San José State University
Charles W. Davidson College of Engineering
Department of Mechanical Engineering

KT-ME 285 Mechatronic Systems Engineering
(Draft 09/23/2016)

Instructor: Neyram Hemati
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Office Hours: After seminar on Monday and Wednesday, or by appointment

Class Meeting Information
Seminar: M & W 7:30 – 8:20 PM
Lab: TBD
(Both sessions in KT Confucius Classroom)
First Session: 8/24/2016; Last Session: 12/12/2016
Plan to bring a computer with you (or share with a colleague) that can access the internet AND that has at least one USB port that can access a flash memory device, such as a USB drive.

Prerequisites: BSME and at least an undergraduate course in Circuit Analysis and Computer Programming (Python, C, or C++)

Required Hardware: Laptop or notebook computer that you can bring to class
BeagleBone Black microcomputer, 5V/1A DC power supply, and Digilent Analog Discovery USB Oscilloscope (okay to share one with a colleague)

Web Pages and Messaging
Copies of the course materials such as the syllabus, informational handouts, etc., may be found on the Canvas course management site. You are responsible for regularly checking this website and the messaging system through MySJSU (or other communication system as indicated by the instructor) to stay on top of deadlines and announcements for the course. When you first log into Canvas, navigate to ‘Settings’ (from upper horizontal, dark blue menu bar), and the ‘Ways to Contact’, and make sure that the email account is set to one that you will check regularly.

Course Description
Concepts, elements, and practice for integrating hardware and software to create intelligent mechatronic systems.

Course Goals and Learning Objectives
The goals of this course are to help you:
- Understand the major conceptual pieces comprising a mechatronic system
- Get hands on experience with the common elements of mechatronic systems, such as sensors, actuators, interface hardware and methods, and microcontrollers.
- Get hands on experience integrating the elements into a mechatronic system.
- See how mechatronic systems can lead to more capable, robust, and adaptable electromechanical systems
- Become more comfortable with the terminology, components, opportunities, and challenges faced by colleagues in disciplines that contribute to the development of mechatronic systems other than your own discipline.
- Apply what you learn to design and build a mechatronic system

Learning Objectives
The student who successfully completes the course will be able to:
1. List and explain the major conceptual pieces comprising a mechatronic system and provide examples of mechatronic systems
2. Explain the basic structure of a microcontroller, the nature of IO ports, and the common peripheral subsystems found in most microcontrollers
3. Interface a microcontroller to sensors, actuators, and user I/O devices
4. Explain the need for and design signal conditioning strategies for signal sources
5. Explain the underlying operational principles and construction of electromagnetic actuators, in particular permanent magnet DC (PMDC) and stepping motors
6. Control the speed of PMDC motors by pulse width modulation (PWM)
7. Select and size an actuator for a particular application
8. Explain the essential features and applications of common communication protocols
9. Implement common communication protocols between a microcontroller and peripheral devices
10. 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
11. Conceive, design, and implement a mechatronic system that satisfies a particular need

Text


Required Hardware
BeagleBone Black. There are many sources from which to obtain this board. See the list of distributors at: [http://beagleboard.org/](http://beagleboard.org/)

5V DC regulated power supply with at least 1A continuous output current. For example, [http://www.adafruit.com/products/276](http://www.adafruit.com/products/276)

Digilent Analog Discovery USB Oscilloscope. (Note: you will use the ‘scope in the lab sessions, which will be done in groups of two to three. If you know a colleague who will be in the class, you may share one of these between the two of you.) The Analog Discovery can be purchased from Digilent at: [http://www.digilentinc.com/Products/Detail.cfm?NavPath=2,1040,1043&Prod=ANALOG-DISCOVERY](http://www.digilentinc.com/Products/Detail.cfm?NavPath=2,1040,1043&Prod=ANALOG-DISCOVERY)

Library Liaison
Our liaison to the University Library is Yiping Wang <yiping.wang@sjsu.edu>, 408-808-2633. Yiping can help you make optimum use of information resources available to you through the University Library.

Dropping and Adding
Students are responsible for understanding the policies and procedures about add/drops, academic renewal, etc. Information on add/drops are available at [http://info.sjsu.edu/home/schedules.html](http://info.sjsu.edu/home/schedules.html).

Information about late drop is available at [http://www.sjsu.edu/aars/policies/latedrops/policy/](http://www.sjsu.edu/aars/policies/latedrops/policy/). Students should be aware of the current deadlines and penalties for adding and dropping classes.

Assignments and Grading Policy
Assessment for the purposes of determining your course grade will consist of evaluating your performance on homework assignments, laboratory projects, quizzes and/or examinations, and a final examination. Quizzes may take place in lecture and/or lab and may be unannounced (so keep up on your reading and studying for this class).
Weighting of Course Components
HW 10%, Laboratory Projects 20%, Term Project 20%, Individual Performance 10%, Quizzes and Exams 20%, Final Exam 20%.

