NORTH CAROLINA STATE UNIVERSITY
DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

MAE 435: PRINCIPLES OF AUTOMATIC CONTROL

DR. GREGORY D. BUCKNER

SPRING 2026

Classroom: 2213 EBIII
Schedule: TTh 1:30-2:45 pm
Moodle Site: https://wolfware.ncsu.edu/courses/my-wolfware/

E-mail: gbuckner@ncsu.edu
Office Hours: TTh 4:00-5:30 pm (also by appointment)

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***, available via the NCSU Bookstores (anthony_sanders@ncsu.edu, 919-515-3868)
- **Digital**: https://ladbookstore.com/products/principles-of-automatic-control

MÖBIUS ONLINE LEARNING (REQUIRED)

Access code must be purchased for homework and exams (https://ncsu.mobius.cloud/)

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"): https://shop.ncsu.edu/adoption-search-results?ccid=47875&itemid=87144

GRADING (YOUR CHOICE… FINAL EXAM IS OPTIONAL)

	Option 1	Option 2
Midterm Exams (2)	40%	50%
Homework[1]	15%	20%
Pop Quizzes[2]	5%	5%
Design Project	20%	25%
Final Exam	20%	

[1] WebAssign-based, lowest score dropped, **late homework not accepted!**
[2] 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

Dates	Topics	Optional Text Read
Jan 13, 15	**I. Introduction**	
	Feedback systems, terminology	(1.1-1.3)
	II. Dynamic System Models	
Jan 20, 22	Modeling mechanical systems	(2.1)
	Modeling electrical, electromechanical systems	(2.2, 2.3)
	Equivalent linear system representations: differential equations, state space,	(7.1, 7.2)
Jan 27, 29	transfer functions, block diagrams	(3.2)
	Linear systems: characteristics, linearization	(9.2)
	III. Analysis of Linear Systems	
Feb 3, 5	Laplace Transforms: properties, final value theorem, partial fraction expansion	(3.1)
	Poles and Zeros: stability, transient response	(3.7.1)
Feb 10, 12	Time response of first-order systems	(3.3)
	Time response of second-order systems	
	IV. Computer Simulation of Dynamic Systems	
Feb 19 (Feb 17 Wellness Day)	Numerical Integration: Euler's Method	
	Numerical simulation using MATLAB/Simulink	
Feb 24, 26	**V. Basic Feedback Control**	
	PID control	(4.3)
Mar 3	**Exam Review**	
Mar 5	**Midterm Exam #1**	
Mar 10, 12	Benefits of feedback, disturbance rejection, sensitivity	(4.1, 4.2)
Mar 24, 26 (Mar 16-20 Spring Break)	**VI. Design Tools for Classical Control**	
	Routh-Hurwitz stability criteria	(3.7.2)
	Root locus: manual plotting	(5.1-5.3)
Mar 24	**Design Projects Assigned**	
Mar 31, Apr 2	Root locus: MATLAB tools	
	Compensator design using Root Locus: Pole and Zero Compensation	(5.4-5.6)
Apr 7	**VII. System Type and Steady-State Tracking Errors**	(4.2)
	VIII. Frequency Response	
	Bode plots: introduction and manual plotting	(6.1)
Apr 9	**Exam Review**	
Apr 14	**Midterm Exam #2**	
Apr 16	Bode plots: manual plotting and MATLAB tools	
	Relative Stability: Gain and phase margins	(6.4)
Apr 21, 23	**IX. Compensator Design Using Frequency Response**	
	Lead, Lag, and Lead-Lag Compensation	(6.7)
	X. State Space Control Design (time permitting)	
Apr 28	**Design Projects, Final Homework Due**	
May 5	**Final Exam (optional):** 12:00-2:30 pm	

OTHER

- C**lass attendance and prompt attention to homework are highly recommended**.
- **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.
- Class participation is encouraged. Please feel free to ask questions, volunteer information, and participate in discussions as you would in any other class.
- Punctuality is especially important. Please arrive on time to prevent noise and distractions.
- Food and beverages are not permitted in the classrooms.
- Online course evaluations will be administered during the last three weeks of the semester.