MECH 3140: SYSTEM DYNAMICS AND CONTROLS
Spring 2024
Shelby 1124, MWF 9:00-9:50

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

Phone: (334)- 844-3446

Email: bevlydm@auburn.edu (limited response)

Office Hours: MW 10-11 or 2-3, M 5-6 (office), Zoom (if required): https://auburn.zoom.us/my/dmbevly

Peer Tutoring: Tuesdays, 6-7 pm, Shelby 1124 (Jack Branham)
Problem Working Session: Wednesday, 6-7 pm, BKENG 0158, (Tyler Long)
Brown-Kopel Engineering Tutoring: by appointment, https://aub.ie/engtutoring

Textbook: Palm, W., "System Dynamics," ***4th Edition***

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

Course Website: http://www.eng.auburn.edu/~dmbevly/mech3140/ (and CANVAS)

Pre-Requisites: MECH 2120; MATH 2650.

Grading Policy:

1.	2 semester exams (2 x 15 points)	30
2.	Simulation Assignments	10
4.	Projects (mid –5, final – 10)	15
5.	Quizzes (including pre-req Quiz)	20
6.	Final Exam (Comprehensive)	25
	Total	100

Scale:

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

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 Frequency Response
7	Modeling higher order and multi-DOF systems
8	Electric Motors and Multi-DOF TF and State Space
9	Second Order Time Response
10	Second Order Frequency Response
11	Second Order Control Design
12	Time and Frequency Response of Higher Order Systems including Bode Plots
13	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 2/19
Exam 2: Night exam ~ week of 4/1
Final Exam: Monday, April 29 @ 8:00 AM (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, and that completing homework is strongly correlated to course performance[1].. 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 simulation assignments that will be collected and graded ("Simulation 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 (announced and unannounced) will be given to measure the understanding of the homework problems. Quizzes will be in person and make up quizzes will only be available if accompanied by an approved University excuse. I reserve the right to drop 1-2 quizzes. However, make-up quizzes are not eligible to be dropped.

[1] Rawson, Kevin, and Tom Stahovich. "Predicting course performance from homework habits." 2013 ASEE Annual Conference & Exposition. 2013.

Assignment Submissions:

Unless otherwise specified, all assignments are to be submitted as physical copies in class (*STAPLED*). If the need arises, we may accept submissions 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. *Note that attendance is a better predictor of course grades and GPA than any other marker, including study habits*[2]. 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, other on-line sources or developed by generative AI (i.e. ChatGPT)! Additionally, answers which do not show the necessary steps will not receive credit.**

Excused Absences:

All excuses (including COVID) will come from ESS using this link: https://aub.ie/EngAbsence.

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)

Additional Resources:

If you or someone you know needs assistance, you are encouraged to contact Auburn Cares in Student Affairs at 334-844-1305 or aub.ie/auburncares. They will help you navigate any difficult circumstances you may be facing by connecting you with the appropriate resources or services. To speak with a counselor 24/7/365, you can contact Student Counseling & Psychological Services at 334-844-5123.

Instruction, Office Hours, and Pandemics:

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. We will follow the requirements of Auburn University. If the classroom environment has to be modified or alternative instruction delivery mechanisms used, we will address them at that time. No quizzes or exams will be allowed to be taken remotely (unless mandated by Auburn University).

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[2] Credé, M., S. G. Roch, and U. M. Kieszczynka. "Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics." Review of Educational Res. 80.2 (2010).

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)***.