ME 575-002/920 Control Systems Analysis Fall 2024

Instructor: Prof. Xiangrong Shen, Department of Mechanical Engineering
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Office hours: Tuesday/Wednesday/Thursday, 11~11:59 am

Prerequisites: ME 349: Engineering Analysis
ME 372: Dynamic Systems

Course Description and Credit Hours: Classical feedback control system analysis, Laplace transform, transfer function, time response, proportional-integral-derivative control, root locus, frequency response, and computerized analysis. Also includes a brief introduction to modern control techniques. 3 credit hours.

Textbook: ***Control Systems Engineering, 7th Ed.***
Author: Norman S. Nise. Publisher: Wiley.

Handouts: Available on the *Blackboard Learn*.

Class Time: Tuesday/Thursday, 12:30~1:45 pm
Classroom: Reese Phifer Hall 334

Topics Covered:

1. Introduction.
2. Modeling in the frequency domain.
3. System response.
4. Feedback control and PID control.
5. Root locus techniques.
6. Control system design with root locus methods.
7. Control system design with frequency response analysis.
8. State space representation of dynamic systems.
9. Control system design with state space methods.

Student Learning Outcomes: Students will demonstrate knowledge and understanding of

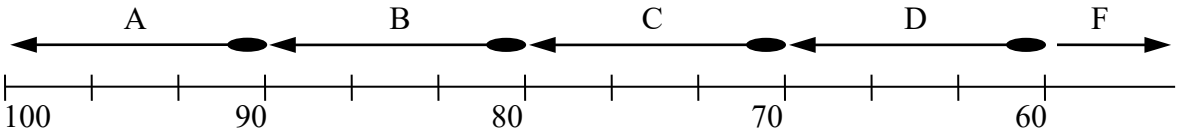
1. Responses of first-order and second-order systems in time domain.
2. Relationships between pole locations and time-domain system responses.
3. Relationships between pole locations and stability of a system.
4. Properties of feedback control systems: disturbance rejection and sensitivity.
5. Dynamic characteristics of PID controlled systems.
6. System types and the corresponding steady-state error.
7. Root locus and its relationship to the dynamic behavior of systems.
8. State space representation of dynamic systems.
9. Canonical forms and full-state feedback control

Students will demonstrate the ability to

1. Design a PID controller and determine the gain values using PID tuning rules.
2. Determine the system type and calculate the steady-state error for various inputs.

3. Sketch root locus of a system and design a controller to meet given time-domain specifications.
4. Use a graphical programming tool, Matlab/Simulink, to design a controller and simulate the controlled system.
5. Design, analyze, and simulate controlled systems in state space.
6. Present the results of design, analysis, and simulation work effectively in written reports.

Grading:



Project:	25 %
Two Hour Tests:	40 %
Final Exam:	35 %
	100 %

Practices:
Practices will be posted on the Blackboard according to the progress of the course, with the corresponding solutions posted approximately one week later. Practices are intended to provide students with opportunities of problem-solving, and no submission is needed.

Project:
A project will be completed by the end of the semester. Each student will design and test a controller through simulation and/or experimentation. More details will follow.

Hour Tests: Two hour tests will be given during the class time on assigned dates, and can be "made-up" only if an excused absence is provided **in advance**. Hour tests will be close-book, close-notes, with a one-page formula sheet allowed. Further, the departmental calculator policy (only *Casio fx-260 Solar ii NF* allowed in all exams) will be strictly enforced in the hour tests and the final exam.

Final Exam: A final exam will be given during the final week according to the UA Final Exam Schedules. More details will follow.

Office Hours Policy: Students are encouraged to see me during the designated office hours or make an appointment to see me at other times (either face-to-face or through online meetings).

Attendance Policy: Students are expected to attend all classes. Please contact me if special accommodation is needed.

Notification of Changes: The instructor will make every effort to follow the guidelines of this syllabus as listed; however, the instructor reserves the right to amend this document as the need arises. In such instances, the instructor will notify students in class and/or via email and will endeavor to provide reasonable time for students to adjust to any changes.

Statement on Academic Misconduct: Students are expected to be familiar with and adhere to the official Code of Academic Conduct provided in the Online Catalog.

Statement On Disability Accommodations: Contact the Office of Disability Services (ODS) as detailed in the Online Catalog.

Severe Weather Protocol: Please see the latest Severe Weather Guidelines in the Online Catalog.

Policy on AI Use:

AI Use is not allowed.

All submitted work must be produced by the students themselves, whether individually or collaboratively. Use of generative AI tools such as ChatGPT to complete an assignment constitutes academic misconduct.

Special Dates:

8/21 First day of classes of Fall 2024
8/28 Last day to add a course or drop a course without a "W" grade
9/19 Technical & Engineering Career Fair, class dismissed
9/26 Test #1 (tentative)
10/30 Last day to drop a course with a "W" grade
10/31 Mid-semester study break, class dismissed
11/7 Test #2 (tentative)
11/25-11/29 Thanksgiving Week – classes dismissed
12/6 Last day of classes of Fall 2024
12/9 Final Exam