SAN JOSÉ STATE UNIVERSITY
Charles W. Davidson College of Engineering
Department of Mechanical Engineering

ME/EE 106 - Fundamentals of Mechatronics Engineering Fall 2016

Class Instructor Winncy Du; Office: E310F; Phone: 408-924-3866; Email: winncy.du@sjsu.edu

Office Hours T 9:50-10:50, Th 8:00-9:00, or by appointment only

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Class/Lab Meeting Information
ME106 (47129)/EE106 (49305) Seminar 01: TuTh 9:00 – 9:50 AM room E331
ME106 Lab 02 (47130)/EE106 Lab 02 (49306): Tu 1430 – 1715 E125
ME106 Lab 03 (47131)/EE106 Lab 03 (49307): W 1800 – 2045 E125
ME106 Lab 04 (47132)/EE106 Lab 04 (49308): Th 1730 – 2015 E125
ME106 Lab 05 (47133)/EE106 Lab 05 (49309): F 1430 – 1715 E125
NOTE! First lab meeting started in the week of 9/5/16

Prerequisites: EE 98 and ME 30 (or CS 49C OR CMPE 30 OR CMPE 46) or their equivalents (with a grade of 'C-' or better in each). For IT majors: TECH 60, MATH 71, CMPE 46 (with a grade of 'C-' or better in each). You must turn in an unofficial transcript with the prerequisites highlighted by the second class period, or you will be dropped from the class.

Course Description (Course website: *http://www.sjsu.edu/people/winncy.du/courses/ME106/*)

Introduction to mechatronics with emphasis on analog electronics, digital electronics, sensors and transducers, actuators, and microprocessors. Lectures are intended to provide the student with foundational concepts in mechatronics and practical familiarity with common elements making up mechatronic systems. Laboratory experiments are designed to give the student hands-on experience with components and measurement equipment used in the design of mechatronic products. (3units; lecture/lab).

Text (Required)

David G. Alciatore and Michael B. Histand (2011). *Introduction to Mechatronics and Measurement Systems*, McGraw Hill, ISBN: 978-0-07-338023-0.

Hardware (Required)

Arduino microcontroller (Duemilanove or UNO R3). Sources: NKC Electronics , Adafruit Industries, Sparkfun Electronics, Modern Device, sainsmart (Local: Jameco, Radio Shack, Fry's Electronics). Ballpark price is $15-$30.

Weighting of Course Components and Grading Scheme

HW 10%; Lab Report 15%; Project 20%; Two Midterms 15%; Quizzes 5%; Final Exam 20%; Individual Performance on the Term Project 15%

A 100 – 93%; A- 92 – 90%; B+ 89 – 87%; B 86 – 83%; B- 82 – 80%;
C+ 79 – 77%; C 76 – 72%; C- 71 – 69%; D+ 68 – 66%; D 65 – 62%; D- 61 – 59%; F <58%.

To pass the course, you must earn at least a grade of C-.

Course Goals and Learning Objectives

The goals of this course are to help you:

1. Develop an understanding of the basic elements underlying mechatronic systems: analog electronics, digital electronics, sensors, actuators, microcontrollers, and embedded software.
2. Understand how to interface electromechanical systems to microcontrollers.
3. Gain hands-on experience with commonly used electronic test and measurement instrumentation.
4. Improve written communication skills through laboratory and project reports.
5. Gain practical experience in applying knowledge gained in the course through a hands-on project.

Learning Objectives

The student who successfully completes the course will be able to:

1. Articulate what the essence of mechatronics is and provide examples of mechatronic systems.
2. Explain the concepts of input and output impedance, voltage division, and circuit loading
3. Explain the concept and characteristics of a signal source.

4. Design and analyze the performance of RC low-pass and high-pass filter circuits.
5. Explain the basic structure of a microcontroller, the nature of IO ports, and the common peripheral subsystems found in most microcontrollers.
6. Write embedded software to successfully interact with sensors, power interfaces, analog and digital IO ports, and other peripheral elements in the control of a mechatronic system.
7. Explain what analog-to-digital-conversion (A/D) is and how to implement it using a microcontroller.
8. Select and configure operational amplifier circuits to achieve desired interfacing requirements between a signal source and a downstream device such as a microcontroller or data acquisition system.
9. Explain the practical limitations of operational amplifiers and quantitatively estimate the effects of these limitations on output voltage and current of the op-amp.
10. Explain the basic operation of bipolar and MOS field-effect transistors and design with them to activate solenoids, relays, motors, etc. from signal sources.
11. Explain the input/output characteristics of digital logic devices and design a logic circuit to accomplish a given task.
12. Explain the underlying operational principles and construction of electromagnetic actuators such as DC, AC, and stepping motors.
13. Determine the torque and speed requirements for a given motion control application considering system inertia, external forces or torques, and motion profiles and select an appropriate motor.
14. Function effectively as part of a team in carrying out laboratory experiments and open-ended projects.
15. Document a laboratory experiment and open-ended projects clearly and completely in written form.

Classroom Protocol/Code

Attendance to each lecture and lab is expected. No phone is activated and used during the lectures and labs. A missing lab may be made up only if a good reason is presented and the lab TA and the lab space is available.

