SJSU SAN JOSÉ STATE UNIVERSITY

Charles W Davidson College of Engineering · Mechanical Engineering

Advanced Control System Design Section 01

ME 281

Spring 2023 3 Unit(s) 01/25/2023 to 05/15/2023 Modified 12/22/2022

Contact Information

Instructor:	Saeid Bashash
Office Location:	ENG 310-A
Telephone:	408-924-8355
Email:	saeid.bashash@sjsu.edu
Office Hours:	Wed. 17:00-18:30 (or by appointment)
Class Days/Time:	Tu-Th 18:00-19:15
Classroom:	ENG 303

Course Description and Requisites

Establishment of design criteria. Digital control system design based on conventional and modern approaches. Intelligent control system design. Digital control system hardware and software. Case studies. Microprocessor implementation of control systems.

Prerequisite: ME 280 or equivalent.

Letter Graded

Classroom Protocols

I expect everyone to make their best effort to attend all class sessions. Please arrive to the classroom before the session begins, and put your cell phone on the 'silent' or 'vibrate' mode. You are encouraged to ask questions and participate in the classroom discussions; however, disrupting the class by engaging in conversation with your classmates must be avoided.

* We will follow the health policies such as masking and social distancing enforced by the university.

Course Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able to:

1. *Analyze dynamic response of discrete-time linear systems using analytical and computer-aided methods.*

2. *Perform transformations from the continuous domain to the discrete domain and vice versa.*
3. *Examine the significance of poles and eigenvalues of discrete dynamic systems.*
4. *Determine stability of discrete dynamic systems.*
5. *Determine the controllability and observability of discrete state-space systems.*
6. *Develop parametric and non-parametric models for discrete-time systems.*
7. *Design digital controllers based on the classical and modern control methods.*
8. *Develop optimal controllers for discrete-time systems.*

Course Materials

Textbooks

There are no required textbooks for this course. Here are a few recommended textbooks:

- Ogata, *Discrete-Time Control Systems*, 2th Edition, Pearson, 1995.
- Phillips, Nagle, and Chakrabortty, *Digital Control System Analysis and Design*, 4rd Edition, Pearson, 2015.
- Franklin, Powel, and Workman, *Digital Control of Dynamic Systems*, 3rd Edition, Addison-Wesley, 1997.

Software

- MATLAB and Simulink (Free for SJSU students via the campus-wide license: https://www.mathworks.com/academia/tah-portal/san-jose-state-university-31511582.html; A Mathworks account with SJSU email address is necessary to access the license)
- Students without a strong background in MATLAB or Simulink are highly encouraged to complete the "MATLAB Onramp" and "Simulink Onramp" courses from https://matlabacademy.mathworks.com/. These courses are free, and come with a certificate upon successful completion.

Course Requirements and Assignments

Lecture Questions: To make sure everyone is engaged in the class, I will frequently call your names and ask simple questions related to the lecture. I will use a software application to randomly draw the names and track the responses. You could earn up to 2% bonus credit by answering the lecture questions.

Homework Assignments: Homework is generally due one week after it is assigned. All submissions will be online via Canvas. There will be only one allowance for late homework submission and that will include a 20% grade penalty. The late submission will be due within a few days after the original due date.

Midterm and Final Exams: Both the midterms and the final exam will be based on the topics covered in the lectures. The exams will be closed book and closed notes, but you may receive a formula sheet. Reviewing the lecture notes and homework problems will help prepare for the exams.

Project: There will be a project assigned toward the end of the semester. The project will focus on the design of a digital feedback controller for a dynamic system. The project will include both analytical and computational components to be carried out via MATLAB and Simulink.

Grading Information

The weighting of course components for determining the course grade are as follows:

- Homework: 25%
- Midterm Exam: 25%
- Project: 15%
- Final Exam: 35%
- Lecture Questions: 2% (Bonus)

The scores on your assignments and exams will be combined and totaled using the weighting scheme described above. The grade will be rounded up to the nearest integer, and a final letter grade will be issued using the following criteria:

Grade	Points	Percentage
A plus	*95 to 100*	*95 to 100%*
A	*91 to 94.9*	*91 to 94.9%*
A minus	*88 to 90.9*	*88 to 90.9%*
B plus	*85 to 87.9*	*85 to 87.9%*
B	*81 to 84.9*	*81 to 84.9%*
B minus	*78 to 80.9*	*78 to 80.9%*
C plus	*75 to 77.9*	*75 to 77.9%*
C	*71 to 74.9*	*71 to 74.9%*
C minus	*68 to 70.9*	*68 to 70.9%*
D plus	*65 to 67.9*	*65 to 67.9%*
D	*61 to 64.9*	*61 to 64.9%*
D minus	*58 to 60.9*	*58 to 60.9%*
F	*0 to 57.9*	*0 to 57.9%*

University Policies

Per University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (https://www.sjsu.edu/curriculum/courses/syllabus-info.php) (https://www.sjsu.edu/curriculum/courses/syllabus-info.php). Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

Week	Date	Topics
1	1/26	Introduction to Digital Control Systems
2	1/31, 2/2	Discrete-Time Systems and z-Transform
3	2/7, 2/9	Inverse z-Transform

4	2/14, 2/16	Data Sampling and Signal Reconstruction
5	2/21, 2/23	Open-Loop Characteristics of Discrete-Time Systems
6	2/28, 3/2	Closed-Loop Characteristics of Discrete-Time Systems
7	3/7, 3/9	Discrete Equivalents to Continuous Transfer Functions
8	3/14, 3/16	Mapping from s-Domain to z-Domain
9	3/21, 3/23	Digital Controller Design; Criteria and Specifications
10	3/28, 3/30	Spring break (no classes)
11	4/4, 4/6	**Midterm Exam Review (4/4) and Midterm Exam (4/6)**
12	4/11, 4/13	Frequency Domain Controller Design
13	4/18, 4/20	State Space Modeling of Discrete-Time Systems
14	4/25, 4/27	Full-State Feedback Control of Discrete-Time State Space Systems
15	5/2, 5/4	State Observer Design for Discrete-Time Systems
16	5/9, 5/11	Optimal LQR Design and Course Review
Final Exam	**5/18**	**Thursday (5/18/2023) 5:15 – 7:30 pm, ENG 303**