The University of Texas at Tyler
Department of Electrical Engineering

EENG 4316 – Digital Control Systems (Elective)

Syllabus

Catalog Description:

Sampling; z-transform; stability; frequency response; root locus; state variables in discrete time; controllability; observability; state variable feedback. Extensive use of computer programming. Three hours of lecture per week.

Prerequisites: EENG 4308

Credits: 3 (3 hours lecture, 0 hours laboratory per week)

Text(s): Introduction to Applied Digital Control Second Edition
Gregory P. Starr Department of Mechanical Engineering, The University of New Mexico November 2006.

Additional Material: Matlab®
Instructor's Lecture Notes

Course Coordinator: Joseph Kamto

Topics Covered: (paragraph of topics separated by semicolons)

Introduction to digital control (review), Emulation of Analog Controllers, Sampling and Reconstruction, Stability Analysis Techniques, Digital Controller Design, Digital Filter Structures and Quantization Effects, Adaptive Inverse Control.

Evaluation Methods: (only items in dark print apply):

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Objectives[1]: By the end of this course students will be able to:

1. Difference equations and Z-transforms Transfer functions and dynamic response s-plane, z-plane, and frequency response. [1,2]
2. Simulation using integration rules Integration rules and pole-zero mapping Comparison of simulation methods [1,2]
3. Sampling modeled as impulse modulation Frequency spectra of sampled signals (aliasing) Desampling (signal reconstruction) Block diagrams. [1,2]
4. System ID—models and data organization System ID using least-squares. [1,2]
5. Transform-based pole placement Design in s-plane, map to z-plane (sampling ignored) Design in z-plane (sampling considered) [1,2]
6. Determine the stability of a control system using the Root-Locus method. [1,2]
7. The use of Simulink in modeling systems Effect of derivative and integral control action PID-style controllers. [4]

8. Continuous system modeling using state variables. MATLAB tools for state-space analysis. [4]
9. Analyze the performance of PI and PID controllers for simple control systems. [1,2]
10. Solution to the discrete-time state equation State feedback control law, controllability State prediction estimator design [1,2]
11. Utilize engineering literature such as technical manuals and product datasheets to select components to meet experimental or prototype requirements. [1,2]
12. Analyze transient performance of control systems using advanced simulation software. [4]
13. Analyze control system stability using advanced simulation software. [4]

[1]Numbers in brackets refer to method(s) used to evaluate the course objective.

Relationship to Student Outcomes (only items in dark print apply)[2]: This course supports the following Electrical Engineering Student Outcomes, which state that our students will possess:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics; [3, 4, 7, 8, 9]
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors; [1, 2, 5, 6]
3. an ability to communicate effectively with a range of audiences;
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts; [16, 17]
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives;
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions; [12, 13]
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [10, 11]

[2]Numbers in brackets refer to course objective(s) that address the Program Outcome.

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:	0	Hours
Engineering Sciences and Design:	3.0	Hours
General Education Component:	0	Hours

Prepared By:	Hassan El-Kishky	Date:	11/24/09
Revised By:	Joseph Kamto	Date:	8/27/2019

EENG 4316/5340: Digital Control Systems

Spring 2021 Syllabus

Instructor Information:

Premananda Indic, PhD
Department of Electrical Engineering,
The University of Texas at Tyler
Office: RBN 2010,
email: pindic@uttyler.edu (preferred)

Office Hours: (via zoom by appointment)

Monday	: 11:30am to 1:00PM
Wednesday	: 11:30am to 1:00PM
Additional Hours	: By appointment

Course Description:

The objective is to develop understanding of

Signal Conversion and Processing
The z-Transform
Transfer Functions, Block Diagrams and Signal Flow Graphs
The State Variable Technique
Controllability, Observability and Stability
Time-Domain and z-Domain Analysis
Frequency-Domain Analysis
State Feedback Design
Output Feedback Design

Evaluation and Grading:

The course grade will be based on the following activities:

1. **Homework Assignments (50%):**
   Homework will be assigned, and it should be submitted through canvas using pdf or word format. No late submissions allowed. Collaboration on homework assignments is strongly encouraged, however expecting a disclaimer statement at the end of your assignments if you have discussed with the students in the class or someone outside. All resources, including materials obtained from internet should be properly acknowledged. There will be five homework assignments

2. **Tests (30%):**
   There will be three tests of duration 2 hour each as given in the outline. There will be a grade replacement policy. For example, if your Test 2 grade is better than

Test 1, then Test 1 grade will be replaced with the Test 2. This approach will be followed for other tests. For Test 3, you will get a score of at least an average of two previous tests. It is important that you should attend all tests and should score at least 50% to be eligible for grade replacement policy.

3. **Final Exam (20%):**
   Final exam as per University Schedule

Students are encouraged to read the academic honesty policy (Student Standards of Academic Conduct).

Course Outline:

Schedule	Topics	Assignments
January 12	Overview of Automatic Control	
January 19	Boot Camp on Automatic Control	
January 26	Introduction to digital control systems Signal Conversion and Processing z-transform Transfer function and Block diagram	HW1
February 2	The state variable Techniques	
February 9	Stability	HW2
February 16	Test 1	Topics covered from January 26 to February 9
February 23	Controllability	
March 2	Observability	HW3
March 9	Frequency Domain Analysis	
March 16	Test 2	Topics: Controllability and Observability
March 23	State Feedback	HW4
March 30	Output Feedback	
April 6	Test 3	Topics: State Feedback and Output Feedback
April 13	PID Controller	HW5
April 20	Review for Final Exam	
April 26	**Final Exam**	