

North Carolina State University  
Department of Mechanical and Aerospace Engineering  
**Mae 435: Principles of Automatic Control**

**Dr. Hao Su, Associate Professor**

**Schedule:** Mon. and Wed. 3:00pm-4:15pm

**Email:** hsu4@ncsu.edu

**Classroom:** 01007 Engineering Building 1,  
Centennial Campus

**Course website:** Moodle

**Office hours:** Mon. and Wed. 11:00-12:00,  
Room 3282,  
EB3

**Zoom Office:** [Zoom Link](#)

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### **COURSE DESCRIPTION**

Model development with applications to mechanical engineering systems. First and higher order system responses. Laplace transform, transfer functions and block diagrams. Frequency response and vibration. Introduction to feedback control. Concepts of PID control, tuning and compensation. Routh-Hurwitz stability. Control analysis and design using various graphical methods such as Bode diagram.

### **COURSE OBJECTIVE**

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

### **PREREQUISITES**

MAE 315 or MAE 361 requisite: 14AEBS, 14MEBS

### **RECOMMENDED MATERIALS (not required, but suggested)**

- Katsuhiko Ogata, *Modern Control Engineering (MCE)*, any recent edition (recommend the 5<sup>th</sup> version), Pearson Prentice-Hall, Upper Saddle River, NJ.
- K. Ogata, *System Dynamics (SD)*, 4<sup>th</sup> ed., Prentice Hall, Upper Saddle River, NJ, 2004.

**Slides:** available in Moodle

### **GRADING:**

	Percentage
Midterm Exam (1)	25%
Homework (6)	30%
Project reports (3)	20%
Final exam (1)	25%

**late homework is not accepted**

## GRADING SCALE (REQUIRED %)

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
97	92	90	87	82	80	77	72	70	67	62	60

## TENTATIVE SCHEDULE

	Week	Monday	Wednesday	Optional Text Read
<b>Modeling</b>	1. Aug. 19, 21	Course Overview	Basics of Laplace Transfer and PID Control	MCE: 1.1 – 1.5
	2. Aug. 26, 28	Project: MATLAB	Project: Simulink Introduction	SD: 2.2 – 2.3
	3. Sep. 2, 4	<b>No Classes (Labor Day)</b>	Laplace Transform & Transfer Function	MCE: 2.1, 2.2 & SD: 2.2 – 2.3
	4. Sep. 9, 11	Mechanical System Modeling	Project: Simulink Introduction Part II	MCE: 3.1-3.2 & SD: 6.1-6.6-
	5. Sep. 16, 18	Electromechanical Systems Modelling	Control Block Diagram Signal Flow Graph	MCE: 2.3 & SD: 8.1 – 8.3
<b>Analysis</b>	6. Sep. 23, 25	Time-Domain Analysis (1 <sup>st</sup> order system)	Time-Domain Analysis (2 <sup>nd</sup> order system)	SD: 8.1 – 8.3 & MCE: 5.1 – 5.8
	7. Sep. 30, Oct. 2	Midterm Review	Project: Robot Modeling	MCE: 5.1 – 5.8
	8. Oct. 7, 9	Frequency Domain Analysis Part I	Frequency Domain Analysis Part II	MCE: 5.1 – 5.8
	9. Oct. 14, 16	<b>No Classes (Fall Break)</b>	<b>Midterm</b>	MCE: 7.1 & MCE: 7.2 – 7.6
	10. Oct. 21, 23	Bode Diagram: Concept	Midterm Recap & Stability Analysis	MCE: 6.2 – 6.5 & MCE: 7.2 – 7.6
	11. Oct. 28, 30	Bode Diagram: Gain and Phase Margin	Bode Diagram: Stability Criterion	MCE: 7.7 -7. 8
<b>Control</b>	12. Nov. 4, 6	Bode Diagram: Design and Control	Lead Compensation Control	MCE: 7.11 – 7.13
	13. Nov. 11, 13	Project: Robot System Simulation Implementation	Lag Compensation Control	MCE: 7.11 – 7.13
	14. Nov. 18, 20	Lead-Lag Compensation Control	Final Exam Review	-
	15. Nov. 25, 27	Project: Control of Robot I	<b>No Classes (Thanksgiving Day)</b>	-
	16. Dec. 2	Project: Control of Robot II (Last Day of Class)		-
	17. Dec. 9	<b>Final Exam</b>		-

## **OTHER**

- Class 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. Su 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.