EE 575 Introduction to Control Theory

Schaefer School of Engineering & Science
Fall 2021

Meeting Times:	Fridays 3:00pm -- 5:30 pm
Classroom Location:	McLean 119
Instructor:	Dr. Lei Wu
Contact Info:	Burchard Building 209; lei.wu@stevens.edu
Office Hours:	Fridays 10:30am-1:30pm. Zoom link https://stevens.zoom.us/j/97401060383. You can always email me with questions you have for this course.
Course Web Address:	https://sit.instructure.com/courses/50605
Prerequisite(s):	Basic linear algebra; familiar with Matlab.
Corequisite(s):	None
Cross-listed with:	None

COURSE DESCRIPTION

This course covers classic and modern control theories with emphasis on state space modeling and feedback control. Contents to be covered include: transfer function, stability issues, analysis of linear control applications (such as root locus, Bode plot, and PID control), notions of controllability, observability, compensation, estimation, and pole placement, as well as control of non-linear systems with the aid of linearization and Lyapunov stability theory. Matlab will be used during this course, for lecture examples and homework.

STUDENT LEARNING OUTCOMES

After successful completion of this course, students are expected to:

- Understand fundamental classic control theories, including transfer function, stability issues, analysis of linear control applications such as root locus, Bode plot, and PID control;
- Understand fundamental modern control theories, including notions of controllability, observability, compensation, estimation, pole placement, as well as control of non-linear systems with the aid of linearization and Lyapunov stability theory;
- Familiar with the procedures of applying the theoretical methods to design basic feedback controllers of practical systems.

FORMAT AND STRUCTURE

- This course is comprised of weekly lectures and assignments, with exceptions for the weeks scheduled for the midterm exam and final project presentations.
- Final project is formed as a "competition". Each group will present the work during the class and will be evaluated by the peers.

TENTATIVE COURSE SCHEDULE

The following is a tentative course schedule, which may be subject to changes.

Date	Topic(s)	Assignment
September 3	Week 1: A Brief Overview of Control	**Assigned on a weekly basis,** **posted on course website.**
September 10	Week 2: Linear Time-invariant System and Dynamic Response	
September 17	Week 3: System Types and PID Control	
September 24	Week 4: Root Locus	
October 1	Week 5: Frequency Response and Bode Plot	
October 8	Week 6: State-Space Design	
October 15	Week 7: State-space Feedback Control Design: control law, reference input; LQR	
October 22	Week 8: State-space Feedback Control Design: Full and Reduced order estimator	
October 29	Week 9: State-space Feedback Control Design: Compensator-– Combined Control Law and Estimator	
November 5	Week 10: State-space Feedback Control Design: Reference Input with Estimator; Integral Control and Robust Tracking	
November 12	Week 11: **Midterm Exam**	
November 19	Week 12: Discuss Midterm Exam and Final Project	
November 26	Week 13: **Thanksgiving Recess**	
December 3	Week 14: Nonlinear Systems, Control System Design Outline and Example	
December 10	Week 15: **Final Project Presentation**	

COURSE MATERIALS

Textbook: G. Franklin, J. Powell, and A. Emami-Naeini, Feedback Control of Dynamic Systems, 8th Edition, Prentice – Hall.

Other References: J. Bay, Fundamentals of Linear State Space Systems, McGraw-Hill, 1998
C. Chen, Linear System Theory and Design, Oxford University Press, 1999.
F. Golnaraghi and B. Kuo, Automatic Control Systems, Wiley, 2009.

COURSE REQUIREMENTS

Homework

- Discussion among students is allowed. However, copying from each other is not allowed;
- For homework submission, **write your name and student ID on the first page**.
- Late homework will be penalized by 25% when handed within 24 hours of the due date, and by 50% when handed within 72 hours of the due date. Homework will not be graded after that point.

Final Project

- Final project is formed as a "competition".
- Students will conduct the final project as a team.
- Each team will present the work during the class (about 15-20 minutes presentation.

GRADING PROCEDURES

Grades will be based on:

Homework	(40 %)
Midterm Exam	(30 %)
Final Project	(30 %)

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"*I pledge my honor that I have abided by the Stevens Honor System*."

Reporting Honor System Violations
Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Special Provisions for Undergraduate Students in 500-level Courses

The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

EXAM ROOM CONDITIONS

The following procedures apply to exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the quiz or exam.

1. Students may use the following devices during exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	**Permitted?**	
	Yes	No
Laptops		X
Cell Phones		X
Tablets		X
Smart Watches		X
Google Glass		X
Other (Nonprogrammable calculator)	X	

2. Students may use the following materials during exams. Any materials that are not mentioned in the list below are not permitted.

Material	**Permitted?**	
	Yes	No
Handwritten Notes		X
Typed Notes		X
Textbooks		X
Readings		X
Other (one letter-size double-sided cheat sheet)	X	

3. Students are not allowed to work with or talk to other students during exams.

LEARNING ACCOMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible

students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone (201) 216-3748.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are strongly encouraged and can be made by phone (201-216-5177) or in-person (on the 7th floor of the Howe Center). CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. Other 24/7 resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.