Feedback Control Systems - ECE-3550-A

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Course Information

Instructor: Dr. Sam Coogan, email: sam.coogan@gatech.edu, Office: TSRB 432

Teaching Assistants: Niyem Bawana, email: bawana@gatech.edu

Class Time: Tues/Thurs, 9:30am–10:45am, Instructional Center 115

Office Hours: Office hours will be held as follows.
Coogan (check Canvas for updates)

- Mondays, 2:30pm-3:30pm via BlueJeans (**https://bluejeans.com/468524575/3211** ⤷ **(https://bluejeans.com/468524575/3211)**)
- Thursdays, 3pm-4pm via BlueJeans (**https://bluejeans.com/468524575/3211** ⤷ **(https://bluejeans.com/468524575/3211)**)
- I am happy to meet in my office at the times above, but please e-mail for confirmation first, and please wear a mask

Bawana (TA)

- Tuesdays 1pm-3pm, one of the tables between Tech green space and Van Leer Building

Course Description: Analysis and design of control systems. Laplace transforms, transfer functions, and stability. Feedback systems: tracking and disturbance rejection. Graphical design techniques.

Prerequisites: ECE2040

Textbook: "Feedback Control of Dynamic Systems" (8th edition). G.F. Franklin, J.D. Powell, and A. Emami-Naeini. Prentice-Hall. NOTE: The 5th, 6th, and 7th editions contain mostly the same material.

Course Website: Canvas and Piazza

Lectures: Lectures will be delivered in-person at the assigned time and location. As a courtesy, and technology permitting, lectures will be broadcast via Bluejeans for remote, synchronous viewing. Lectures will also be recorded for asynchronous viewing. See canvas for up-to-date location and remote viewing information.

Attendance Policy and Rules

This is a fully residential course, and the best way to learn the material and interact with classmates and the instructor is in-person. However, given the extraordinary circumstances we continue to encounter due to the pandemic, as a courtesy, it is intended that lectures will be broadcast on Bluejeans and also recorded. **If you do not feel well, do not come to class**, and instead participate remotely.

You are strongly encouraged to wear a mask while attending in-person lecture, regardless of your vaccination status.

Grading And Assignments

Grade Weights:

- Homework: 20%
- Quiz 1: 20% (Sept 30)
- Quiz 2: 20% (Nov 9)
- Final: 40% (Dec 16)

Homework: Homework will be assigned approximately every week. Digital copies of your assignment will be turned in via Gradescope. Hard copies of homework will not be collected.

Quizzes: There will be two take-home quizzes, tentatively scheduled for Sept 30 and Nov 9. Quizzes will be open-book and open-notes. Quizzes will be posted to Canvas and available during a window of at least 24 hours. A digital copy of completed quizzes will be turned in

to Gradescope. There will be no lectures on the days of the quizzes.

Missed exams: No make-up exams will be given without prior approval. In case of a documented emergency, the Dean of Students will contact the instructor on the student's behalf.

Final Exam: The final exam will operate like the quizzes and will be take-home, open-book, open-notes, and available for at least 24 hours on Canvas. It will be turned in via Gradescope.

Grade Assignments:

Grade	A	B	C	D	F
Percentage	≥ 85%	≥ 70%	≥ 60%	≥ 50%	<50%

*Grade cutoffs for the class are subject to change at the discretion of the instructor, but only in the direction of the students' favor.

Course Topics

The following is a list of course topics with approximate timing:

- Introduction and review of dynamical models (2 weeks)
- Review of Laplace transform (2 weeks)
- Block diagrams, the effect of poles and zeros, time domain specifications (2 weeks)
- Introduction to open-loop and closed-loop control and the advantages of feedback (2 weeks)
- PID control (1 week)
- Root locus (2 weeks)
- Frequency design methods (2 weeks)
- Introduction to digital control (1 week)
- Review and wrap-up (1 week)

