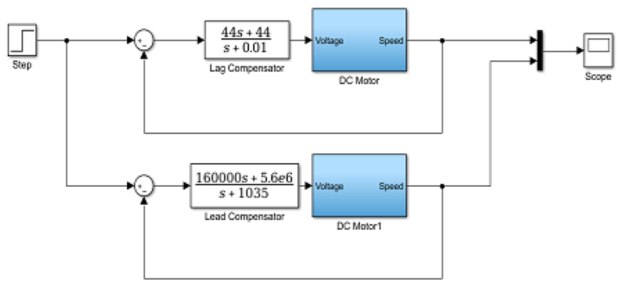
ECE 171A: Linear Control System Theory
Fall 2022 Syllabus



Instructors

- **Instructor**: Nikolay Atanasov, Assistant Professor, ECE, natanasov@ucsd.edu
- **Teaching Assistant**: Shrey Kansal, Graduate Student, MAE, skansal@ucsd.edu

Time and Location

- **Lectures**: Monday and Wednesday, 5:00 pm - 6:20 pm, in PCYNH 121
- **Discussion**: Monday, 3:00 pm - 3:50 pm, in CENTR 222
- **Office Hours**: Friday, 11:00 am - 12:00 pm, on Zoom
- **Final Exam**: Thursday, December 08, 2022, 8:00 am - 11:00 am

Course Description

This is an undergraduate course on classical control theory. The course focuses on single-input single-output linear time-invariant control systems emphasizing frequency-domain methods. The topics include modeling of feedback control systems, transient and steady-state behavior, Laplace transform, stability, root locus, frequency response, Bode plots, Nyquist plots, Nichols plots, PID control and loop shaping.

In addition to attending in-person lectures, the students are expected to sign up on Piazza and GradeScope. Discussion and important announcements will happen on Piazza. The homework should be turned in and will be graded on GradeScope.

Prerequisites

- **Calculus**: derivatives, integration, exponential function, Taylor series
- **Introductory physics**: Newton's law, Ohm's law, Kirchhoff's voltage and current laws
- **Programming experience**: Matlab, Python, or similar language
- **Optional**: ordinary differential equations, linear algebra

These prerequisites are fulfilled by **ECE 45: Circuits and Systems or MAE 40: Linear Circuits**. It is expected that the students have access to Matlab, which will be used for some of the homework problems.

Grading

- The class assignments consist of several homework sets (45% of the grade), a midterm exam (25% of the grade), and a final exam (30% of the grade).
- The due date of each homework will be clearly stated when the assignment is released. Late submissions and deadline extensions will **not** be possible because the course schedule is tight.
- The midterm and final exam will be in-class, closed-book, closed-notes, and no electronics will be allowed except calculators. One letter-size sheet of notes (single-sided for the midterm, double-sided for the final) will be allowded.
- A standard grade scale (e.g., 93%+ = A) will be used with a curve based on the class performance (e.g., if the top students have grades in the 83%-86% range, then this will correspond to letter grade A).

References

- **Primary Textbook**: The main reference for the course will be:
  - Feedback Systems: Åström & Murray
- **Additional References**: There are many excellent books on control systems theory. While none of these will be required to follow the course, this list may be useful if you want to consult additional references:
  - Modern Control Systems: Dorf & Bishop
  - Feedback Control of Dynamic Systems: Franklin, Powell & Emami-Naeini
  - Automatic Control Systems: Kuo & Golnaraghi
  - Control System Design: Goodwin, Graebe & Salgado
  - A Mathematical Approach to Classical Control: Lewis
- **Online References**: There are also many excellent online resources for control systems theory. Here is a recommended YouTube playlist:
  - Brian Douglas's Classical Control Theory

Academic Integrity

Integrity of scholarship is essential for an academic community. To protect the validity of intellectual work both faculty and students must honor this principle. For students, this means that all academic work will be done by the individual to whom it is assigned, without unauthorized aid of any kind. It is dishonest to cheat on exams, copy other people's work, or fake experimental results. Cheating, plagiarism and any other form of academic dishonesty will not be tolerated. An important element of academic integrity is also fully and correctly acknowledging any materials taken from the work of others. Never claim work or ideas to be yours if they are not, and never aid others in cheating, e.g., by offering them your solutions. Do not upload solutions or assignments online, even after you have finished the course. You are encouraged to discuss the assignments with other students but please note that all assignments in this course are individual and the work you turn in should be entirely your own! Use of other students' course work, in part or in total, to develop, complete or correct course work is unauthorized. Each student is responsible for knowing and abiding by UCSD's Code of Academic Integrity. Instances of academic dishonesty will be penalized by grade reduction at the instructor's discretion and will be reported to the Office of Student Conduct for adjudication. Committing acts that violate Student Conduct policies are cause for suspension or dismissal from UCSD.

Tentative Schedule

Week	Date	Lecture	Material	Assignment
1	Sep 26	Introduction	Ch. 1	
	Sep 28	Feedback Principles	Ch. 2	
2	Oct 03	Discussion		
	Oct 03	System Modeling	Ch. 3	
	Oct 05	Solving ODEs	Ch. 5	HW1
3	Oct 10	Discussion		
	Oct 10	Catch-up		
	Oct 12	Laplace Transform, Transfer Function	Ch. 9	HW2
4	Oct 17	Discussion		
	Oct 17	Block Diagram, Signal Flow Graph		
	Oct 19	Stability, Routh-Hurwitz	Ch. 6	HW3
5	Oct 24	Discussion		
	Oct 24	Transient and Steady-state Response	Ch. 6	
	Oct 26	Root Locus	Ch. 10	
6	Oct 31	Discussion		
	Oct 31	Midterm Exam		
	Nov 02	Root Locus	Ch. 10	HW4
7	Nov 07	Discussion		
	Nov 07	Frequency Response	Ch. 10	
	Nov 09	Frequency Response	Ch. 10	HW5
8	Nov 14	Discussion		
	Nov 14	Nyquist Stability	Ch. 10	
	Nov 16	Performance Measures		HW6
9	Nov 21	Discussion		
	Nov 21	PID control	Ch. 11	
	Nov 23	Lead-Lag Compensation	Ch. 12	HW7
10	Nov 28	Discussion		
	Nov 28	Uncertainty and Robustness	Ch. 13	
	Nov 30	Fundamental Limits	Ch. 14	
11	Dec 05	Final Exam Review		
	Dec 08	Final Exam		