ENGR 511: Controlled and Autonomous Systems
Spring 2024 Term
Course Syllabus

General Information
Professor: Anthony Lemus
Lecture Time and Location: Monday & Wednesday 4:00 – 5:15 KC N214
Office Hours: Friday 3:00 – 4:00 (N203 Swenson Hall)

Course Description
Students explore advanced topics related to controlled and autonomous systems including linear systems, transfer functions, Laplace transforms, frequency-response, transient response, feedback, nonlinear systems, and digital control systems through a combination of analytical and computational techniques. Letter grade. 3 credits

Program Learning Outcomes
The Chapman experience creates outcomes which are consistent with our identity. Similar to the General Education program, each degree program, or major, at Chapman has a unique set of learning outcomes, or student abilities that are not only related to Chapman's institutional mission and goals, but also unique to the student's discipline or field of study. For more information, Fowler School of Engineering Program Learning Outcomes.

Overview
A control system is a collection of things assembled together with the intention to perform a specific task. When we excite the system with an input we get a specific outcome called a system response. This class will focus on how to design systems with the ability to perform the desired objective with precision, repeatability, and reproducibility utilizing feedback. This advanced class provides the necessary analytical tools to design, predict, and execute a robust control operation. Additionally, through laboratory practice, the class will use embedded software autonomous control techniques using Matlab and Arduino microcontrollers to practice digital control system design using dynamic feedback. The student will be able to critically design & analyze a system's intention, diagnose it robustness mathematically, predict its design constraints and most importantly synthesize a robust performance control architecture.

Course Textbook:
Feedback Control of Dynamic Systems, Author: Franklin, Publisher: Pearson Lifetime eBooks, Edition: 8th, Year Published: NA,

Course Materials
MAX 2560 Arduino kit (supplied by Maker Space)
Material to be supplied by instructor.

Course Grade Breakdown
Grading scale used for the course

Letter grades in the class will be assigned according to the following breakdown:

Grade	*Letter Grade*
93+	*A*
90-92.9	*A-*
87-89.9	*B+*
83-86.9	*B*
80-82.9	*B-*
77-79.9/73-76.9/70-72.9	*C+/C/C-*
67-69.9/63-66.9/60-62.9	*D+/D/D-*
<60	*F*

Assignments
Assignments will be assigned every week, due the following Wednesday's class.

Late Policy
As I know life can get hectic and occasionally everything does not go to plan, you will be allowed 3 late days or grace periods on assignments for the semester. These can only be used in 24 hour increments, i.e. – if you submit an assignment 3 hours late or 22 hours late, 1 of your 3 days will be used. If you would like to use a late day, please state so in a comment at the top of your program. You do not need to ask me to use a late day.
No late work will be accepted outside of this policy. ***This includes instances of not hitting submit or submitting incorrect files. You are responsible for ensuring the correct files are submitted by the deadline.*** *The timestamp on a file that missed a deadline is not valid.***

Participation and Quizzes
No Quizzes!

Exams
A. Midterm Exam:
This exam will focus on two areas
- *Material covered through the week before the test*
- *Closed book but with necessary tables provided*
- *Laptop required with Matlab*

B. Final Exam:
   a. *This exam will cover the entire semester work*
   b. *Closed book but with necessary tables provided*
   c. *Laptop required with MATLAB*

Homework Project
You will get a chance to practice creating your own innovative product using the tools taught in this class. More details will be announced during the class. Grading of this project will involve a rating on your approach and analysis workflow and final conclusions. I will provide a rubric.

Grading Percentages Breakdown (subject to change):

Attendance/Participation	5 %
Assignments	10 %
Midterm Exam	25 %
Final Exam	35%
Homework Project	25 %

Assignment Grading
All assignment will be graded by myself. Any questions concerning late submission or assignment grade inquiries should be directed to me via email. By all means approach me before or after class to ask questions, but I will request a follow-up email to make sure I don't overlook any action items.**

Final Exam Time
Final Exam time assigned for TBD

Collaboration Policy
You have much to learn from your colleagues, and so I encourage you to discuss and study course material together. However, all work you submit for this course must be your own, and must be completed individually unless otherwise specified. More specifically, you may not present source code or programs copied from the Internet, other texts, other students, etc. as your own work. Of course, you are free to use whatever *reference* materials you like, but please cite them in a README turned in with your assignments. A README is a .txt document with a list of all reference materials used to aid in the assignment as well as names of other classmates you collaborated with. I assume you are familiar with Chapman's policy on academic misconduct, it is presented below and any incidents of academic misconduct or dishonesty will be dealt with severely in accordance with this policy.

