ME 340
Introduction to Mechanical Systems
Fall 2019

Contact Information

Instructor:	Dr. Hasan A. Poonawala
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Office hours:	Mon & Thur 11:00 am - 12:00 pm

Course Information

Time & Location Tue & Thur 9:30am - 10:45am, CB 110.

Course Description
The objective of this course is to teach the fundamentals of modeling and analyzing dynamic systems, such as mechanical, electrical, thermal, and fluid systems. The first half of the semester focuses on developing ordinary differential equations to model dynamic systems. The second half of the semester focuses on analyzing and solving the ordinary differential equations that describe the behavior of the dynamic systems.

Prerequisites
EM313, CS221, engineering standing.

Required Materials
Main text: C. M. Close, D. K. Frederick, and J. C. Newell, *Modeling and Analysis of Dynamic Systems*, 3rd edition, Wiley, 2002.

Student Learning Outcomes
Students will learn

1. To know the differences between distributed systems and lumped systems.
2. To linearize non-linear system equations.
3. To derive the equations of motion for translational and rotational mechanical systems.
4. To select state variables and set up the state-variable equations.
5. To put equations in matrix form.
6. To combine equations into an input-output equation by eliminating unwanted variables.
7. To derive the differential equations for electrical systems.
8. To know how to use operational amplifiers in analog computer circuits.
9. To solve first- and second-order ordinary differential equations for free response, step response, impulse response, and frequency response.
10. System identification for first- and second-order systems.
11. To use Laplace transform.
12. To derive the transfer function and the frequency-response function.

13. To find the amplitude and phase angle of a frequency-response function.
14. To draw simulation block diagrams from equations.
15. To derive the transfer function from a block diagram.

Workload
Students can expect to spend approximately 5 to 8 hours per week (outside of normal course meetings hours) working on homework and studying course material.

Office Policy
I encourage students to seek help if they have questions. I am available for technical questions during my office hours. For discussions related to other issues, please set up an appointment with me or the TA.

Email Policy
I will respond to relevant emails within 48 hours, between 8am and 6pm. I welcome general questions through email; however, I prefer that you visit my office for technical questions.

Course Assignments
The required assignments for this course are:

	Weight	Date (Tentative)
Homework & Quizzes	10%	
Exam I	27.5%	Oct 08
Exam II	27.5%	Nov 19
Final Exam	35%	Dec 16

Midterm and Final Exams
The midterm exams are administered during a normal scheduled course meeting time and in the normal classroom. The date of each midterm exam will be announced at least 2 weeks before the exam is held. Tentatively, the midterm exams are scheduled for Tuesday October 08, 2019 and Tuesday November 19, 2017.

The final exam is administered during the final exam period scheduled by the Office of the Registrar. The final exam is scheduled for Monday December 16, 2019 from 10:30am to 12:30pm.

No make-up exams will be given except in the case of an excused absence (please see the Excused Absences section of this syllabus.). In this case, the student must make a reasonable attempt to notify the instructor before the scheduled exam is missed.

Unless otherwise stated, exam problems are graded based on the correctness of your work. For example, a correct answer without any work may receive zero credit.

If you want to have an exam re-graded, then you must submit a re-grade request, which consists of the graded exam and a typed letter explaining why you request a re-grade. A re-grade request must be submitted within 2 weeks of the date that graded exams were distributed to the class. If you request a re-grade, then the entire exam is re-graded.

Homework Assignments
There are 10 homework assignments, which are assigned approximately once per week. Each homework assignment is generally due 7 to 10 calendar days after it is assigned. Homework can be submitted during normal course meeting hours or left in the homework box outside my office. Please do not leave homework in my ME department mailbox. Homework left in my ME department mailbox is not be graded and receives zero credit. Your solutions to each homework assignment must be submitted in hardcopy. Electronic submission of homework solutions will not be accepted unless approved by the instructor in advance of the due date and time.

I will not answer questions regarding homework on the day that the assignment is due.
Homework submissions must be legible and adhere to the following rules:

- Homework must be neat and professional in appearance
- Unless otherwise stated in the problem, hand-written solutions are acceptable
- Unless otherwise stated in the problem, all plots must be computer generated and the axes should be labeled with an appropriate name and with the correct units
- Each page must contain your name, the course name, the homework assignment number, and the problem number
- Each problem should begin on a new page
- All pages of the homework must be stapled (or paper clipped) and arranged with problems in the correct numerical order
- All work must be shown; homework is graded on the correctness of your work rather than the correctness of your answer
- Answers must be boxed
- No paper with frayed edges (e.g., torn from a notebook) should be used
- Diagrams must be drawn using a straightedge

Failure to adhere to any of the above rules may result in a reduction of score by up to 30% on the assignment.

