ECE 4600 Syllabus, Fall 2011

No: ECE 4600

Title: (WI) Capstone Design I Cr. 4 (LCT: 4)

WSU Catalog Description:
Prereq: ENG 3050, ECE 3610 and senior standing. Study of microcontroller architecture, timers, interrupt structures, input capture functions, output compare functions, analog-to-digital converters and synchronous and asynchronous serial I/O. Design and development of complete microprocessor based digital systems. (T)

Coordinator: Syed Masud Mahmud, Associate Professor of Electrical and Computer Engineering.

Instructor: Syed Masud Mahmud, Associate Professor of Electrical and Computer Engineering.
Office Hours: MW 1:00pm – 3:00pm
Office Location: 3138 Engineering Building
Phone: 313-577-3855 Fax: 313-578-5845
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Web Page: http://ece.eng.wayne.edu/~smahmud
Course Meeting Time: MW 5:30 – 7:20pm
Course Meeting Location: 1129 MAIN

Goals: The goals of this course are to become familiar with different subsystems of a microcontroller, to design various types of real-time systems using microcontrollers and off-the-shelf chips, and to learn techniques of teamwork and product design.

Learning Objectives: After completing this course, students should be able to do the following:
1. Design and implement software that utilizes interrupts.
2. Develop software to collect data from various types of sensors.
3. Use input capture and output compare functions of a microcontroller.
4. Design products using microcontrollers and various types of sensors and actuators.
5. Identify constraints imposed by various regulating bodies with regards to designing various types of products.

Textbook: Lecture Notes by Syed M. Mahmud

Reference Texts: Manuals from Motorola

Prerequisites by Topic:
- ENG 3050: Instruction in basic technical writing skills. Requirements include writing letters and memos, summaries, technical instructions, proposals, and reports. Topics include: audience and purpose analysis, visual support of texts, and formatting.
- ECE 3610: Boolean algebra; switches, gates. Minimization of switching circuits, ROMs, PROMs, and PLAs, Flip-flops. Reduction and minimization of sequential machines. The state-assignment problem. Asynchronous sequential circuits. and senior standing.

Corequisites by Topic: none

Topics:
PART I: Embedded System Design Project
1. Subsystems of the 68HC11 microcontroller:
   - Parallel Input/Output (1.0 Lectures)
   - Main Timer, Pulse Accumulator and Real Time Interrupt (3 Lectures)
   - Asynchronous Serial Communication Interface (1.0 Lectures)
   - Synchronous Serial Peripheral Interface (1.0 Lectures)
   - A/D and D/A Converters (1.0 Lecture)
   - CAN (Controller Area Network) Protocol (1.5 Lectures)
   - Voice Chip (1.0 Lecture)
2. Discussions about the Project (1.0 Lectures)

PART II: Design Principles and Managing Design Projects (2 Lecture):
- How a design process unfolds
- Objective trees: Translating and clarifying the client’s problem
- Weighted Objectives
- Examples of objective trees
- Work breakdown structure
- Linear responsibility chart
- Team Calendar
- Gantt Chart
- Budgets: Keeping track of the money
- Patents & intellectual properties
- Ethics in Design

Course Structure: The class is divided into a number of groups and each group contains 2 to 3 students. During the first half of the semester, the students attend lectures and work on three design assignments. During the second half of the semester, the students work on a major design project.

Computer Resources: Windows XP PC with AXIDE Software

Laboratory Resources: A laboratory containing 9 PCs, several high-end multimeters, function generators and oscilloscopes is available for the students.

Laboratory Policy: There is absolutely no smoking: eating or drinking in any ECE instructional lab. These labs must be kept neat and each student is responsible for insuring that the equipment on his/her workbench is neatly arranged, that all the leads and other equipment are put away, and that there are no scraps of paper or other garbage left on or near his/her work station. Coats, briefcases: Knapsacks and other personal belongings are not permitted on or near the benches. These items must be kept on the coat rack near the door, not on the benches, window sills or the floor near the benches. The door to the lab must be kept locked at all times; unlocking or propping open the door at any time is expressly forbidden. Guests are not permitted in the lab at any time, and no one but the instructor may open the door to admit anyone after the class has begun.

