

# MAE 435: PRINCIPLES OF AUTOMATIC CONTROL

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**Moodle Site:** <https://wolfware.ncsu.edu/courses/my-wolfware/>  
**Discussion Board:** on Moodle Site

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## COURSE DESCRIPTION

An introduction to feedback control of linear systems, with emphasis on linear system dynamics, time and frequency response, stability analysis, classical control theory, and design applications.

## COURSE OBJECTIVE

To provide students with practical design skills and tools for the synthesis of engineering control systems.

## PREREQUISITES

MA 341 (Applied Differential Equations I) or equivalent

## COURSE NOTES (REQUIRED)

- **Print:** Buckner, G.D., *Course Notes: MAE 435 Principles of Automatic Control (Spring 2024)*, available via the NCSU Bookstores (anthony\_sanders@ncsu.edu, 919-515-3868)
- **Digital:** <https://ladbookstore.com/products/principles-of-automatic-control>

## WEBASSIGN ACCESS (REQUIRED)

Access code must be purchased for homework and exams (<http://www.webassign.net>)

## RECOMMENDED REFERENCE TEXTBOOK (NOT REQUIRED)

- **Print:** Franklin, Powell, and Emani-Naeini, *Feedback Control of Dynamic Systems*, any recent edition, Pearson Prentice-Hall, Upper Saddle River, NJ.
- **Digital** ("All-In E-Text"): available via course Moodle site

## GRADING (YOUR CHOICE... FINAL EXAM IS OPTIONAL)

	<u>Option 1</u>	<u>Option 2</u>
Midterm Exams (2)	40%	50%
Homework <sup>1</sup>	15%	20%
Pop Quizzes <sup>2</sup>	5%	5%
Design Project	20%	25%
Final Exam	20%	

<sup>1</sup> WebAssign-based, lowest score dropped, **late homework not accepted!**

<sup>2</sup> Moodle-based, lowest score dropped

## GRADING SCALE (REQUIRED %)

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
98	92	90	88	82	80	78	72	70	68	62	60

**TENTATIVE SCHEDULE**

<b>Week</b>	<b>Topics</b>	<b>Optional Text Read</b>	<b>Archived Lecture Date</b>	<b>Due Date</b>
May 15	<b>I. Introduction</b> Feedback systems, terminology	1.1-1.3	1/9	
May 20	<b>II. Dynamic System Models</b> Modeling mechanical systems, Modeling electrical, electromechanical systems Equivalent linear system representations: differential equations, state space,	2.1 2.2, 2.3 7.1, 7.2	1/16,18 1/23 1/25	HW #1 Due
May 27	transfer functions, block diagrams, Linear systems: characteristics, linearization,	3.2 9.2	1/30	
June 3	<b>III. Analysis of Linear Systems</b> Laplace Transforms: properties, final value theorem, partial fraction expansion	3.1	2/1 2/6	HW #2 Due
June 10	Poles and Zeros: stability, transient response Time response of first-order systems Time response of second-order systems Exam Review (confirm proctor is EOL-approved)	3.7.1 3.3	2/8	HW #3 Due
June 14	<b>Midterm Exam #1</b>		2/20,Q&A	
June 17	<b>IV. Computer Simulation of Dynamic Systems</b> Numerical Integration: Euler's Method Numerical simulation using MATLAB/Simulink		2/15	
June 24	<b>V. Basic Feedback Control</b> PID control Benefits of feedback, disturbance rejection, sensitivity	4.3 4.1, 4.2	2/27 2/29 3/5	HW #4 Due
July 1	<b>VI. Design Tools for Classical Control</b> Routh's stability criteria Root locus: manual plotting Root locus: MATLAB tools	3.7.2 5.1-5.3	3/7 3/19 3/21	HW #5 Due
July 8	<b>Design Projects Assigned</b> Compensator design using Root Locus: Pole and Zero Compensation <b>VII. System Type and Steady-State Tracking Errors</b> Exam Review (confirm proctor is EOL-approved)	5.4-5.6 4.2	3/21 3/21,28 3/28 4/4, Q&A	HW #6 Due
July 12	<b>Midterm Exam #2</b>			
July 15	<b>VIII. Frequency Response</b> Bode plots Bode plots using MATLAB	6.1	4/2 4/4,11	
July 22	Relative Stability: Gain and phase margins <b>Course conclusion</b>	6.4	4/16, 18 4/23	
July 26	<b>Design Projects, Final Assignments Due</b>			
July 30	<b>Final Exam (Optional)</b>			Final Exam

## OTHER

- Lecture videos are accessible via the course Moodle site (<https://wolfware.ncsu.edu/>). These lectures were recorded during the spring semester of 2024; due dates and deadlines discussed in these videos obviously do not apply to the summer semester. The schedule on the next page lists recommended dates for viewing lectures, plus dates for exams, homework submissions, and project submissions.
- **Late homework will not be accepted.**
- Academic dishonesty rules, as outlined in the NCSU Code of Student Conduct, will be strictly enforced. **Any suspected act of academic misconduct will be immediately referred to the NCSU Office of Student Conduct.**
- Students are encouraged to work in small groups and use additional reference materials for the solution of homework assignments and design projects. However, **copying and submitting the work of other students as your own is a violation of the NCSU Code of Student Conduct, and will be treated as such.**
- Note: copying figures, equations, or text from other sources without properly referencing these sources is **plagiarism: a violation of the NCSU Code of Student Conduct that will be referred to the NCSU Office of Student Conduct.**
- Any student with a disability who is registered with the University Office of Student Disability Services should schedule an appointment with Dr. Buckner at the beginning of the semester to discuss academic accommodations.
- Online course evaluations will be administered during the last three weeks of the semester.