San José State University
Charles W. Davidson College of Engineering
Department of Mechanical Engineering
ME 190, Mechatronics System Design, Fall 2016

Instructor: Saeid Bashash

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Office Hours:

Tuesday 17:00-18:00
Thursday 13:00-14:00
Or by appointment

Class Days/Time:

Lecture (40578): Tu-Th 14:00-14:50 (Loc: BBC 204)
Lab, Sec. 1 (41374): Th 15:00-17:45 (Loc: E-135)
Lab, Sec. 2 (46961): Tu 15:00-17:45 (Loc: E-135)
Lab, Sec. 3 (50587): W 10:00-12:45 (Loc: E-135)

Classroom:

Lecture: Boccardo Business Complex (BBC), Room 204
Lab: Engineering 135

Prerequisites:

ME-106; co-req. ME-147

* Undergraduate students are required to turn in an unofficial transcript with the prerequisites highlighted by the second class period. Undergraduate students are also required to provide proof of enrollment in ME 147.

Course Description

ME-190 is the capstone course for the mechatronics specialization track. Students will integrate and build upon knowledge and skills gained in previous courses to design, assemble, and analyze mechatronic systems using modern methods and tools. Lectures and laboratory experiences will include dynamic systems behavior, motion sensing and control, digital and analog signal filtering, pneumatics, embedded programming, and analysis in time and frequency domains. The course concludes with an open-ended team-based multi-week design project.

Course Learning Outcomes

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

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

7. *Design and analyze basic pneumatic systems*
8. *Analyze and process digital images and videos*

Required Texts/Readings/Materials

Recommended Textbooks

- 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
- Scherz, P. (2013). Practical Electronics for Inventors, McGraw-Hill, 3rd edition.

Required Hardware

- Arduino Uno or Mega (preferred)
- An Arduino-compatible analog sensor (Temperature, light, acceleration, distance, etc.)
- Resistors, inductors, and capacitors or arbitrary size
- Breadboard, LEDs, and jumper wires
- Multimeter

Required Software

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

Course Requirements and Assignments

Assessment for the purposes of determining your course grade will consist of evaluating your performance on homework assignments, laboratory reports, midterm examination, term project, and the final examination. Homework is generally due one week after it is assigned. You must turn in the hardcopy at the *beginning* of the lecture period. 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 following class session. Laboratory reports will be handled similarly: a hardcopy must be submitted one week after the laboratory experiment was performed. Turn in the hardcopy to your lab instructor at the beginning of the lab period.

Grading Information

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

- Homework: 15%
- Lab Reports and Presentations: 25%
- Midterm Exam: 20%
- Term Project: 15%
- Final Exam: 25%

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. A final letter grade will be determined using the following criteria:

A 100 – 93% | A- 92 – 90% | B+ 89 – 87% | B 86 – 83% | B- 82 – 80% | C+ 79 – 77% |
C 76 – 73% | C- 72 – 70% | D+ 69 – 67% | D 66 – 63% | D- 62 – 60% | F < 59%.

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/

ME-190 / Mechatronics System Design, Fall 2016

Tentative Course Schedule

Week	Date	Topics
1	8/25	Course overview, examples of mechatronic systems, introduction to MATLAB
2	8/30	Introduction to Simulink
2	9/1	Modeling electrical systems
3	9/6	State-space modeling and simulation
3	9/8	Analog and digital filtering
4	9/13	Transfer function and frequency domain analysis
4	9/15	Time response of linear time-invariant (LTI) systems
5	9/20	Stability analysis of LTI systems
5	9/22	Motion sensors: Accelerometers, gyros, encoders
6	9/27	Discrete time (digital) representation of dynamic systems
6	9/29	Linearization of nonlinear systems
7	10/4	Pneumatics
7	10/6	Modeling electromechanical systems
8	10/11	Midterm Review
8	10/13	**10/13: Midterm Exam**

Week	Date	Topics
9	10/18	Review of rigid body dynamics
9	10/20	Lagrange method for deriving equations of motion
10	10/25	Friction modeling and compensation
10	10/27	System identification and parameter estimation
11	11/1	Controller design in the s-domain
11	11/3	PID control
12	11/8	State feedback control
12	11/10	Linear quadratic regulator (LQR)
13	11/15	Programmable Logic Controllers (PLCs)
13	11/17	Frequency domain control design
14	11/23	Path planning and motion guidance
14	11/25	Thanksgiving Break
15	11/30	Feedback linearization and nonlinear controllers
15	12/1	Sliding mode control
16	12/6	Basics of image and video processing
16	12/8	Course review
Final Exam	**12/16/16**	**Friday, 12:15 – 14:30, BBC 204**