University of Southern California
Daniel J. Epstein Department of Industrial and Systems Engineering
ISE 511L: Mechatronics Systems Engineering
Class Number 31511D, Units 3
Spring 2016

Course Syllabus

Course General

The course meets: Tuesday, 6:30~9:10pm, at KAP-147.

Course Instructor

Dr. Yong Chen, GER-201
Tel: 213-740-7829, Email: yongchen@usc.edu
Office Hours: Tuesday from 2:00 to 5:00pm or by appointment.

Teaching Assistant

TBD.

Course Description

Mechatronic systems engineers use precision mechanical, electrical, computer engineering, as well as math and physics, to design high performance and sophisticated products and equipments demanded by competitive marketplace. Modern products (such as automobiles, dishwashers, cameras, ATMs, medical equipment, space craft, communication satellites, etc.) and manufacturing equipments (such as 3D printers, CNC machines, industrial robotics and autonomous systems, etc.) contain numerous computers and mechatronics modules. Their creations require engineers to be able to combine mechanical, electric, electronic and software subsystems using advanced scientific and engineering knowledge.

This course introduces to graduate students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and systems. Several lab-oriented assignments and team-based course projects are presented with innovative case studies in diverse application domains. The course will also prepare the students to read literature, understand research problems, and identify possible innovations to the field.

The course is a combined lecture and laboratory teaching. The Labs will require students to use a provided micro-controller kit to finish hardware development assignments. The course is intended for students who plan to have a career in the areas of product development and engineering, robotics, design and manufacturing automation, technology management and innovations, etc.

Course Objectives

- To enable the student to understand the modern mechatronics components;
- To present the underlying principles and alternatives for mechatronics systems design;
- To provide the student with the opportunity for hands-on experience with the related components of the technology for diverse domains of application;

- To develop the student's ability to evaluate appropriate technology and create and devise realistic industrial systems.

Prerequisites

No formal prerequisites. Bachelor's degree in engineering or physical sciences is recommended. The material and assignments will assume students have ***hand-on skills*** and are comfortable with ***computer programming*** (the microcontroller used in the course will use basic C or BASIC instructions).

Textbook

- "Mechatronics," Sabri Cetinkunt, Wiley, 2006.
- Supplementary material will be supplied for lectures and lab projects.

References

- "Fundamentals of Mechatronics," Musa Jouaneh, Cengage Learning, 2011.
- "Mechatronics: a Foundation Course", Clarence de Silva, CRC Press, 2010.
- "Mechatronics Systems Fundamentals", Rolf Isermann, Springer, 2005.
- "Automation, Production Systems, and Computer-Integrated Manufacturing," Mikell P. Groover, Prentice Hall, 2008.

Grading Policy

The first part of the course will include problem assignments and will be capped into a midterm exam. A product dissection project will be assigned. In the second part of the course, students will be required to do an application development project. The grading for the class will be determined using the following weights:

- Problem assignments…… 30%
- Midterm……..…… 20%
- Product dissection project……... 15%
- Application development project …30%
- Participation…… 5%

Total Score……100%

Problem Assignments: Students will be given a week for each assignment. An assignment will consist of solving problems that correspond to the materials covered in the previous week. Most assignments are hands-on and required to use the microcontroller board that will be provided to the students in the beginning of the class. Assignments are due at the start of the next class. Submission will be accepted for credit up to one class period after the due date for 50% credit. There will be no acceptance after one week.

Midterm Exam: One examination will be given in the middle of the semester.

Product dissection project: The objective of the product dissection project is to help the students to learn the design of an existing mechatronics system product in depth. A project team will have 2

students. Each team is expected to select a product, read related materials, and dissect the product to understand and modify the product. The students are required to write a dissection study report and present their findings in the class.

Application Development project: The objective of the application development projects is to help the students to gain hands-on experience by using learned materials in solving real world problems. Each project team will have 2 students. They are expected to work together to accomplish the assigned tasks. In the application development project, each team is expected to develop a mechatronics system application to solve a non-trivia problem. Formal project proposals should be submitted and approved by the instructor. The final project should include a presentation with a working system demonstration and a technical report.

Participation: Participation in the class is required and will be taken into account. Bonus points are available for enthusiastic participation in class. If you miss a class, please work with your fellow students to catch up on what you missed. Please turn cell phones and pagers off or put them in vibrate mode before coming to class.

Academic integrity

"The Department of Industrial and Systems Engineering adheres to the University's policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course." Check out the helpful "Trojan Integrity: A Guide to Avoiding Plagiarism" and other publications of the USC Office of Student Judicial Affairs.

Disability Accommodation

"Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776."

Tentative Course Schedule

There is a lecture session each week with lab-related assignments.

Week #	Lecture - Thursday (6:30~9:10pm)	Lab / Assignment	Reading / Project
1	**Lecture 1** Jan. 12 – Course introduction and mechatronics systems	- Self-study on related prerequisites.	Help to form project team (2 students/team)
2	**Lecture 2** Jan. 19 – Case study of a mechatronics system and introduction of micro-controllers	Assignment 1	
3	**Lecture 3** Jan. 26 – Electrical components	Assignment 2	Product dissection assigned.
4	**Lecture 4** Feb. 2 – Actuators and motor control	Assignment 3	Dissection product

			selection due.
5	**Lecture 5** Feb. 9 – Mechanical components & mechanisms	Assignment 4	
6	**Lecture 6** Feb. 16 – Sensors		
7	**Lecture 7** Feb. 23 – Modeling and control	Assignment 5	Application development project assigned.
8	**Lecture 8** Mar. 1 – Midterm Exam & Introduction of a motion testbed and C++ programming		
9	**Lecture 9** Mar. 8 – Programmable motion control and algorithm development	Assignment 6	Application development topic due.
10	Mar. 15 – Spring Recess (no class)		
11	**Lecture 10** Mar. 22 – ***Product Dissection Presentation***		Product dissection report due
12	**Lecture 11** Mar. 29 – Application 1: Numerical control manufacturing (machining and accumulation)		
13	**Lecture 12** Apr. 5 – Application 2: Digital fabrication and 3D printing systems		
14	**Lecture 13** Apr. 12 – Application 3: Robotics, scanning and user interaction systems		
15	**Lecture 14** Apr. 19 – Application 4: Development of a multi-axis non-layer-based 3D printer and development project discussion		
16	**Lecture 15** Apr. 26 – ***Application development project presentation*** and course evaluation		
17	May. 3 – Study day (no class)		Application development project report due.
18	May. 10 – Application development project demonstration (7pm)		