Department of Electrical and Computer Engineering
The University of Alabama in Huntsville

Spring 2007

CPE 496-01: Computer Engineering Design II

Course Home Page: http://www.eb.uah.edu/~jovanov/CPE496/CPE496.html

Course Hours Tuesday 6 – 9 PM, EB240.

Laboratory Room 248 Engineering Building
The Rapid Prototyping Laboratory (EB226) and The DSP/Microcontroller Laboratory (EB205) will also be made available for group projects upon request.

Description Second course in the senior capstone design sequence. The focus of this class is the application of techniques to the design of electronic systems that have digital hardware and software components. Students will apply the theory acquired from numerous engineering courses to solve real-world design problems.

Focus The focus of this class will be the application of techniques to the design of electronic systems that have both digital hardware and software components, similar to the previous design course (CPE 495). Efficient digital system design often involves the careful consideration of hardware/software design trade-offs -- areas which are the cornerstone of the Computer Engineering discipline.

In this course, students must be able to propose the design project, create new designs, evaluate the effectiveness and cost of each design alternative, document the design process, and demonstrate a working prototype of their final designs that meets the stated specification. Students must review legal, economic, ethical, environmental, health and safety issues, and evaluate manufacturability and sustainability of the proposed solution, as well as possible social and political impact of the proposed solution.

Students will work as individuals or teams under the direction of an ECE faculty member to design, fabricate and test their projects. Oral presentation and written reports are required.

Prerequisites CPE495 Computer Engineering Design I

Textbook Ralph M. Ford, Chris S. Coulston, Design for Electrical and Computer Engineers, Theory, Concepts, and Practice, McGraw-Hill, 2005.

References

- Gerald Luecke, Analog and Digital Circuits for Control System Applications : Using the TI MSP430 Microcontroller, Newnes, 2004. (ISBN 0750678100)
- Chris Nagy, Embedded System Design using the TI MSP430 Series, Elsevier Science, 2003. (ISBN 075067623x)
- MSP430 Family, User's Guide, Texas Instruments, 1996.
- MSP430 Family, Software User's Guide, Texas Instruments, 1994.
- *Patent it Yourself*, David Pressman, Nolo Press, 9th Ed., 2002.
- Robert Pool, *Beyond Engineering: How Society Shapes Technology*, Sloan Technology Series, 1999, ISBN: 0195129113.
- Foundation Series 3.1i Quick Start Guide, Xilinx Corporation, 2000.
- Foundation Series 3.1i VHDL Reference Guide, Xilinx Corporation, 2000.
- M. Slater, "Microprocessor-based Design, A Comprehensive Guide to Hardware Design," Prentice Hall, 1989.M68000 8/16/32 bit Microprocessor User's Manual 8th Edition, Prentice Hall, Englewood Cliffs, NJ
- Alan D. Wilcox, *Engineering Design for Electrical Engineers*, Prentice Hall,

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Office hours Tuesday 10 – 11:30 AM, Wednesday 5:20 – 7 PM, and by appointment.

Lab Assistant

Vladimir Uzelac uzelacv@eng.uah.edu

Lab office hours **(EB142 & EB248)**:

- Tuesday/Thursday: 4 – 8 PM
- Monday/Wednesday: 7 – 8 PM
- Friday: 10:15 – 12:15 AM

Design Groups:

The scope of most modern day design projects in industry and government require that sizable design teams be assembled. The ability to work in groups is considered by industry experts to be a critical skill to master for any engineering student. Therefore, all CPE 496 design projects should be implemented as group projects.

A member of each group will be designated the Group Leader. The role of group leader will be rotated in a uniform manner among the students of the group. The Group Leader's task will be to oversee the managerial aspects of the project at hand in addition to his/her technical duties. It is the responsibility of the Group Leader to meet

with the design group on a regular basis, send weekly progress report to the instructor via E-mail, and maintain hardcopies for the final report. During the first week of group activities each group will submit to the instructor via E-mail a proposed Group Leader rotation schedule.

Attendance Policy

Unless prior arrangements are made or unless the student is unavoidably detained attendance for all Project Proposals, Preliminary Design Reviews, and Final Design Reviews associated with a particular course section is mandatory. Otherwise attendance at all other class meetings is recommended but optional.

Grading

Academic misconduct of any type will not be tolerated. Students are expected to conform to the UAH policies concerning academic misconduct as outlined in Section 8.32 of the current UAH Student Handbook.

