Control of Dynamic Systems

EML 4312 Section 054G
Class Periods: T 5-6, R 6 (11:45am-1:40pm and 12:50pm-1:40pm, respectively)
Location: WEIL 270
Academic Term: Spring 2026

Instructor:
Jonathan Brooks (he/him)
brooks666@ufl.edu
(352) 294-0472
Office Hours: Thursday, 11am-12:30pm, NEB 139

Teaching Assistant/Peer Mentor/Supervised Teaching Students:

- TBA

Course Description
Theory, analysis, and design of control systems, including mechanical, electromechanical, hydraulic, pneumatic, and thermal components and systems. Credits: 3

Course Pre-Requisites / Co-Requisites

Pre-requisites:	MAP 2302	Elementary Differential Equations
	EGM3344	Introduction to Numerical Methods of Engineering Analysis
	EGM 3401	Engineering Mechanics - Dynamics

Course Objectives
This course is intended to instruct engineering students on fundamental aspects of feedback control. The focus will be on classical control design and analysis techniques. Numerical simulation of feedback control systems using mathematical software will be stressed. The course is not intended to teach students topics such as programming industrial controllers.

By the end of this course, you should be able to:
1. Recognize feedback when you see it.
2. Describe what feedback control is, and its pros and cons, to a layperson.
3. Use the Laplace transform to describe the transfer function of engineering systems and determine the time domain response to a wide range of inputs.
4. Determine transfer function and state-space description of a linear dynamical system from its governing differential equations.
5. Visualize feedback interconnections through block diagrams.
6. Analyze stability of such a system and determine its frequency response.
7. Design controllers for a class of systems arising in mechanical and aerospace engineering systems to meet stability and performance requirements.
8. Perform numerical simulation of feedback control systems using MATLAB/Simulink.

Materials and Supply Fees
None

Relation to Program Outcomes (ABET):
This course contributes to enhancing the students' knowledge of advanced mathematics through multivariable calculus, differential equations, and linear algebra. This course also contributes to the students' ability to work professionally in mechanical and aerospace systems areas including design and analysis of such systems. The course supports several program outcomes in the Mission Statement of the Department of Mechanical and Aerospace Engineering. Specific ME and AE program outcomes supported by this course include:

(1) Using knowledge of advanced mathematics through multivariate calculus and differential equations (ME and AE Program Outcomes M2 and A2);
(2) Be familiar with linear algebra (ME and AE Program Outcome M3 and A3);
(3) Possess knowledge of stability and controls (AE Program Outcome A5).

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Low
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	High

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Software

- Software: MATLAB Student Version ***with Simulink*** (any recent version should be fine)
- You may consider using UFApps (not recommended) to access a number of popular software applications for "free" including MATLAB at: http://info.apps.ufl.edu/
- MATLAB is also available for purchase and download at https://www.mathworks.com/products/matlab/student.html
- I recommend against using UFApps and instead purchasing a MATLAB student license because it eliminates friction caused by using UFApps (downloading data files, saving .m files, poor Internet connection, etc.).

Recommended Materials

- Title: *Control Systems Engineering*
- Author: Norman S. Nise
- Publication date and edition: 2003, 4th Edition (Wiley & Sons)
- ISBN number: 0471445770
- ***Any recent version*** will suffice

- lpsa.swarthmore.edu
- This is the website I used to supplement my learning when I took undergraduate controls

- Brian Douglas' controls videos on YouTube; he is the GOAT

Required Computer
Recommended Computer Specifications: https://it.ufl.edu/get-help/student-computer-recommendations/
HWCOE Computer Requirements: https://www.eng.ufl.edu/students/advising/fall-semester-checklist/computer-requirements/

Tentative Course Schedule

Week	Topics	Estimated Assignments
1	Feedback; mathematical preliminaries	
2	Linear systems; linearization of nonlinear systems	HW1
3	Laplace transforms; transfer functions	HW2
4	Stability	HW3
5	Impulse response; step response	
6	Second-order systems	HW4
7	Block diagrams; PID control design	Exam 1
8	PID control design; root locus	HW5
9	Root locus; frequency domain	HW6
10	Bode plots	
11	Bode plots; frequency-domain controller design	HW7
12	Frequency-domain controller design	
13	State-space system	HW8

Important Dates
Wednesday, March 4th Exam 1 (8:20pm-10:10pm)
Monday, April 27th Exam 2 (10:00am-12:00pm)

Attendance Policy, Class Expectations, and Make-Up Policy
Attendance
- Regular class attendance is expected although not explicitly included in the grade evaluation.
- The course will be delivered in a hybrid format. A Zoom conference will be created for each lecture for students to attend remotely if they do not wish to come to the classroom.

Homework
- HW will be posted on Canvas along with its due date.
- HW will be turned in on Canvas.
- Some or all assigned problems will be graded for each assignment. You are required to complete all assigned problems.
- Late HW will be accepted up to 24 hours after the due date with a maximum-grade penalty of 20 points. That is, your grade will be rounded down to an 80. If this sounds severe, turn in your homework on time. If you have an absolute doomsday of a week, this is your safety valve. Hardship cases will be considered on an individual basis and only if the instructor has been contacted before the due date of the assignment. Students with hardship cases (e.g., due to medical problems) will be referred to the Dean of Students office, which will perform a background investigation to determine if the hardship is legitimate.
- If you do not agree with the grading of a HW problem, you will have one week from the date the HW is returned to submit a written argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

Exams

- Exams will be closed-book and closed notes. The instructor will announce, in class, any allowed formula sheets or resources at least one week before the exam.
- No cell phones or calculators (or anything that can store formulae) are allowed during exams. An abacus is allowed if desired.
- Exam problems may be taken directly from the homework problems or from lecture discussions with some modifications. Thus, in addition to the weight placed on homework in the final grade, it is to your advantage to understand as many of the homework problems as possible. The emphasis of the exams will be to test your understanding, not on formulaic repetition, so expect the exam problems to be challenging and to test your grasp of the methods taught in the class.
- Makeup exams are only allowed for students with extreme, documented circumstances. Students must contact the instructor as soon as possible to provide documentation and request a make-up exam. Excused absences must be consistent with university policies in the undergraduate catalog and require appropriate documentation.
- If you do not agree with the grading of a particular exam problem, you will have one week from the date the exam is returned to submit a written argument of why you think the grade should be higher. However, the final decision will remain the instructor's.

E-learning course web site (Canvas)

- Students are expected to check Canvas on a regular basis for up-to-date course information. This may include changes to homework assignment due dates, exam schedules, etc.

Evaluation of Grades

Assignment	Percentage of Final Grade
Homework	20%
Exam 1	40%
Exam 2	40%

Grading Policy

Percent	Grade	Grade Points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

Academic Policies & Resources

To support consistent and accessible communication of university-wide student resources, instructors must include this link to academic policies and campus resources: https://go.ufl.edu/syllabuspolicies. Instructor-specific guidelines for courses must accommodate these policies.

Commitment to a Positive Learning Environment

The Herbert Wertheim College of Engineering values varied perspectives and lived experiences within our community and is committed to supporting the University's core values.

If you feel like your performance in class is being impacted, please contact your instructor or any of the following:

- Your academic advisor or Undergraduate Coordinator
- HWCOE Human Resources, 352-392-0904, student-support-hr@eng.ufl.edu
- Pam Dickrell, Associate Dean of Student Affairs, 352-392-2177, pld@ufl.edu