Criteria for Assigning Letter Grades
The scores on you homework, laboratory projects, quizzes and exams, and final examination will be combined and totaled using the weighting scheme described above. A final letter grade will be determined from your overall performance (percentage) using the following criteria:
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%. Note: MAE must earn at least a grade of C- to pass the course.

The final examination for the course will be on 12/19/2016.

University Policies
Academic Integrity
Students in this course are expected to maintain high ethical standards in all matters pertaining to the course, including, but not limited to, examinations, homework, course assignments, presentations, writing, laboratory work, team work, treatment of class members, and behavior in class. Cheating and plagiarism are violations of the SJSU Policy on Academic Integrity S07-2 and will not be tolerated in the class. Students are expected to have read the Policy, which is available at:
http://www.sjsu.edu/studentconduct/docs/S07-2.pdf

Plagiarism is defined as, the use of another person’s original (not common-knowledge) work without acknowledging its source.1 Thus plagiarism includes, but is not limited to2:
- 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

Students are expected to familiarize themselves with how to avoid plagiarism. Several helpful resources can be found at:
http://studentaffairs.stanford.edu/communitystandards/integrity/plagiarism

I encourage students to collaborate on assignments, such as homework and lab reports, however what this means is that you can work together, decide on solution strategies, discuss what should be included in reports and how they should be organized, etc., but you may not copy answers in whole or in part (this includes program code), and you must put together your own lab reports. So for this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU’s Academic Policy F06-1 requires approval of instructors.

Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The website for Student Conduct and Ethical Development is available at http://www.sjsu.edu/studentconduct/.

Campus Policy in Compliance with the American Disabilities Act
If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

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2 Adapted from, “Avoiding Plagiarism,” https://owl.english.purdue.edu/owl/resource/589/01/.
Mechatronics Concept Map

References

(In addition to these references, check out the tutorial web pages for the undergraduate ME106 course)


Mims, Forrest M. III. (1983). *Getting Started in Electronics* (Radio Shack cat. no. 62-5004), 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.


## K-T ME 285 Course Schedule (tentative)

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<thead>
<tr>
<th>Wk.</th>
<th>Week</th>
<th>Subjects</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>8/24/2016</td>
<td>Enrollment, course organization and overview, overview of mechatronics, embedded systems. Reading: beagleboard.org website; ExpBB - Chapter 4; Analog Discovery Quick Start videos (<a href="https://www.youtube.com/watch?list=PLSTiCUiN_BoJ0ZwU5wj73OO_7B12NcibM&amp;v=aYgFK1srOYQ">https://www.youtube.com/watch?list=PLSTiCUiN_BoJ0ZwU5wj73OO_7B12NcibM&amp;v=aYgFK1srOYQ</a>); and other resources (TBA). Lab 1: Basic Electronics Review and Test and Measurement Equipment.</td>
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<td>3</td>
<td>9/7/2016</td>
<td>Power electronics for interfacing actuators, PMDC motors and RC servos. Reading: ExpBB - Chapter 4, 6, 9. Lab 3: Interfacing to control power: DC motors and actuators.</td>
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<td>5</td>
<td>9/19/2016</td>
<td>Signal sources, signal conditioning, op-amps and amplifiers. Reading: ExpBB - Chapter 4, 6, 9, 10. Lab 5: Sensors and signal conditioning.</td>
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<tr>
<td>6</td>
<td>9/26/2016</td>
<td>Midterm exam.</td>
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<td>8</td>
<td>10/10/2016</td>
<td>Project proposal presentations.</td>
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<tr>
<td>10</td>
<td>10/24/2016</td>
<td>User interface and sensors. Reading: ExpBB - Chapter 4, 6, 9, 10, 11. Lab 8: System integration and testing (bring as much of your project as you can to debug).</td>
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<tr>
<td>11</td>
<td>10/31/2016</td>
<td>Project progress report presentations.</td>
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<tr>
<td>12</td>
<td>11/7/2016</td>
<td>Advanced topics.</td>
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<tr>
<td>13</td>
<td>11/14/2016</td>
<td>Invited speaker.</td>
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<tr>
<td>14</td>
<td>11/21/2016</td>
<td>Course wrap-up.</td>
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<tr>
<td>15</td>
<td>11/28/2016</td>
<td>Final project presentations.</td>
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<tr>
<td>16</td>
<td>12/5/2016</td>
<td>Final project presentation.</td>
</tr>
<tr>
<td>17</td>
<td>12/12/2016</td>
<td>Course review.</td>
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