Fall 2020

24-352 Dynamic Systems and Controls

Class	Monday, Wednesday 10:40 AM – 12:30PM		Zoom
Recitation	Wednesday	9:10 PM – 10:00 PM	Zoom
Instructor	Levent Burak Kara lkara@cmu.edu , SH-411 Office Hours: Thursday 11:00 AM – 12:00 PM		Zoom
Teaching Assistants	Sean Wang <sjw2@andrew.cmu.edu> Wentai Zhang wentaiz@andrew.cmu.edu		
Undergraduate Assistant	Kamal Carter krcarter@andrew.cmu.edu		
Website	Carnegie Mellon University Canvas system		
Textbook	Katsuhiko Ogata, System Dynamics, 4 ed., Pearson; ISBN 978-0131424623. Older editions are also acceptable.		

The primary topics covered in this course include (1) mathematical modeling of dynamic systems -- particularly those with mechanical, hydraulic, pneumatic, thermal, electrical, and electromechanical elements, (2) analyzing the system response in both time and frequency domains, and (3) an introduction to feedback control -- a method by which the dynamics of a closed loop system can be modified.

Course Objectives:

1. To understand the behavior of simple dynamic systems, including their energy storing and energy dissipating subsystems.

2. To derive mathematical models of simple (or simplified) dynamic systems, and to obtain solutions for those mathematical models.

3. To understand the utility of Laplace Transforms and transfer functions for use in modeling systems, including the concepts of stability, poles, zeros, and how they relate the response of a dynamic system.

4. To be able to identify the inputs, outputs, and components of a feedback control system, and be able to represent a system using block diagrams. Be able to use various techniques to understand the system behavior and how to design the controls for a given response requirement.

5. To understand the utility of feedback controls and its advantages/disadvantages.

6. To understand a system's frequency response and how to apply this to the modeling and simulation of dynamic systems.

Learning Outcomes:

If you complete this course successfully, you should be able to:

1. Feel comfortable with complex numbers, Laplace transforms, and frequency response functions.

2. Use Laplace transforms to solve linear time-invariant differential equations

3. Identify simplified mechanical elements of a mechanical system, and use associated mathematical models to model a mechanical system.

4. Use transfer function AND state-space techniques to simulate dynamic systems

5. When a mathematical model of a system is presented, analyze the stability of the system

6. Understand block diagram representations of dynamic systems

7. Understand basics of feedforward and feedback controls, and how to use these fordynamic systems

8. Simulate and control a model of a dynamic system using MATLAB®

Grading:

Each assignment will be out of 100 points. Only neatly written classwork will be graded.

Homework (10 assignments)	65
Test (3 tests)	30
Attendance and course participation	4
Faculty Course Evaluation	1
Total	**100%**

Grading Scale and Description:

85%-100% = A

75%-85% = B

65%-75% = C

55%-65% = D

0%-60% = R

Late Submission Policy:

You have the option to submit your assignment after the announced deadline (started late, had to travel, computer malfunction etc.). The following policy will apply:

- Submission after the deadline, but within the first 2 hours of the deadline: Your nominal assignment grade is multiplied by 0.95.
- Submission after the deadline, but within the first 24 hours of the deadline: Your nominal assignment grade is multiplied by 0.80.
- For further delays, 10% will be deducted for additional 24-hour blocks. For example, if you submit your assignment 30 hours passed the deadline, the multiplier is 0.70. 50 hours passed the deadline; the multiplier is 0.60 etc.

Gradescope:

In this course, we will be using Gradescope (a tool accessed through our Canvas course) to grade and provide feedback on all of your classwork. This will allow your graders to provide more timely and effective feedback. It also promotes fairer grading practices by facilitating anonymous grading and question-by-question (rather than student-by-student) grading. In addition, Gradescope makes it easy for you to access and review all your (graded) work. During the semester, students will use Gradescope to (a) submit work online, (b) view feedback and scores on graded work, and (c) make a re-grade request (allowed up to 1 week after grades are posted). To access Gradescope, simply log on to our course's Canvas site and click on the Gradescope assignment(s) link. This website https://www.cmu.edu/canvas/gradescope/index.html provides students with more information on using Gradescope, including how to scan assignments via your mobile device, where to find copier/scanners around campus, and how to submit assignments online to Gradescope.

Collaboration:

For your assignments, we encourage you to collaborate with each other. However, some of you may have differing ideas of what appropriate collaboration means.

Here are some guidelines for you when it comes to collaboration:

1. Any text or graphics contained in your submissions should be solely your work. You should not use anything that was created by someone else.

2. Any code that you submit should be entirely written by you (excluding, of course, the framework we provide you).

3. To reiterate (1) and (2), you should not be cut-and-pasting from someone else, sending work via email to someone else, or having someone else type the work for you.

Here are some forms of good collaboration:

1. Discussing the implications of results with your classmates. "Hey, for this small system, my iterative solver gives worse results than my direct inversion of the matrix, but that doesn't make intuitive sense to me. What do you think?" "Yeah, my inversion is better than my iterative solver. Perhaps your code is doing <insert statement about the code> incorrectly?"

2. Asking for help conceptualizing something. "I don't get the purpose of convolution as it relates to Laplace transforms. Do you know what it means?" "Yes, it means..."

3. Discussing theorems, principles, equations, etc. "Hey, in the proof on Problem 2a, I tried using the definition closed loop transfer function; did you do something similar?" "Yes, I did, and I noticed that the fact that open loop transfer function can be obtained from the closed transfer function."

4. Debugging code. "My code is giving me this error. Can you come take a look?" "Sure...oh yeah, I got that error as well. You can get rid of it by using this function instead."

If you are unsure of whether or not you are participating in inappropriate collaboration, talk to the TAs. We reserve the right to deduct points if cheating is suspected.

Academic Integrity:

Students at Carnegie Mellon are engaged in preparation for professional activity of the highest standards. Each profession constrains its members with both ethical responsibilities and disciplinary limits. To assure the validity of the learning experience a university establishes clear standards for student work.

In any presentation, creative, artistic, or research, it is the ethical responsibility of each student to identify the conceptual sources of the work submitted. Failure to do so is dishonest and is the basis for a charge of cheating or plagiarism, which is subject to disciplinary action. Cheating includes but is not necessarily limited to:

1. Plagiarism, explained below.

2. Submission of work that is not the student's own for papers, assignments or exams.

3. Submission or use of falsified data.

4. Theft of or unauthorized access to an exam.

5. Use of an alternate, stand-in or proxy during an examination.

6. Use of unauthorized material including textbooks, notes or computer programs in the preparation of an assignment or during an examination.

7. Supplying or communicating in any way unauthorized information to another student for the preparation of an assignment or during an examination.

8. Collaboration in the preparation of an assignment. See above.

9. Submission of the same work for credit in two courses without obtaining the permission of the instructors beforehand.

Plagiarism includes, but is not limited to, failure to indicate the source with quotation marks or footnotes where appropriate if any of the following are reproduced in the work submitted by a student:

1. A phrase, written or musical.

2. A graphic element.

3. A proof.

4. Specific language.

5. An idea derived from the work, published or unpublished, of another person

Here is a useful link to CMU's policy on the matter:

http://www.cmu.edu/academic-integrity/cheating/index.html

Take care of yourself:

This semester is unlike any other. We are all under a lot of stress and uncertainty at this time. Attending Zoom classes all day can take its toll on our mental health. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at http://www.cmu.edu/counseling/ Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day

or night:

CaPS: 412-268-2922

Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police

On campus: CMU Police: 412-268-2323

Off campus: 911

If you have questions about this or your coursework, please let me know. Thank you, and have a great semester.