Project Report: The project report must contain the following items in the same order as shown below.
1. Abstract (5 Points)
2. Introduction (9 Points)
3. Background materials (14 Points)
4. Detailed description of your work including design with detailed schematic diagram (25 Points)
5. Analysis, results and discussions of your work (15 Points)
6. Conclusions (5 Points)
7. References (2 Points)
8. Appendix (25 Points)
   i  Executive summary. (3 Points)
   ii  Design alternatives considered. (3 Points)
   iii  Operating procedure of your product (explain how to use the product). (3 Points)
   iv  Constraints due to OSHA, FCC, EPA and other regulations. (3 Points)
   v  Parts list. (2 Points)
   vi  Cost analysis. (2 Points)
   vii  Description of the problems occurred during the design process and how the problems were solved. (2 Points)
   viii Distribution of work among different partners of a group, and the contribution of each partner in percent. (2 Points)
   ix  Program Listing (well documented assembly code). (3 Points)
   x  Data sheets of the components used. (2 Points)

Oral Presentation: Your oral presentation will be graded based on the following items.
1. A title slide containing the title of the project, name of the team members, group number, year and semester.
2. A slide containing the outline of the talk.
4. Technical contents of the slides.
5. Eye contact with the audience.
6. Loudness of speaker's voice.
7. Speaker's confidence.
8. Speaker's body motion.

9. Reading slides versus talking to the audience.

10. Handling of questions.

Distribution of Points:
Midterm Exam 40%
Homework 10%
Working prototype 25%
Professional looking prototype 3%
Ten-Minute Oral Presentation by Each Student (all students must attend presentations)
Report: 12%
Poster: 2%

Some extra credits will be given for submitting Professional Quality Video Clips of Good Working Prototypes.

Grading Scale: Percentage Grade (Honor Point Value)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Honor Point Value</th>
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<tr>
<td>95-100</td>
<td>A (4.00)</td>
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<tr>
<td>90-94</td>
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<tr>
<td>55-59</td>
<td>D+ (1.33)</td>
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Attendance: Every student is expected to attend all lectures. All students must also attend their regular group meetings.

Schedule:
- Late Registration, Late Adds: Aug 31 - Sep 7, 2011
- Last Day to Withdraw: Nov 12, 2011
- Midterm Exam: Oct 24, 2011
- Oral Presentations: Dec 14, 2011
- Project Report Due (Both Hard and Soft copies): Dec 14, 2011

Makeup Exam and Makeup Assignment Policy:
- All assignments must be submitted on time. No late submission will be accepted unless the student notifies the instructor ahead of time showing some valid reasons (such as town of out business trip, sickness, etc.) for not being able to submit the assignment on time. The student must present valid official documents to defend his/her case.
- All students must take the midterm on the scheduled date. If a student thinks that he/she can't take the midterm on the scheduled date due to some unavoidable circumstances, such as of town business trip, sickness, etc., then he/she must notify the instructor before the scheduled exam time. In that case the instructor may give a makeup exam to the student. However, the student must present valid official documents to defend his/her case.

Outcome Coverage:
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Students work in teams of three students. The assignments involve the design of various real-time embedded systems which is constrained by the type of processor, the clock frequency of the process, number of digital I/O pins, number of analog channels, the size of analog-to-digital converter and the amount RAM and ROM available within the system. Memory saving and execution time are practical constraints that must be met in designing assembly code for critical applications in automotive control and other application area. Students go through several iterations of refining and debugging their initial code before they are able to arrive at working designs (programs). The students are required to work on a major design project to make a product. The students make their product in compliance to the laws and constraints imposed by the federal and local regulating agencies such as FCC, OSHA and EPA.

(d) an ability to function on multi-disciplinary teams: Students work or their design assignments and projects in teams of three students. The project work involves the design of electronic controllers, automated vehicles, voice activated devices and many other types of systems that are of multi-disciplinary types. Organization and active contribution to team effort is required in the course.

(f) an understanding of professional and ethical responsibility: A lecture is given on professional and ethical responsibilities of engineers.

(g) an ability to communicate effectively: All students are required to make an oral presentation on their project work. The students are also required to submit a well-written technical report on their project work. The oral presentation and technical report writing process help them in achieving effective communication skills.
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

(i) a recognition of the need for, and an ability to engage in life-long learning: Since the students have to do literature search, patent search and study material on their own to design their project, this helps them to recognize the need for life-long learning.

(j) a knowledge of contemporary issues:

**Cheating Policy and Penalty for Cheating:** Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment or exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure “Academic Integrity,” will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course.

**Accommodations for Students with Disabilities:** If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services’ mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Please refer to the SDS website for further information about students with disabilities and the services we provide for faculty and students: [http://studentdisability.wayne.edu/](http://studentdisability.wayne.edu/)

**Prepared By:** Syed Masud Mahmud, Associate Professor of Electrical and Computer Engineering

**Last Revised:** August 31, 2011