Project Summary	4%
Project Proposal (oral presentation)	9%
Preliminary Design Review (oral presentation)	9%
Successful Project Demonstration / Functionality	20%
Individual Project Participation	10%
Final Design Review (oral presentation)	10%
Final Written Report	10%
Web Documentation	5%
News Article	4%
Weekly Reports	9%
Self Evaluation Report	10%

Important Dates

Updated Project Proposal:	Tuesday, January 23, 2007
Preliminary Design Review:	Tuesday, February 27, 2007
Final Design Review:	Tuesday, April 17 and April 24, 2007
Last Class:	Tuesday, May 1, 2007
Web Documentation, Final Report, News Article, Self Evaluation Report:	Tuesday, May 1, 2007
Weekly Reports:	1/30, 2/6, 2/13, 2/20, 3/6, 3/13, 3/27, 4/3, 4/10.

Project Deliverables

1. **Project Summary** (Hard and soft copy). The Project Summary will include a brief descriptive title of the project, a brief description of the design problem, project objectives and finally a brief description of the design concept (proposed approach or solution). The Project Summary will also include the members of the project team and description of their principal role on the project. The Project Summary should be written in terms understandable to a non-specialist. The Project Summary must be updated if the information it contains changes.

2. **Project Proposal** (Hard and soft copy). The project proposal will include a detailed description of the design problem, design concept (proposed approach or solution), and the results of the market research, the patent/product search and the literature search. Preliminary cost data, test plan, and project schedule will be included. A written proposal and oral presentation are required.

3. **Preliminary Design Presentation** (Oral presentation required. A copy of the presentation is required.) The presentation will include preliminary design information, revised cost and schedule data, an outline of their final project report, and information on how the design will be tested (test scenarios and cases). You should also present how you plan to demonstrate your design.

4. **Final Project Report, Presentation and Project Demonstration** (A written final project report, project demonstration and oral presentation are required). The final project report will include a detail description of the design problem, background information (including a summary of the market research, the patent/product search and the literature search), the design approach and detailed design information, test scenarios, cases and results, cost data, and conclusions and recommendations. The final project report should provide sufficient information for making and using your prototype. It should also describe how you demonstrated your design.

5. **News Article** (Hard and soft copy). The students will write a news article about their project to be published in one of the on-campus newspapers or newsletters. This article will be an informative article (e.g. a product news release) to serve as a form of advertising. It will include a description of the design problem, a summary of the design approach, the main features of the design, how their course work prepared them for their project and the benefit they derived from their project as future engineers.

6. **Weekly Progress Reports** The weekly progress report will include work completed, in progress, and remaining; discussion of any problems or changes in the project; and a schedule showing your progress on the project.

7. **Project Workbook** The workbook is where you record your activities on the project. All your ideas and thoughts on the project should be included in it, beginning with the project concept, through the written proposal, and ending with the final report. It will contain all written and visual materials associated with the project, including all graded

material. Also include the weekly progress reports in your workbook.

8. **Self-Evaluation Report** Each student will prepare a Self-Evaluation Report, which consists of two (2) parts.

   PART I: Read "Beyond Technology – Renaissance Engineers" and other provided material, and answer the following questions:

   a. What is meant by transdisciplinary education? In addition to technical activities, what other activities must engineering involve?
   b. In addition to technical skills, what other skills are needed for career success in engineering? What skills can help prepare students for a life of constant change and learning?
   c. Why must engineers be aware of non-technical as well as technical contemporary issues? Give example of how non-technical contemporary issues may affect project outcomes.
   d. Why must engineers be aware of the global and societal impacts of the technologies they create?
   e. What must industry and higher education do to foster a lifelong commitment to learning?

   PART II: Supported by specific examples of the group's/individual's design project activities, the group/individual will address, point by point, how well the group/individual addressed each of the ten areas of the IEEE Code of Ethics:

   a. To accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;
   b. To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exists;
   c. To be honest and realistic in stating claims or estimates based on available data;
   d. To reject bribery in all its forms;
   e. To improve the understanding of technology, its appropriate application, and potential consequences1;
   f. To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training and experience, or after disclosure of pertinent limitations;
   g. To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
   b) To treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;
   c) To avoid injuring others, their property, reputation, or employment by false or malicious action;
   d) To assist colleagues and co-workers in their professional development2 and to support them in following the code of ethics;

   Note 1: "appropriate application, and potential consequences" may include, for example, any societal, global, political or economic consequences/considerations. Such factors as usability, sustainability and manufacturability may also be included.

Note 2: "professional development" may include the development of non-technical as well as technical skills.

