

University of Southern California
Daniel J. Epstein Department of Industrial and Systems Engineering
ISE 511L: Computer Aided Manufacturing
Class Number 31511D, Units 3
Spring 2009

Course Syllabus

Course General:

The course meets Thursday, 6:30~9:10pm.

Lecture sessions: KAP-165
Lab sessions: RTH-319 and GER-309

Course Instructor:

Dr. Yong Chen, GER-201

Tel: 213-740-7829, Email: yongchen@usc.edu

Office Hours: Thursday from 2:00 to 4:00pm or by appointment.

Teaching Assistant:

Chi Zhou, PhD Student

Email: chizhou@usc.edu

Office Hours: Thursday 10:00 to 12:00am.

Course Description:

This course aims to provide students with deep understanding and practical experience in the application of automation and computational techniques to solve manufacturing related problems. It will introduce the underlying concepts and principles behind advanced computer-aided manufacturing (CAM) systems including both hardware and software components. It will also train the students with hands-on development skills by working on lab oriented assignments and team-based course projects. In addition, the course will prepare the students to read literature, understand current research problems, and identify possible contributes to the field.

This is a graduate level course and intended for students who plan to have a career in the areas of CAD/CAM/CAE, product development and engineering, robotics, design and manufacturing automation, technology management and innovations.

The course is a combined lecture and laboratory teaching. The lectures will consist of three parts: (1) hardware and micro-controller for CAM and automation, (2) software and algorithms for CAM and automation, and (3) real-world applications of digital technologies in solving CAM related problems such as CNC tool path planning, layer manufacturing process simulation, and computer-aided inspection, etc. The Labs will require students to use a provided micro-controller kit to finish hardware development assignments. Source codes of a testbed will also be given in the class to demonstrate concepts and applications. Based on it, the students will develop programs to finish software development assignments.

Prerequisites:

No formal prerequisites. The material and assignments will assume students have hand-on skills and are comfortable with programming (C++ preferred).

Textbook

“Mechatronics,” Sabri Cetinkunt, Wiley, 2006.

Reference

“Computer-Aided Manufacturing,” Third Edition, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Prentice Hall, 2005.

“Principles of CAD/CAM/CAE Systems,” Kunwoo Lee, Addison Wesley, 1999.

Suggested Reading

“Automation, Production Systems, and Computer-Integrated Manufacturing,” Third Edition, Mikell P. Groover, Prentice Hall, 2008.

“Advanced Manufacturing Technology for Medical Applications,” Ian Gibson, Wiley, 2005.

Grading Policy:

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

- Problem assignments..... 30%
- Midterm..... 20%
- Literature survey project 15%
- Application development project ...30%
- Participation..... 5%
- Total Score.....100%

Problem Assignments: Students will be given a week for each assignment, which will consist of solving problems that correspond to the materials covered in class in the previous weeks.

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

Literature Survey project: The objective of the literature survey project is to help the students to learn cutting-edge research in an area of computer-aided manufacturing. Each student is expected to select a topic and read 5-6 technical papers related to the topic. The students are required to write a literature survey paper 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 and to use learned materials to solve real world problems. Each project team will have 2 students, who are expected to work together to accomplish tasks. In the application development project, each team is expected to develop an application of computer-aided manufacturing techniques to solve a non-trivial problem. Possible projects should be agreed with the professor with a formal project proposal. The final project should be done with a demonstration and a technical report.

Each project team must prepare a conference style presentation to explain their ideas, methods and results to the class. Presentations should take about 15 minutes and the presenters should be prepared to answer questions on the topic. The presentation and project report will be used in evaluation.

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 are a lecture session and a laboratory session each week.

| Week # | Lecture Thursday (6:30~9:10pm) | Lab / Assignment Thursday (10:00~5:00pm) | Reading / Project |
|---------------|---|---|---|
| 1 | <u>Lecture 1</u> Jan. 15 – Course Introduction and CAM Introduction | - Self-study on related prerequisites. | Help to form project team (2 students/team) |
| 2 | <u>Lecture 2</u> Jan. 22 – Case Study of CAM systems & Micro-Controller - Hardware: mechanical, electrical; - Software: controller; CAM software system | Assignment 1. | Research paper review assigned and topic suggested. |
| 3 | <u>Lecture 3</u> Jan. 29 – Electrical Components | Assignment 2. | Research paper review topic due. |
| 4 | <u>Lecture 4</u> Feb. 5 – Actuators & Control | Assignment 3. | Form project teams. |
| 5 | <u>Lecture 5</u> Feb. 12 – Mechanical Components & Motion Transformations | Assignment 4. | Application project assigned. |
| 6 | <u>Lecture 6</u> | | |

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| | Feb. 19 – Motion transformation and Application Development Project | | |
| 7 | Lecture 7 Feb. 26 – Sensors | Assignment 5. | Application project topic due. |
| 8 | Lecture 8 Mar. 5 –Programmable Motion Control & Algorithm Development | Assignment 6. | |
| 9 | Lecture 9 Mar. 12 – Midterm Exam & <i>Research Paper Review Presentation</i> | | Research paper review due |
| 10 | Mar. 19 – Spring Recess (no class) | | |
| 11 | Lecture 10 Mar. 26 – kinematics of Articulate Machine and Application Development Project | | |
| 12 | Lecture 11 March. 30 ~ Apr. 2 – WestTec exhibition, LA Convention Center (no class) | Assignment 7. | |
| 13 | Lecture 12 Apr. 9 – Application 1: CNC Machining, NC controller and NC programming | | |
| 14 | Lecture 13 Apr. 16 – Application 2: Geometric Modeling and Reasoning and its Application to Injection Molding and Deformation | | |
| 15 | Lecture 14 Apr. 23 – Application 3: Solid Freeform Fabrication | | |
| 16 | Lecture 15 Apr. 30 – <i>Lab Project Presentation</i> - Course Review & Evaluation | | Application project due. |
| 17 | May. 7 – Final Exam (7pm) – Lab project demonstration | | |