before most classes, meeting a minimum of posts on Piazza, and attending and being involved in class.

There are seven **laboratory assignments** and a final project that will contribute to your laboratory grade. For labs with a written component, you will be allowed to work in groups of three to four and turn in one copy, but the role of "first author" must rotate.

Three **tests** will be given to assess your progress in the course. You will decide as a class whether you would like a formula sheet or to make your own notecard as a reference for each test. Prior to each test, the instructor will provide a list of learning objectives you can use as a study guide. An optional final will be available to anyone who would like to replace their lowest test grade with their final score. If you need to miss a test or require other accommodations, please inform the instructor at least two weeks in advance.

The instructor reserves the right to adjust class test grades (never lower) as she deems appropriate. Your final letter grade will correspond to your weighted average according to the usual scheme:

	$X-$	X	$X+$
A	90–92.9	93–96.9	97–100
B	80–82.9	83–86.9	87–89.9
C	70–72.9	73–76.9	77–79.9
D	60–62.9	63–66.9	67–69.9
F		< 60	

Conduct expectations It is the expectation that students, TAs, and the instructor will regard each other with mutual respect.

Students will abide by the Duke Community Standard:
I will not lie, cheat, or steal in my academic endeavors;
I will conduct myself honorably in all my endeavors; and
I will act if the Standard is compromised.

Support Control systems is a challenging discipline, but you have many options for getting help. Instructor and TA office hours are great places to get help with something you didn't understand in class or a homework problem you're stuck on. You can ask questions of your colleages on Piazza. TAs and the lab manager will be available during your lab sections. While you are responsible for your own learning, you have many people and resources to support you in this challenge.

Schedule

Week	Date	Topic	HW	Lab
1	8/28 9/1	Welcome, history, modeling Laplace transform, PFE review		No lab
2	9/4 9/8	Electrical networks in the freq. domain Mechanical systems in the freq. domain	 HW 1	1 Introduction to Maple
3	9/11 9/15	Motors and electromechanical systems Time response	 HW 2	2 DAQ, aliasing, and quantization
4	9/18 9/22	Time response cont. Test review		3 Instrumentation basics and Simulink
5	9/25 9/29	TEST 1 (Ch 1, 2) Reduction of multiple subsystems	 HW 3	4 Comp tools for transfer fcns and sim
6	10/2 10/6	Reduction of multiple subsystems cont. Stability		5 Loudspeaker dynamics
7	10/9 10/13	FALL BREAK Stability cont.	 HW 4	No lab
8	10/16 10/20	Steady-state errors Steady-state errors cont.	 HW 5	6 Motor simulation
9	10/23 10/27	Root locus definition Test review	 HW 6	MagLev intro—RC demo
10	10/30 11/3	TEST 2 (Ch 4, 5, 6, 7) Sketching the root locus		7 Record player lab
11	11/6 11/10	Root locus cont. Root locus and design	 HW 7	Project open hours
12	11/13 11/17	Root locus and design cont. Modeling in the time domain		Project open hours
13	11/20 11/24	Modeling in the time domain cont. THANKSGIVING BREAK	HW 8	No lab
14	11/27 12/1	Frequency response techniques Test review	 HW 9	MagLev presentations
15	12/4 12/8	TEST 3 (Ch 8, 9, 3, 10) Test return, review	 HW 10	MagLev report due
16	12/16	Optional final exam 7:00 pm–10:00 pm		