Course Schedule

Date	Topic	Homework
8/24/21	**Introduction to the Course** (https://gatech.instructure.com/courses/209138/files/24501125?wrap=1)	
8/26/21	**Introduction to Feedback Control** (https://gatech.instructure.com/courses/209138/files/24556641?wrap=1)	
8/31/21	**Dynamic Response of Systems** (https://gatech.instructure.com/courses/209138/files/24784715?wrap=1)	
9/2/21	**Laplace Transform Review Continued** (https://gatech.instructure.com/courses/209138/files/24784717?wrap=1)	**HW1 Due** (https://gatech.instructure.com/courses/209138/assignments/881300)
9/7/21	**The Transfer Function** (https://gatech.instructure.com/courses/209138/files/24946509?wrap=1)	
9/9/21	**System Response** (https://gatech.instructure.com/courses/209138/files/25035307?wrap=1)	**HW2 Due** (https://gatech.instructure.com/courses/209138/files/24852953?wrap=1)
9/14/21	**Time-Domain Specifications and Figures of Merit** (https://gatech.instructure.com/courses/209138/files/25173115?wrap=1)	
9/16/21	**Design Synthesis from Time-Domain Specifications** (https://gatech.instructure.com/courses/209138/files/25257979?wrap=1)	**HW3 Due** (https://gatech.instructure.com/courses/209138/files/25188239?wrap=1)

9/21/21	**Stability and Feedback** (https://gatech.instructure.com/courses/209138/files/25501469?wrap=1)	
9/23/21	**Advantages of Closing the Loop** (https://gatech.instructure.com/courses/209138/files/25723307?wrap=1)	**HW4 Due** (https://gatech.instructure.com/courses/209138/files/25249863?wrap=1)
9/28/21	**PID Control** (https://gatech.instructure.com/courses/209138/files/25872771?wrap=1)	
9/30/21	Quiz 1 **(no lecture)**	
10/5/21	**Introduction to Root Locus** (https://gatech.instructure.com/courses/209138/files/26082277?wrap=1)	
10/7/21	**Root Locus Rules** (https://gatech.instructure.com/courses/209138/files/26150029?wrap=1)	**HW5 Due 10/12** (https://gatech.instructure.com/courses/209138/files/25976573?wrap=1)
10/12/21	Fall Break **(no lecture)**	
10/14/21	**Root Locus Rules Continued** (https://gatech.instructure.com/courses/209138/files/26458195?wrap=1)	**HW6 Due** (https://gatech.instructure.com/courses/209138/files/26458185?wrap=1)
10/19/21	**Root Locus Review** (https://gatech.instructure.com/courses/209138/files/26603589?wrap=1)	
10/21/21	**Introduction to Frequency Response** (https://gatech.instructure.com/courses/209138/files/26674345?wrap=1)	**HW7 Due** (https://gatech.instructure.com/courses/209138/files/26466827?wrap=1)
10/26/21	**Bode Plots** (https://gatech.instructure.com/courses/209138/files/26835017?wrap=1)	
10/28/21	**Bode Plots Continued** (https://gatech.instructure.com/courses/209138/files/26891371?wrap=1)	**HW8 Due** (https://gatech.instructure.com/courses/209138/files/26614277?wrap=1)
11/2/21	**Control Design from Frequency Response** (https://gatech.instructure.com/courses/209138/files/27076083?wrap=1)	
11/4/21	**Bode Plotting Review** (https://gatech.instructure.com/courses/209138/files/27143193?wrap=1)	**HW9 Due** (https://gatech.instructure.com/courses/209138/files/26864385?wrap=1)
11/9/21	Quiz 2 **(no lecture)**	
11/11/21	**Introduction to Nyquist Plots** (https://gatech.instructure.com/courses/209138/files/27332651?wrap=1)	
11/16/21	**Nyquist Stability Theorem** (https://gatech.instructure.com/courses/209138/files/27451171?wrap=1)	
11/18/21	**Nyquist Theorem, Continued** (https://gatech.instructure.com/courses/209138/files/27573495?wrap=1)	**HW10 Due** (https://gatech.instructure.com/courses/209138/files/27514431?wrap=1)
11/23/21	**Introduction to Nonlinear Systems** (https://gatech.instructure.com/courses/209138/files/27715659?wrap=1)	
11/25/21	Thanksgiving **(no lecture)**	

11/30/21	**Introduction to Nonlinear Systems, Continued** **(https://gatech.instructure.com/courses/209138/files/27773617? wrap=1)**	
12/2/21	**Analysis of Nonlinear Systems by Local Linearization** **(https://gatech.instructure.com/courses/209138/files/27916261? wrap=1)**	**HW11 Due** **(https://gatech.instructure.com/courses/209138/files/27701769? wrap=1)**
12/7/21	Last Lecture	