SAN JOSÉ STATE UNIVERSITY
Mechanical and Aerospace Engineering Department

ME 285 - Mechatronic System Engineering Spring 2001

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Office hrs: Monday 2-3:30 pm, Tuesday 1:45 –5:30 pm, or by appointment only.

Prerequisites: ME 106, ME 187, or equivalents.

Class rooms: E-333 (Lecture), E-125 (Lab.)

Class time/code: Lecture - MW 19:00 – 20:15 (16870) Lab - Thurs 19:00 - 2100

Final Exam: Wednesday, May 23, 2001 19:45 – 22:00

COURSE DESCRIPTION:

Overview of mechatronic system engineering with emphasis on analog electronics, digital electronics, sensors and transducers, actuators, and microprocessors. Lectures are intended to provide the student with major concepts underlying the design of 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.

Required Text: *none*

References: see last page

Grading: Homework 15%, Lab Reports 20%, Term Project 25%, Quizzes 20%, Final Exam 20%

Course Goals

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

Learning Objectives for ME 285

1. The student can explain the concept and characteristics of a signal source.

2. The student can 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.

3. The student can explain the practical limitations of operational amplifiers and can quantitatively estimate the effects of these limitations on output voltage and current of the op-amp.

4. The student can design and analyze the performance of RC low-pass and high-pass filter circuits.

5. The student can explain the basic operation of bipolar and MOS field-effect transistors and can design with them to activate solenoids, relays, motors, etc. from signal sources.

6. The student can explain the input/output characteristics of digital logic devices and can design a logic circuit to accomplish a given task.

7. The student can explain the underlying operational principles and construction of electromagnetic actuators such as DC, AC, and stepping motors.

Learning Objectives for ME 285 (cont.)

8. The student can 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.

9. The student can explain the basic structure of a microcontroller.

10. The student can successfully write a program to perform digital input and output from a microcontroller port.

11. The student can explain the common analog-to-digital-conversion (A/D) methods.

12. The student can successfully write a program to do A/D conversion using a microcontroller.

13. The student understands the digital-to-analog (DAC) conversion process.

14. The student can successfully write a program to drive a DAC using a microcontroller.

15. The student can successfully write a program to interface analog and digital devices, such as sensors and actuators, with a microcontroller.

Additional Notes:

Homework and lab reports will be due at the start of the respective session on the assigned date. Late homework or lab reports will not be accepted unless ***prior*** arrangements have been made.

If you are going to be absent from class, please give me a call, or send me an email prior to the class meeting to let me know that you will not be coming. Don't just not show up!

Start working on the term project 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 project."

Lab experiments should be performed in a group of two students. The laboratory report is to be written *individually*. It is acceptable to work collaboratively with your lab partner or other students in the class on the lab report, but it is **NOT** acceptable to copy someone else's report, in whole or in part. Such action is called plagiarism and is a specific violation of the SJSU policy on Academic Dishonesty, section 1.2.

References: (In addition to these hardcopy references, check out the ME106 tutorial web pages)

1. Horowitz, P., Hill, W., *The Art of Electronics*, 2nd ed., Cambridge University Press, New York, 1989.
2. Histand, M. B., Alciatore, D. G., *Introduction to Mechatronics and Measurement Systems*, WCB/McGraw-Hill, Boston, 1999.
3. Stiffler, A. K., *Design with Microprocessors for Mechanical Engineers*, McGraw-Hill, New York, 1992.
4. Fraser, C., Milne, J., *Electro-mechanical Engineering An Integrated Approach*, IEEE Press, 1994.
5. Jones, J. L., Flynn, A. M., *Mobile Robots: Inspiration to Implementation*, 2nd ed. A. K. Peters, Wellesley, Mass., 1998.
6. Bolton, W., *Mechatronics: Electronic Control Systems in Mechanical Engineering*, Addison Wesley Longman, Edinburgh Gate, England, 1995.
7. Martin, F., *Robotic Explorations: A Hands-on Introduction to Engineering*,, Prenctice-Hall, NJ, 2001.
8. McComb, G., *The Robot Builder's Bonanza: 99 Inexpensive Robotics Projects*, 2nd ed., Tab Books, Blue Ridge Summit, PA, 1987.
9. Mims, Forrest M. III, *Getting Started in Electronics*, and his *Engineer's Mini-Notebook* series (particularly: Schematic Symbols, Device Packages, Design and Testing; Sensor Projects; 555 Timer Circuits; Optoelectronic Circuits), Radio Shack, Tandy Corp., Fort Worth, TX, 1983.

(Check the Reserve Book Room in Clark Library under ME 106 for several of the references above.)

Course Schedule (tentative)

Date	Wk.	Lecture Topic	Reading	Lab
1/24	1	Course intro, review of basic electronics, signal sources	May 1997 ME article, Auslander IEEE paper, http://webhome.idirect.com/~jadams/electronics/theory.htm	none
1/29	2	Diodes, transistors, MOSFET's, applications	http://hyperphysics.phy-astr.gsu.edu/hbase/solids/trans.html#c1 http://129.118.19.6/lab/robot/trans.htm http://ftp.unina.it/pub/electronics/REPAIR/F_Bipolar.html	none
2/5	3	Microprocessor fundamentals, I/O ports, digital I/O	www.tip.net.au/~glennpur/micropro.htm http://bd.thrijswijk.nl/thrsim11/68hc11/ http://www.vlsilab.polito.it/~max/motorola/68hc11/	Intro to the Mechatronics lab
2/12	4	RC filters	http://pneuma.phys.ualberta.ca/~gingrich/phys395/notes/phys395.html	RC Filters
2/19	5	Intro to the Handy Board, Interactive C	http://handyboard.com/techdocs/index.html http://www.newtonlabs.com/ic/dist/ic-monolithic.html	Handy Board Intro
2/26	6	Op amps	http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/opampvar.html	Digital I/O
3/5	7	A/D D/A conversion	http://www.phys.ualberta.ca/~gingrich/phys395/notes/node151.html	Sensor Lab 1
3/12	8	Comparators	http://www.national.com/an/AN/AN-74.pdf	Sensor Lab 1
3/19	9	Motor action, dc motors, servos, drivers	www.srl.gatech.edu/education/ME3110/primer/motors.htm	Motor Drive Lab
3/26	10	**Spring Break**	http://www.epemag.wimborne.co.uk/solderfaq.htm	**Spring Break**
4/2	11	DC motor sizing	http://www.compumotor.com/literature/pg223_engrg.htm#SIZING	open lab
4/9	12	Stepper motors, stepper motor drivers	http://www.ee.ualberta.ca/%7Everret/ee401/steppers.pdf http://www.cs.uiowa.edu/~jones/step/	open lab
4/16	13	Digital electronics, basic logic functions, combinational logic	http://www.ee.usyd.edu.au/tutorials_online/digitalsys_tutorial.htm http://www.play-hookey.com/digital/	open lab
4/23	14	Sequential logic, state machines	http://www.ee.usyd.edu.au/tutorials_online/digitalsys_tutorial.htm	open lab
4/30	15	Special topics	TBD	open lab
5/7	16	Special topics	TBD	Final Presentation
5/14	17	Course review		Project Report