San José State University
Charles W. Davidson College of Engineering
Department of Mechanical Engineering
ME 285, Mechatronic Systems Engineering, Fall 2019

Instructor:	Saeid Bashash
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Office Hours:	Tuesday and Thursday 5:00 PM-6:00 PM Or by appointment
Class Days/Time:	Lecture (47778): Tu-Th 6:00 PM-6:50 PM Lab (47779): Fri 4:30 PM-7:15 PM
Classroom:	Engineering 135
Prerequisites:	Basic knowledge in computer programming and system dynamics

Course Description

Introduction to mechatronic systems: Combine hardware, software and system integration. Subjects include basic circuits, logic gates, OpAmps, encoder/decoder, DC and stepper motor, A/D and D/A, C-language, interfacing and control. Hands-on lab practices.

Course Learning Outcomes

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

1. *Develop mathematical models for electrical, mechanical, and electro-mechanical systems*
2. *Simulate the models of dynamic systems in computer environment*
3. *Explain the basic structure of a microcontroller, the nature of IO ports, and the common peripheral subsystems found in most microcontrollers*
4. *Interface a microcontroller to sensors, actuators, and user I/O devices*
5. *Extract useful data from a noisy signal*
6. *Identify system characteristics by inspection of a data plot*
7. *Design and implement a hardware controller*
8. *Write and optimize code for embedded programming*

Required Texts/Readings/Materials

There are no required textbooks for this course. The main reference is the lecture notes. Three textbooks are recommended for further reading.

Recommended Texts/ Readings/Materials

- J. Carryer, R. Ohline, and T. Kenny (2010). Introduction to Mechatronic Design. Pearson.
- K. Åström and R. Murray. (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
- William Palm III (2013). System Dynamics. McGraw-Hill Education, 3rd edition.

Required Hardware

- A laptop computer with sufficient memory (at least 4 GB) and battery life (at least 2 hours) for the lab activities; A limited number of desktop computers will be available as backup alternatives.
- An Arduino Uno (or Mega) microcontroller
- A standard multimeter for voltage, current, and resistance measurements

Additional materials will be supplied in the lab.

Required Software

- MATLAB and Simulink Student Suite (with **Simscape** add on) 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.
- Python with PyCharm IDE
- Arduino IDE
- Tinkercad (online account)

Course Requirements and Assignments

- All the lecture notes, lab instructions, and homework assignments will be regularly posted on the "Pages" section of the Canvas course website.
- Homework is generally due one week after it is assigned. All submissions are online via Canvas unless otherwise is requested. There will be **only one allowance** for late homework submission and that will include a **20% grade cut**.
- You are expected to study the lab instructions and complete the pre-lab assignments before attending the labs. Completion of the pre-lab exercises will be checked at the beginning of each lab session. Moreover, there will be an assignment completion check at the end of each lab session. You must notify the instructor in advance if you will be late to the lab.

Grading Information

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

- Homework: 10%
- Lab Assignments: 25%
- Midterm Exam: 20%
- Term Project: 15%
- Final Exam: 30%

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

- Completion of the pre-lab exercises: 40%
- Involvement in the lab activities: 30%
- Completion check at the end of the lab: 30%

* Although the labs are team-based, each individual will be evaluated independently based on the above criteria.

The scores on your homework, lab assignments, 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 issued using the following criteria:

Grade	*Points*	*Percentage*
A plus	*96 to 100*	*96 to 100%*
A	*92 to 95*	*92 to 95%*
A minus	*89 to 91*	*89 to 91%*
B plus	*86 to 88*	*86 to 88%*
B	*82 to 85*	*82 to 85%*
B minus	*79 to 81*	*79 to 81%*
C plus	*76 to 78*	*76 to 78%*
C	*72 to 75*	*72 to 75%*
C minus	*69 to 71*	*69 to 71%*
D plus	*66 to 68*	*66 to 68%*
D	*62 to 65*	*62 to 65%*
D minus	*59 to 61*	*59 to 61%*
F	*0 to 58*	*0 to 58%*

Midterm and Final Exams

Both the midterm and the final exam will be based on the topics covered during lectures and lab sessions. The exams will be closed book and closed notes, but you may receive a formula sheet. Reviewing the lecture notes, lab manuals, and homework problems will help prepare for the exams. We will also hold review sessions before each exam.

Classroom Protocol

I expect everyone to make their best effort to attend *all* class sessions and laboratory periods. Please arrive to the classroom or laboratory *before* the session begins, so that others are not disturbed by your entry after instruction has begun. If you normally keep a cell phone activated and with you, put your cell phone 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 conversation with your classmates must be avoided. Moreover, using computers and tablets during lecture time is highly discouraged unless for taking notes in 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/

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Tentative Course Schedule

Week	Date	Topics
1	8/22	Course overview
2	8/27-8/29	Modeling and simulation of dynamic systems using MATLAB and Python
3	9/3-9/5	Introduction to Simulink, Simscape, and C programming language
4	9/10-9/12	Microcontroller architectures and arithmetic operations
5	9/17-9/19	Microcontroller peripherals (Parallel I/O system, PWM, timers, and interrupts)
6	9/24-9/26	Modeling electrical systems (resistor-capacitor-inductor and op-amps circuits)
7	10/1-10/3	Inter-processor communications (Bit parallel, bit serial: SPI, UART, and I2C)
8	10/8-10/10	Midterm review - **Midterm Exam (10/10)**
9	10/15-10/17	Modeling electromechanical systems
10	10/22-10/24	DC motor types and rotary encoders
11	10/29-10/31	Fundamentals of feedback control systems
12	11/5-11/7	State space modeling
13	11/12-11/14	State space control
14	11/19-11/21	State space estimation and Kalman filtering
15	11/26	Nonlinear systems
16	12/3-12/5	Project and Final Exam review
Final Exam	**12/13/2019**	**Friday, 2:45 – 5:00 pm, ENG 135**