Homework (hardcopy) is generally assigned by Thursday and due next Tuesday. You must turn in your HW at the *beginning* of the lecture. No credit for late HW.

Laboratory reports (individual report, hardcopy) must be submitted at the beginning of the lab period to your lab instructor one week after the laboratory experiment was performed.

University Policies

University's Academic Integrity policy (Important!) located at www.sjsu.edu/studentconduct/docs/S07-2.pdf, requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. Your commitment as a student to learning is evidenced by your enrollment at San José State University. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/. Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified.

Plagiarism is defined as, *the use of another person's original (not common-knowledge) work without acknowledging its source*.[1] Examples of plagiarism include, but are not limited to[2]:

- copying in whole or in part, a picture, diagram, graph, figure, program code, algorithm, etc. and using it in your work without citing its source
- using exact words or unique phrases from somewhere without acknowledgement
- putting your name on a report, homework, or other assignment that was done by someone else

Several helpful resources can be found at:

https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard/additional-resources/what-plagiarism

SJSU Senate Policy S12-3 - Federal Regulation of the definition of the credit hour

For this class, it is expected that you will spend *at least* seven hours outside of class working on homework, lab work, project work, test preparation, etc. See: http://www.sjsu.edu/senate/docs/S12-3.pdf for more information.

Campus Policy in Compliance with the American Disabilities Act

Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the AEC (Accessible Education Center) to establish a record of their disability.

Other Reminders

[1] Definition adapted from "Defining and Avoiding Plagiarism: The WPA Statement on Best Practices," http://wpacouncil.org/positions/WPAplagiarism.pdf; and "What is Plagiarism?" https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard/additional-resources/what-plagiarism.

[2] Adapted from, "Avoiding Plagiarism," https://owl.english.purdue.edu/owl/resource/589/01/.

- All lectures are arranged to support the lab experiments. Be sure to understand the lectures before doing the lab.
- The pace of this class is relatively fast, especially if you have little prior experience with electronics, so don't slack off.
- Start working on the projects as soon as possible. The most common lament heard from students who fare poorly in the class is, "We should have started earlier on the term project."
- Lab experiments are intended to be performed in a group of ***two*** students (although the lab reports are wrote and submitted individually).

Tentative Course and Lab Schedule

WEEK #	LECTURE	Lab
Week #1 08/25	Enrollment, syllabus, course prerequisite, Ch. 1.1,1.2 Intro to mechatronics and measurement system; course overview	No lab
Week #2 08/30, 09/01	Ch. 2.1 – 2.3; 2.8 Basic electronic components Ch. 2.4-2.7; 2.9-2.10 Voltage/current sources, meters, Thevenin circuits, power	No lab
Week #3 09/06, 09/08	Ch. 7.1-7.2 Microprocessors, microcontroller, and microcomputer Introduction to the Arduino microcontroller, ATmega328P MCU	1. Intro to Mechatronics Laboratory
Week #4 09/13, 09/15	Ch. 4.1 – 4.4 System response; bandwidth RC filters; transfer functions Course project	2. Intro to Arduino Microcontroller
Week #5 09/20, 09/22	Ch. 6.1-6.3 Digital representations, combinational logic I/O ports, digital I/O	3. RC Filters
Week #6 09/27, 09/29	Ch. 3.1 – 3.5 Semiconductor basic, diodes, transistors/MOSFET,photoresistors Review for Exam#1	4. Digital I/O
Week #7 10/04, 10/06	**Midterm Exam #1** Ch. 9.1-9.2 Position sensors, drivers, interrupters	5. Photoresistor, LED, and Transistor
Week #8 10/11, 10/13	Ch. 9.2 Optical encoder; PWM Ch. 10.5 DC motors, servo motors	6. Printer Carriage Motion Control
Week #9 10/18, 10/20	Ch. 10.5 Stepper motors Motor control and drivers	7. Servo System Design
Week #10 10/25, 10/27	Ch. 5.1-5.7 Op-amps, inverting/non-inverting op-amps, summer Ch. 5.8-5.14 Difference/instrumentation amps, integrator, S&H circuit, comparators	8. Stepping Motors
Week #11 11/01, 11/03	Ch. 8.1-8.3 Quantizing theory, A/D conversion Ch. 8.4-8.6 D/A conversion, data acquisition, virtual instrumentation	9. Electronic Scale
Week #12 11/08, 11/10	Review for Exam #2 **Midterm Exam #2**	Project work – open lab
Week #13 11/15, 11/17	Invited speaker: microcontroller and smart system design Ch. 6.4-6.8 Boolean algebra, logical network, truth table, sequential logic	Project work – open lab
Week #14 11/22	Ch. 6.9-6.11 Flip-Flops, TTL & CMOS circuits Thanksgiving Holiday	Project work – open lab
Week #15 11/29, 12/01	Ch. 10.1-10.3 Actuating principles & devices (solenoids, relays, motors) Ch. 9.3-9.7 Other sensors: stress/strain/temperature/vibration/pressure/flow	Project work – open lab
Week #16 12/06, 12/08	Term Project Demonstration Course Review	
Term Project Exhibition: 9:00–12:00, Tuesday, December 6, Room E125		
Final Exam: 7:15 AM -9:30 AM, Wednesday, December 14, E331		