ELEN 572– Introduction to Digital Control Systems
WINTER 2025

Instructor: Dr. Lingxiao Wang
Lecture room: IESB 124
Lecture hours: 10:00 am – 11:50 pm Tuesday/Thursday
Email: lwang@latech.edu
Office: NETH 213
Office hours: 2:00 pm – 4:00 pm Monday to Friday
Prerequisites: ELEN 321, MATH 244

Course Description:

This course provides an introduction to digital control systems, focusing on the fundamental concepts required to analyze and design these systems. The course begins with a ***review of analog and digital signals***, followed by an exploration of ***discrete-time system modeling*** and ***system stability analysis***. It then delves into key topics in digital control, including ***discrete-time root locus and PID control***. Additionally, the course introduces foundational concepts in ***optimal control*** and ***reinforcement learning***, offering a comprehensive overview of modern control techniques.

Textbook (Optional):

Digital Control Engineering Analysis and Design by Fadali and Visioli (Second Edition, Academic Press, 2013)

Recommended Software:

MATLAB Student Version + Control Systems Toolbox

Homework:

1. Homework due dates are 1 week after the post date (You can find the post date on the schedule table).
2. Homework should be submitted online on the Canvas.
    a. Download homework questions on the Canvas and print them out.
    b. Complete homework questions.
    c. Scan your completed homework questions and upload them on Canvas.
3. Handwriting should be clear and recognizable.
4. Use standard homework papers.
5. Some homework may require computer simulation using MATLAB.

Exams:

1. There will be four in-class exams given during the course.
2. Exams are individual tasks (no collaboration).

3. Exams are open-note (4 letter-paper size paper notes allowed, front and back sides).
4. You can bring a regular calculator.
5. No make-up exams will be permitted unless approval is obtained from the instructor prior to the scheduled examination.

Grading: The weighting of grades is as follows:
- Homework – 30%
- Graduate Student Assignment – 10%
- Exam 1 – 25%
- Exam 2 – 25%
- Attendance (10 random roll calls throughout the semester) – 10%

Grading Scale: The grading scale used for this course is shown below:
- A – 100-90%
- B – 89.99-80%
- C – 79.99-70%
- D – 69.99-60%
- F – below 60%

Class Attendance: This class will adhere to the guidelines for class attendance found in Chapter 3 of the University Catalog, available online at www.latech.edu/registrar/bulletin/. Additionally, attendance will be taken promptly at the beginning of class and any student arriving after attendance has been checked without a reasonable excuse will be considered absent. Reasonable excuses DO NOT include routine doctor visits, car trouble, parking difficulties, oversleeping, or work schedules. Any student who misses three or more classes without university approved excuses may be penalized at the instructor's discretion.

Emergency Class Disruption Policy: In the event that a disaster or other emergency results in campus closure, this course will continue via Moodle and Zoom. You will be required to login to moodle.latech.edu for further instructions. Please enroll in the Emergency Notification System (instructions below) to receive official campus updates. You may also refer to ert.latech.edu for updated information.

Disability Disclosure: Students needing testing or classroom accommodations based on a disability are encouraged to discuss those needs with the instructors as soon as possible. For more information about eligibility for accommodations, contact the Department of Testing and Disability Services, 318-257-4221, www.latech.edu/ods for assistance.

Academic Misconduct: Academic behavior is governed by university policies and guidelines found in Chapter 4 of the University Bulletin. It is the student's obligation to be familiar with and understand these policies, regulations, and guidelines.

- Behavior: Students are expected to maintain a professional classroom environment. Students are to refrain from: verbal or physical violence, threats, improper language, disrespect to classmates and the instructor. Participants of such activities will be asked to leave the class. If you are removed from class for behavioral reasons, you will be considered absent for that class period.
- Cheating: Cheating of any kind will not be tolerated. Collusion during examinations through verbal or electronic communication and/or plagiarism of any kind throughout the course will result in a zero grade for the assignment or exam as well as notification of the proper university officials. Multiple infractions will result in a zero grade for the course.

Emergency Notification System: All Louisiana Tech students are strongly encouraged to enroll and update their contact information in the Emergency Notification System. It takes just a few seconds to ensure that you are able to receive important text and voice alerts in the event of a campus emergency. For more information on the Emergency Notification System, please visit www.latech.edu/administration.ens.shtml.

COVID -19 Information: Students can access COVID-19 related information, guidelines, FAQs, and policies at Louisiana Tech's website: www.latech.edu/coronavirus.

Louisiana Tech's Return to Campus Plan is located at www.latech.edu/return-to-campus. Masks are required to be worn indoors on campus. Masks are required to be worn outdoors if six feet of physical distance cannot be maintained. Every member of the Tech Family will need to take personal responsibility for their behavior, which includes wearing masks, maintaining physical distancing, washing hands regularly, using proper sneeze and cough practices, helping maintain clean academic and office areas, and monitoring for symptoms of COVID-19.

The direct link to the reporting protocol for students is located at www.latech.edu/return-to-campus-plan/for-students/. Students can reach out to Stacy Gilbert, Dean of Student Services & Academic Support, at stacyc@latech.edu for help with accommodations and additional information.

Failure to comply with Safety Protocols listed in the "Back to Campus Fall 2020" booklet, located at www.latech.edu/documents/2020/07/covid-return-book.pdf/, specifically on pages 5-7 about masks and social distancing, could result in students being in violation of the Classroom Behavior Policy listed on page 125 of the "Student Handbook," located at www.latech.edu/documents/2018/09/student-handbook.pdf/.

Information and contact numbers and sites for Louisiana Tech Counseling Services are located at https://www.latech.edu/current-students/student-advancement-affairs/counseling-services/.

Tentative Course Schedule

Date	Topics	HW Due
5-Dec	Syllabus & Introduction to Digital Control Systems	
10-Dec	Discrete Time Systems and Z-Transform	
12-Dec	z-Transform Inversion	
17-Dec	Time & Frequency Response of a Discrete-time System	
19-Dec	Modeling of Digital Control Systems	HW1
24-Dec	*Christmas Holidays*	
7-Jan	Systems with Transport Lag	
9-Jan	Steady-State Error and Error Constants	
14-Jan	Stability of Digital Control Systems	
16-Jan	Nyquist Criterion, Phase Margin, and Gain Margin	
21-Jan	Exam 1 Review	
23-Jan	Exam 1	HW2
28-Jan	Analog Control System Design	
30-Jan	Digital Control System Design I	
4-Feb	Digital Control System Design II	
6-Feb	Discrete Time State Space Model	
11-Feb	Properties of State Space Model	
13-Feb	State Feedback Control	HW3
18-Feb	Optimal Control	
20-Feb	Digital Control MATLAB Session	
25-Feb	Exam 2 Review	
27-Feb	Exam 2	HW4