San José State University
Charles W. Davidson College of Engineering
Department of Mechanical Engineering
ME 190, Mechatronic Systems Design, Fall 2021

Instructor:	Saeid Bashash
Office Location:	Engineering 310-A
Telephone:	408-924-8355 (Available only by email and Zoom during Fall 2021)
Email:	saeid.bashash@sjsu.edu
Office Hours:	Tu & Th 17:00-18:00 (or by appointment) via Zoom
Class Days/Time:	Lecture, Sec. 1 (40321): Tu-Th 1:30 PM-2:20 PM Lab, Sec. 2 (40730): Tu 2:30 PM-5:15 PM Lab, Sec. 3 (42051): Th 10:45 AM-1:30 PM Lab, Sec. 4 (42403): Th 2:30 PM-5:15 PM
Classroom:	Online via Zoom (Registration required for the first attendance)
Prerequisites:	ME-106; co-req. ME-147

Course Description

Process modeling from test data. Computer-aided dynamic system control analysis and design. Application and integration of microcontroller for digital process and servo control. Development of smart and intelligent products with microcontroller.

Course Learning Outcomes

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

1. *Develop models for electrical, mechanical, and electro-mechanical systems*
2. *Simulate the models of dynamic systems in the computer environment*
3. *Extract useful data from a noisy signal*
4. *Identify system characteristics by inspection of experimental data*
5. *Design and implement hardware controllers*
6. *Write and optimize code for embedded programming*

Required Texts/Readings/Materials

There are no required textbooks for this course. Lecture notes will be uploaded onto Canvas on a regular basis. The following references are highly recommended:

- William Palm III (2013). System Dynamics. McGraw-Hill Education, 3rd edition.
- Åström, K. and Murray, R. (2012). Feedback Systems: An Introduction for Scientists and Engineers. Princeton University Press, Princeton, NJ. The complete text is available for free online at: http://www.cds.caltech.edu/~murray/books/AM08/pdf/am08-complete_28Sep12.pdf

Required Hardware

- We will be using the MinSeg Mega robotic kit for most of the labs and the final project. The ME department will provide the kits via an equipment loan program.
- To perform the labs, you will need to install MATLAB and Simulink on your computer, as well as the Arduino Support Package for Simulink via MATLAB's add-on explorer, and the Rensselaer Arduino Support Package library (RASPlib). You will also need a multimeter for the labs.

Required 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). When installing MATLAB, install the following Toolboxes:
  - Simulink
  - Simscape
  - Control System Toolbox
  - Signal Processing Toolbox
  - Optimization Toolbox
  - Symbolic Math Toolbox
- Students without a strong background in MATLAB and/or Simulink are highly encouraged to complete "MATLAB Onramp" and "Simulink Onramp" courses from https://matlabacademy.mathworks.com/. These courses are free, and come with a certificate upon successful completion.

Grading Information

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

- Homework: 15%
- Lab Activities and Reports: 25%
- Midterm Exam: 20%
- Term Project: 10%
- Final Exam: 30%
- Lecture questions (Extra credit): 2%

The grade for each lab is the aggregation of three sub-grades:

- Preparation before the lab: 30%
- Completion check at the end of the lab: 30%
- Report: 40%

The scores on your homework, laboratory reports, midterm exam, term project, and final exam 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 determined 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%*

Lecture Questions

To further engage you in the class, I will frequently call your names and ask spontaneous questions related to the lecture. The questions will be simple enough to be answered within a few seconds. I have developed a tool to randomly call your names and track your responses. You will need to be ready to turn on your microphone, answer the question, and then turn it off. There will be 2 bonus points for answering the in-class questions.

Homework

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 at the beginning of the next class period.

Lab Assignments

All the MinSeg labs will be carried out via Simulink. More information will be provided on the details of the libraries required for the labs.

You will be provided with full instructions for each lab. You must attempt to complete the lab before the corresponding lab schedule, as much as possible. During the lab hours, the TAs will help you with any questions or issues you have not been able to resolve on your own. Both the preparation before the lab and the completion at the end of the lab will be a part of your lab grade. The lab report submission policy is similar to that of homework: Only one late submission is allowed, which will come with 20% grade deduction.

Any complaints about the lab and homework grades must be taken to the lab TAs and the ISA first. If the issue is not resolved, you may contact the instructor.

- Hugh Pham, Lab TA (Section 2): hugh.pham@sjsu.edu
- Amaris De La Rosa, Lab TA (Section 3): amaris.delarosa-moreno@sjsu.edu
- Vincent Tran, Lab TA (Section 4): vincent.v.tran01@sjsu.edu
- Hugh Pham, Homework ISA: hugh.pham@sjsu.edu

Midterm and Final Exams

Both the midterm 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 will be given the necessary formula. Reviewing the lecture notes, homework problems, and the labs will help you prepare for the exams.

Due to the online class system, all the exams will be carried out online via Canvas through the Respondus Monitor system. You will need to make sure you have a quiet place, a reliable internet connection, and a device with properly working camera and microphone. You must not communicate with anyone, by any means, during the exams.

Project

There will be a project assigned toward the end of the semester on developing a control system for the MinSeg robot to stabilize it in the upright position. The project will include analytical, computational, and experimental components.

Zoom Meeting Registration

The class registration link is available on Canvas. Please provide your correct and complete first and last name and email address the first time you attend the class. Once your registration is completed, the Zoom link will be sent to you via email. You can click on that link from any device to join the class without any further registration. Please make sure to keep the email or the meeting link for the rest of the semester.

Class Protocols

1. Make your best effort to attend all class sessions and be responsive to the questions and quizzes.
2. Try to keep your microphone on mute, except for when you have a question or a comment, or when you are asked a question.
3. Have a backup device ready for use in the case of technical difficulties with your primary device (e.g. automatic update, OS issues, hardware failure, etc.). Installing the Zoom app on your cellphone or tablet might be a good backup plan.

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-190: Mechatronic Systems Design (Fall 2021 Tentative Course Schedule)

Week	Date	Topics
1	8/19	Course overview, introduction to MATLAB
2	8/24, 8/26	Introduction to MATLAB and Simulink
3	8/31, 9/2	Modeling electrical systems
4	9/7, 9/9	Discretization of differential equations
5	9/14, 9/16	Analog and digital filtering
6	9/21, 9/23	Laplace Transform and transfer function
7	9/28, 9/30	State-space modeling and simulation
8	10/5, 10/7	Modeling electromechanical systems
9	10/12, 10/14	Midterm Review - **Midterm Exam (10/14)**
10	10/19, 10/21	Modeling and analysis of DC motors
11	10/26, 10/28	Fundamentals of feedback systems
12	11/2, 11/4	Control design using classical methods
13	11/9, 11/11	Control design using modern methods
14	11/16, 11/18	Review of rigid body dynamics
15	11/23	Modeling the MinSeg robot
16	11/30, 12/2	Linear Quadratic Regulator (LQR)
Final	**12/10/2021**	**Friday (Dec 10), 12:15 – 2:30 PM**