Project Deliverables - Summary

1. Project Summary (hard and soft copy). Approximately ½ to 1 page.
2. Project proposal (hard and soft copy). Approximately 10 pages, excluding appendices.
3. Proposal presentation (hard and soft copy). The presentation should not exceed 30 min, allowing for questions.
4. Preliminary design presentation (hard and soft copy). The presentation should not exceed 30 min, allowing for questions.
5. Final design presentation (hard and soft copy). The presentation should not exceed 30 min, allowing for questions.
6. Final design report (hard and soft copy). Approximately 10 - 15 pages, excluding appendices.
7. Project demonstration. Up to 15 minutes.
8. Weekly project reports. Approximately 1 page, excluding any attachments.
9. News article. Approximately 2 pages.
10. Self evaluation report. Approximately 2 pages.
11. Project Workbook. Use 3-rign binder and indexed sections.
12. Individual Labor Hours (review weekly, submit final on May 1, 2007).
13. Indicate project specific hardware/software deliverables.

All submitted files should be named according to the following format:

CPE49601S07_Gx_filename.ext

ABET's Definitions

Engineering is the profession in which knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind.

Engineering design is the process of devising a system, component, or process to meet desired needs. It is decision-making process (often iterative), in which the basic sciences and mathematics and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.

Each educational program must include a meaningful, major engineering design experience that builds upon the fundamental concepts of mathematics, basic sciences, the humanities and social sciences, engineering topics, and communication skills.

IEEE Code of Ethics

(See also IEEE Ethics & Member Conduct Committee)

We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree:

1. to accept responsibility in making engineering decisions consistent with the safety, health and welfare of the public, and to disclose promptly factors that might endanger the public or the environment;

2. to avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;

3. to be honest and realistic in stating claims or estimates based on available data;

4. to reject bribery in all its forms;

5. to improve the understanding of technology, its appropriate application, and potential consequences;

6. to maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

7. to seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;

8. to treat fairly all persons regardless of such factors as race, religion, gender, disability, age, or national origin;

9. to avoid injuring others, their property, reputation, or employment by false or malicious action;

10. to assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

Approved by the IEEE Board of Directors
August 1990

Product Development

Identification of Need/Opportunity

The process starts with the definition of the need for a product or the identification of an exploitable technological opportunity. Each of these possibilities needs to be examined separately. In the commercial arena, companies are continually evaluating their markets to determine market segments which are not being served with and appropriate product and which could be profitably served by a new product or a modification of an existing product.

Market Research. Before initiating the design effort to produce a new product it is imperative to obtain answers to the following questions:

- Who is the customer?
- What does the customer really want?
- What will the customer expect in terms of product support?
- When will the customer require the product?
- What is the competition?
- What is the customer willing to pay per item?
- What is the potential for related products or services?

In a market oriented approach, engineering is perceived as a key element of a commercial enterprise where the aim is to produce the product demanded by the market at the price the market is willing to pay, with constant emphasis on improving quality and reducing costs.

Design Features Affecting Marketability:

- Cost
- Weight
- Size
- Safety/Health Factors
- Ease of Use
- Speed
- Ease of Production
- Durability
- Repairability
- Convenience/Social Benefits
- Reliability
- Ecology
- Quality
- Seasonal Demand

Determination of the preferred approach

The determination of the preferred approach utilizes the results of the evaluation of the candidate approaches against the measures of effectiveness, in conjunction with the near term financial constraints, to define the nature of the next element of the development process. Within the commercial environment, the approach may also be constrained in terms of the eventual cost to the consumer of the product to be developed.

Product Design
When the preferred approach has been identified, detailed design of the extended product is initiated. The term “extended product design” includes design of the product in terms of its interaction with the manufacturing system from which it will be produced, the use environment it will face and other products of systems with which it must interface, as well as details of the product itself. In the commercial arena, the emphasis on use environment has been strongly reinforced through increased product liability litigation and legal and regulatory action such as recall.

Fabrication of Prototypes
When the design is defined, prototypes are fabricated. There are two primary purposes for prototype fabrication. They are:

1. To demonstrated through test that the product has the features and capabilities required, and
2. to validate that the product can be built with the budget and time constraints.

Often the testing addresses two separate, but related issues:

1. How well does the product meet its defined performance objectives?
2. Howe well does it satisfy the current need of the ultimate user?

It is essential to make your working model or prototype as simple as possible. Simplicity enhances reliability, decreases cost, decreases weight, and facilitates salability, both to a manufacturer and to the public. Your next step is to build and test it for feasibility and cost.

Production
The release for production normally involves a significant financial commitment for the developer. The manufacturing system must be adapted to the new product and often significant amount of production tooling may have to be built and put in place.

Product Improvement
As production of the product continues and feedback is received from the users, there is often a series of product improvements that are defined and executed.

Product Disposal

Document Templates

- Outline of a typical proposal
- Outline of a typical engineering report
- Outline of a typical oral presentation
- Outline of a progress report
- Individual Labor Hours Form