MECH 3140: SYSTEM DYNAMICS AND CONTROLS
Spring 2020

Instructor: Dr. David M. Bevly (Wiggins 2418F)

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Office Hours: **MW 12-1, TR 4-5 (office or via Zoom: https://auburn.zoom.us/my/dmbevly)**

Peer Tutoring (Colton Bevel): Thursdays 5-6 pm via Zoom**:** https://auburn.zoom.us/j/3377995161
Problem Session (Amy Strong): Wednesdays 6-7 pm in person in Brown-Kopel 2117 and also via Zoom: https://zoom.us/j/8845561109 (password required)

Textbook: Palm, W., "System Dynamics," ***3rd Edition***

Supplemental Text: Ogata, K., "System Dynamics," 4th Ed., Prentice-Hall Publishing, 2004.
Beginning MATLAB for Engineers, S. J. Reeves,

Course Website: Canvas ***and*** http://www.eng.auburn.edu/~dmbevly/mech3140/

Pre-Requisites: MECH 2120; MATH 2650.

Grading Policy:

1.	2 semester exams (2 x 15 points)	30
2.	Matlab Assignments	8
3.	Pre-Requisite Quiz	2
4.	Projects (mid –5, final – 10)	15
5.	Quizzes	20
6.	Final Exam (Comprehensive)	25
	Total	100

Scale:

A**:** 90-100 B: 80-89 C 70-79 D: 60-69 F: Below 60

Instruction, Office Hours, and COVID-19

As we return to campus this fall, our classroom will be altered in planned and unplanned ways. It is our strong commitment to maintain the quality of instruction and the quality of the learning environment. To this end, I plan to present lectures for this section in person (as was desired by the majority of students polled). Because of the way I tend to lecture and interact with the students, it may not be possible to record my lectures. However, in the event that you are unable to attend my lectures, Dr. Rose's lectures will be available on-line synchronously with our class time at https://auburn.zoom.us/j/5878042973. I may also be able to post Dr. Rose's lectures. We plan to do our very best to keep lectures fairly synchronized. In the event that I am unable to come to class (I have scheduled travel days already planned), I will post lectures to the class website and ***may*** hold a zoom discussion of the lecture or discuss the lecture during the next class period. Should I be unable to lecture for an extended period (say 14 days), we may have to rely on Dr. Rose's lectures during that period.

Due to unforeseen circumstances or changes in university guidance, the syllabus and course is subject to change, and you will be notified as soon as possible to any changes to the course syllabus.

Learning Objectives

This course is centered on the *Modelling*, *Analysis*, and *Control* of linear, time-invariant dynamic systems, and is structured such that you will first master these concepts for first order systems before extending these principles to higher order systems. Successfully completing this course will require:

- Remembering fundamental aspects of differential equations, calculus, and linear algebra
- Understanding relationships between systems and responses in the time and frequency domains
- Applying modeling procedures to dynamic (mechanical, electrical, etc) systems
- Analyzing the responses of dynamic systems
- Evaluating the performance of control algorithms
- Creating simplified models of complex systems and control algorithms

Tentative Lecture Topic Outline (Subject to Change)

WEEK	TOPIC
1	Modeling First Order Mechanical Systems
2	Modeling First Order Electrical Systems
3	First Order Time Response
4	First Order Frequency Response
5	Intro to Controls
6	Laplace Transform, Transfer Functions, and use in Controls & Frequency Response
7	Modeling with additional energy storage elements
8	Second Order Time Response
9	Second Order Frequency Response
10	Second Order Control Design
11	Modeling higher order and multi-DOF systems, Multi-DOF TF & State Space
12	Time and Frequency Response of Higher Order Systems
13	Bode Plots and Higher Order Control
14	Root Locus
15	More on Root Locus (Lead/Lag), Conclusion and Review

Tentative Schedule for Exams

Exam 1:	Night exam ~ week of 9/30
Exam 2:	Night exam ~ week of 11/4
Final Exam:	December 2 @ 4:00 PM (from course schedule bulletin)

Homework and Bonus Opportunity Points (BOPS)

Suggested homework problems will be given but not collected for a grade. Note you must work problems 2-3 hours per day to succeed in this class. Do not get behind as everything in this class builds on itself and it is impossible to catch up. This is a challenging class, but one you should look forward to applying your engineering knowledge and capabilities gained to this point in your career.