Homework Grading
The total grade for an assignment will consist of evaluating a subset of the assigned problems. This subset is chosen at random, and the same subset of problems are graded for all students.

Each homework problem is graded on a scale of 0 to 5 points. Five points will be awarded for problems with a correct solution; 4 points will be awarded for problems with an incorrect solution, where the problem is conceptually understood and the mistakes are minor; 1 to 3 points will be awarded for problems with an incorrect solution; and 0 points will be awarded for problems that are not attempted in good faith.

Late homework is not accepted and receives zero credit except in the case of an excused absence. Please see the Excused Absences section of this syllabus.

Matlab
The design project and some homework assignments require the use of Matlab. Students are expected to be familiar with Matlab. Several lectures will cover Matlab.

Course Grading

Cumulative Score	Letter Grade
90-100%	A
$< 90\%$	B
$< 80\%$	C
$< 70\%$	D
$< 60\%$	E

Academic Integrity
Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses.

Attendance Policy
Students are responsible for all material covered during lectures. Attendance is strongly recommended; however, attendance will not be taken during lecture.

Classroom Conduct
Students are expected to conduct themselves in a professional and courteous manner. While this course consists primarily of lectures, students are encouraged to ask questions during lectures. There is no talking during class unless contributing to class discussion. There is no eating during class. Please ensure that cell phones do not ring during class.

Excused Absences
Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud ($859-257-3737$).
Per Senate Rule 5.2.4.2, students missing any graded work due to an excused absence are responsible for informing the Instructor of Record about their excused absence within one week following the period of the excused absence (except where prior notification is required).

Make-up Exams
Make-up exams for excused absences will be held in the last week before finals. The syllabus will include all topics covered during the course.

Accommodations due to disability
If you have a documented disability that requires academic accommodations, please arrange to meet with me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC).

Further Information
Please see this link for further information and details on policies regarding excused absences, verification of absences, academic integrity, Title IX and discrimination.

Tentative Course Schedule
See next page.

Tentative Course Schedule

Class	Date	Day	Topic	Notes
1	Aug 27	T	Introduction to ME 340	-
2	Aug 29	R	Modeling Translational Mechanical Systems	
3	Sep 03	T	Modeling Translational Mechanical Systems	
4	Sep 05	R	Modeling Translational Mechanical Systems	
5	Sep 10	T	Input-Out & State-Variable Models	
6	Sep 12	R	Input-Out & State-Variable Models	
7	Sep 17	T	Modeling Rotational Mechanical Systems	
8	Sep 19	R	Modeling Rotational Mechanical Systems	
9	Sep 24	T	Modeling Rotational Mechanical Systems	
10	Sep 26	R	Modeling Electrical Systems	
11	Oct 01	T	Modeling Electrical Systems	
12	Oct 03	R	Modeling Electrical Systems	
13	Oct 08	T	**Exam I**	
14	Oct 10	R	Simulating Dynamic Systems	
15	Oct 15	T	Simulating Dynamic Systems	
16	Oct 17	R	Laplace Transforms	
-	Oct 22	T	- (Fall Break)	
17	Oct 24	R	Laplace Transforms	
18	Oct 29	T	Solving linear time-invariant ...	
19	Oct 31	R	... differential equations	
20	Nov 05	T	Transfer functions	
21	Nov 07	R	Transfer functions	
22	Nov 12	T	Stability and response characteristics	
23	Nov 14	R	Frequency Response	
24	Nov 19	T	**Exam II**	
25	Nov 21	R	Linearization techniques for nonlinear systems	
26	Nov 26	T	Linearization techniques for nonlinear systems	
-	Nov 28	R	- (Thanksgiving)	
27	Dec 03	T	Linear state-space equations	
28	Dec 05	R	Linear state-space equations	
29	Dec 10	T	Modeling thermal systems	
30	Dec 12	R	Modeling fluid systems	
-	Dec 16	T	**Final Exam**	