Expectations and Technology Use
I expect that everyone will maintain a classroom conducive to learning. I like an informal atmosphere, but it must be orderly. Thus, everyone is expected to behave with basic politeness, civility, and respect for others. In particular, talking in class is okay if it's part of a class discussion or with me. Private communications are not permitted, especially during exams. Neither are reading extraneous materials, using electronic equipment off task, or sleeping. As this is a Computer Science class, technology is allowed to aid in learning and understanding material. However, please do not use a personal device for any purpose unrelated to our class. All devices should be silenced. Cell phones should be put away. Suggestions for improvement are welcome at any time. Any concern about the course should be brought first to my attention.

Technology Requirements
This course will require you're your laptop with the following software packages: MS Office, a web browser (Chrome, Edge, or Safari), MATLAB, Arduino IDE

Chapman University's Academic Integrity Policy
Chapman University is a community of scholars that emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work and academic dishonesty of any kind will be subject to sanction by the instructor/administrator and referral to the university Academic Integrity Committee, which may impose additional sanctions including expulsion. Please see the full description of Chapman University's policy on Academic Integrity.

Chapman University's Students with Disabilities Policy
In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to contact the Office of Disability Services. If you will need to utilize your approved accommodations in this class, please follow the proper notification procedure for informing your professor(s). This notification process must occur more than a week before any accommodation can be utilized. Please contact Disability Services at (714) 516–4520 if you have questions regarding this procedure or for information or to make an appointment to discuss and/or request potential accommodations based on documentation of your disability. Once formal approval of your need for an accommodation has been granted, you are encouraged to talk with your professor(s) about your accommodation options. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course.

Chapman University's Equity and Diversity Policy
Chapman University is committed to ensuring equality and valuing diversity. To access information part of Chapman's DEI (Diversity, Equity, and Inclusion) initiative, including on-campus resources, student-driven clubs, faculty and staff advocates, and how to report a concern or incident, please view the Diversity and Inclusion Resources. Students and professors are reminded to show respect at all times as outlined in Chapman's Discrimination, Harassment, and Retaliation Prevention Policy. Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.

Student Support at Chapman University
Over the course of the semester, you may experience a range of challenges that interfere with your learning, such as problems with friend, family, and or significant other relationships; substance use; concerns about personal adequacy; feeling overwhelmed; or feeling sad or anxious without knowing why. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. You can learn more about the resources available through Chapman University's Student Psychological Counseling Services.

Fostering a community of care that supports the success of students is essential to the values of Chapman University. Occasionally, you may come across a student whose personal behavior concerns or worries you, either for the student's well-being or

yours. In these instances, you are encouraged to contact the Chapman University Student Concern Intervention Team who can respond to these concerns and offer assistance. While it is preferred that you include your contact information so this team can follow up with you, you can submit a report anonymously. 24-hour emergency help is also available through Public Safety at 714-997-6763.

Religious Accommodation
Religious Accommodation at Chapman University Consistent with our commitment of creating an academic community that is respectful of and welcoming to persons of differing backgrounds, we believe that every reasonable effort should be made to allow members of the university community to fulfill their obligations to the university without jeopardizing the fulfillment of their sincerely held religious obligations. Please review the syllabus early in the semester and consult with your faculty member promptly regarding any possible conflicts with major religious holidays, being as specific as possible regarding when those holidays are scheduled in advance and where those holidays constitute the fulfillment of your sincerely held religious beliefs.

Syllabus
This syllabus timing and order is subject to change but the fundamental topics to master Control Systems will be covered. Updates will be posted on the course website. The class will adjust topics as necessary based on mastery and comprehension feedback from the students and homework. THIS CLASS IS DESIGNED FOR A 12 WEEK INSTRUCITON PERIOD. LABORATORY ASSIGNMENT WILL BE SHOWN IN THE TOPIC COLUMN by a *. "**" indicates the homework project to be assigned.

TOPIC	DESCRIPTION
Control System Definition & Introduction	Understand what a system is, learn what open and closed feedback is, review the necessary mathematics
Modeling Systems	How to model systems consisting of electrical, mechanical, and combinations. What is a transfer function.
System Response*	Laplace Transforms, Model Diagrams to look at responses, Time-Domain response, Introduction to MATLAB
Stability*	Bounded Systems, Complex variable application (ZEROS and POLES)
Feedback*	Stability, Tracking, Regulation, Sensitivity. Proportional, Integral, Derivative, and combinations (PI, PID)
Dynamic Compensation	Root Locus Introduction, Lead, Lag, Notch, Plots (Bode, Root Locus)
Frequency Response	Bode Techniques, Nyquist Stability
Digital Control	Z Transforms, Discrete Equivalents, Sample Rate
Non-Linear	Linearization Analysis and basic Stability
Design**	Arduino MATLAB Control Project