Occasionally, the homework problems will include a "MATLAB" problem that will be collected and graded ("Matlab Assignment" from the Grading Policy). To further incentivize completing the suggested homework problems, we will collect your homework before each exam, the work should be maintained according to the Mechanical Engineering Homework Standard. This work should be maintained in either a *Spiral Bound Notebook* or *Three Ring Binder*. We will collect your notebook at each exam and provide a 0 or 1 point based on completion. These points will be added to your final class average (up to 3 points possible). Note that zero credit will be received if it appears the work is copied from solution manuals or other students. Copying solutions from other sources does not result in learning.

Quizzes

Quizzes will be given to measure the understanding of the homework problems. Quizzes will be available in class and on-line through Canvas. We reserve the right to drop 1-2 quizzes. However, make-up quizzes are not eligible to be dropped.

Assignment Submissions

All assignments will be submitted via Canvas as a ***SINGLE PDF File***. Failure to submit work as a single file will result in the submission not being graded. There are several applications for smartphones such as "CamScanner" to accomplish this. You should also be wary of file size to facilitate uploading.

General Policies

Class attendance is expected but not *formally* recorded. Late submission of assigned work or make-up examinations will be allowed if and only if accompanied by an approved University excuse. Additionally, we expect a very high standard of honesty among students at Auburn University as we feel that engineers with moral integrity is of the utmost importance in society. Because of the importance of academic honesty to the reputation of Auburn Engineers, we will report violations of academic honesty as outlined in the Auburn Tiger Cub. **This includes plagiarism of software and solutions found on CourseHero, Chegg or other on-line sources! Additionally, answers which do not show the necessary steps will not receive credit.**

Accessibility

It is the policy of Auburn University to provide accessibility to its programs and activities, and reasonable accommodations for persons defined as having a disability under Section 504 of the rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act of 1990. Students who need special accommodations should make an appointment to see the instructor as soon as possible or contact The Student with Disabilities Program office at (334) 844-5943 (Voice/TT)

Face Coverings and Social Distancing

This class will adhere to the guidelines documented in *A Healthier U – Comprehensive Health and Safety Plan*. All students should read, become familiar with, and follow the guidelines in this safety plan: http://ahealthieru.auburn.edu/.

While students, faculty and staff are expected to follow all the guidelines, the following items emphasize expectations for in-person instruction and interactions:

- Students, faculty, and staff will use the STAY SAFE TOGETHER™ platform.
- Students, faculty, and staff will wear face coverings at all times when inside classrooms, laboratories, and any university buildings when in the presence of others. Face coverings must also be worn outdoors on campus when appropriate physical distancing is impractical or impossible. Face coverings must be worn properly (i.e., completely covering nose and mouth) at all times. Anyone not adhering to proper face coverings will be required to leave immediately.
- Students, faculty, and staff will practice social distancing when meeting in person. Though *A Healthier U* states that social distancing will be achieved by limiting classrooms to 50% capacity, it will be maintained in this class with a minimum of 6 feet between people. Anyone not adhering to proper social distancing will be required to leave the building immediately.

Noncompliance with these policies will be considered a violation of the AU Policy on Classroom Behavior. The offending student(s) will be charged in accordance with the AU Code of Student Conduct. Please note that *A Healthier U* may be updated, or additional guidance developed, as conditions change. This class will adhere to the latest guidance as it becomes available.

Auburn University Department of Mechanical Engineering
Universal Homework Format

Turned-In Work Standards

1. All assignments are to be submitted on single sides of clean 8.5 by 11-inch engineering paper with clean, straight edges. ***A single staple in the upper left corner will be used to fasten multiple pages***. If the work includes plots and/or figures in the results, then these must either be drawn on engineering paper, or be computer-generated.

2. All marks and characters will be clear, neat, and legible, done with ink or lead that provides for an easily legible contrast.

3. Each page will be marked with:

3.1. In the upper left corner:

Name (Last name, First name)
Course and Section number
Due Date

3.2. In the upper right corner:

Page x of xmax (If a problem is on two pages, put "Page 1 of 2" in the upper right corner of the first page and "Page 2 of 2" on the second page. Number and staple each problem separately.)

4. Each exercise will note:

4.1. Source of exercise (text problem number or other)
4.2. Statement of the exercise in the student's own words (reproduction of the assignment statement is NOT acceptable)
4.3. Statement of goals of exercise (what must be found)
4.4. Statement of methods and assumptions used to solve exercise
4.5. Statement of solution process (calculation, derivation, etc.)
4.6. Statement of results (suitably highlighted)
4.7. *All numerical values must be stated with appropriate units, without exception.*
4.8. A detailed nomenclature list for all symbols used including units.

Since only select individual problems will be collected and graded, ***each problem should be ready to be turned in without disconnecting it from any other problem(s)***.