San José State University
Charles W. Davidson College of Engineering
Department of Mechanical Engineering
ME 281, Advanced Control System Design, Spring 2019

Instructor:	Saeid Bashash
Office Location:	Engineering 310-I
Telephone:	408-924-8355
Email:	saeid.bashash@sjsu.edu

Office Hours:	Tu-Wed 17:00-18:00 or by appointment
Class Days/Time:	Tu-Th 18:00-19:15
Classroom:	Duncan Hall 243
Prerequisites:	ME 280 or equivalent

Course Description

Fundamentals of digital control systems. Sampling theorem, z-transform, and discrete-time systems analysis. Discretization methods for continuous-time systems. Stability analysis and synthesis of discrete-time control systems. Time domain analysis of discrete-time systems based on the transfer function and state-space equations. Frequency-domain analysis of discrete-time systems. Control design based on classical and modern approaches. Computer aided system analysis and design. Optimal LQR design. Case studies.

Course Learning Outcomes

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.*

Required Texts/Readings/Materials

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.

Required Software

MATLAB and Simulink Student Suite to be purchased from:
https://www.mathworks.com/store/link/products/student/SV?s_tid=ac_buysuite_sv_bod

Although it is highly recommended to purchase the student license for MATLAB and Simulink, the full package is available on the ME Computer Labs as well.

Course Requirements and Assignments

Assessment for the purposes of determining your course grade will consist of evaluating your performance on homework assignments, midterm exam, term projects, and the final exam. Homework is generally due one week after it is assigned. There will be **only one allowance** for late homework submission and that will include a **20% grade penalty**. The late submission will be due at the beginning of the next class session.

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%

The scores on your homework, projects, and exams will be combined and totaled using the weighting scheme described above. A final letter grade will be determined using the following criteria:

A+ 100 – 95% | A 94 – 91% | A- 90 – 88% | B+ 87 – 85% | B 84 – 81% | B- 80 – 78% | C+ 77 – 75% | C 74 – 71% | C- 70 – 68% | D+ 67 – 65% | D 64 – 61% | D- 60 – 58% | F < 57%.

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. We will also hold review sessions before the exams.

Classroom Protocol

I expect everyone to make their best effort to attend *all* class sessions. Please arrive to the classroom *before* the session begins, so that others are not disturbed by your entry after instruction has begun. Put your cell phones on 'silent' or 'vibrate' before you enter the classroom. You are encouraged to ask questions and participate actively in the classroom discussions raised during the lectures. However, disrupting the class by engaging in long conversation with your classmates must be avoided. Moreover, using computers and tablets during lecture time is highly discouraged unless for taking notes in the tablet mode or working on in-class activities.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/.

ME-281 / Advanced Control System Design, Spring 2019

Tentative Course Schedule

Week	Date	Topics
1	1/24	Introduction to Digital Control Systems
2	1/29, 1/31	Discrete-Time Systems and z-Transform
3	2/5, 2/7	Inverse z-Transform
4	2/12, 2/14	Data Sampling and Signal Reconstruction
5	2/19, 2/21	Open-Loop Characteristics of Discrete-Time Systems
6	2/26, 2/28	Closed-Loop Characteristics of Discrete-Time Systems
7	3/5, 3/7	Discrete Equivalents to Continuous Transfer Functions
8	3/12, 3/14	Mapping from s-Domain to z-Domain
9	3/19, 3/21	Digital Controller Design; Criteria and Specifications
10	**3/26, 3/28**	**Midterm Exam Review (3/26) and Midterm Exam (3/28)**
11	4/2, 4/4	Spring Break, No Class
12	4/9, 4/11	Frequency Domain Controller Design
13	4/16, 4/18	State Space Modeling of Discrete-Time Systems
14	4/23, 4/25	Full-State Feedback Control of Discrete-Time State Space Systems
15	4/30, 5/2	State Observer Design for Discrete-Time Systems
16	5/7, 5/9	Optimal LQR Design and Course Review
Final Exam	**5/16**	**Thursday (5/16/2019) 17:15 – 19:30, DH 243**