ESE 381 Embedded Microprocessor System Design II

Spring 16, K. Short   *January 19, 2016 3:57 pm*

Lecture: Tue. and Thu. 10:00 - 11:20 am, Light Engineering 154
Office Hours: Tue. and Thu. 12:30 - 1:30 pm and 4:00 - 5:00 pm, Light Engineering room 229.

Course Objectives

This course builds on concepts introduced in ESE 380 Embedded Microprocessor System Design I to further develop a student's expertise in embedded system design. The focus is on designing systems using microcontrollers and embedded C. Three primary course objectives are for you to learn:

1. Additional and more advanced embedded system design concepts
2. Detailed design techniques for implementing embedded systems using AVR microcontrollers
3. Embedded C programming and mixed C and assembly language programming

These objectives are covered through lectures, discussions, demonstrations, and laboratory work that emphasize basic concepts and specific applications. The laboratory work culminates in the design of a complete embedded system prototype.

Tentative List of Course Topics

The following is a tentative list of topics to be covered. Some variation from this list will likely occur based on the design project selected for this semester.

1. Introduction
2. Bit Manipulation in C
3. Digital Input and Switch Debouncing
4. Keypad Scanning Hardware and ASM Software
5. Keypad Scanning C Software
6. LCD Display Hardware
7. LCD Display Software
8. Sensors and Analog Information
9. ATmega128 Analog-to-Digital Converter
10. Common Operational Amplifier Signal Conditioning Circuits
11. Serial Peripheral Interface (SPI)
12. Digital-to-Analog Conversion
13. Analog-to-Digital Conversion
14. Pointers and Pointers to Functions
15. Table Driven Finite State Machines in C
16. ATmega128 Interrupts and Interrupt Driven Systems
17. Real Time and Calendar Clocks
18, Power on Self Test (POST)

19. Driving High Power Loads
20. Wireless Data Transfer
21. Storage Classes in Single and Multifile Programs
22. Parameter Passing and the Stack
23. Mixed C and Assembler Programs
24. Data Storage and Memory Models
25. AVR External Memory Interface
26. Low Power Operation and Battery Powered Systems

Prerequisites

The prerequisites for this course are ESE 380 Embedded Microprocessor System Design I and ESE 271 Electrical Circuit Analysis I. In addition, a basic understanding of the C programming language (for example, from a course such as ESE 124) is assumed.

Course Structure

This course has a lecture, discussion, and laboratory format. Lectures and discussions assume that students have completed the prerequisite reading assignments.

Laboratory sessions start the week of January 31st. They are held in the Embedded Systems Design Laboratory, room 230 in the Light Engineering Building. The first laboratory module is one week in duration. Subsequent modules are typically two weeks in duration. The modules culminate in a complete design that you must document in the form of a design document and a user's manual.

Source Material

You will need a textbook to review C basics and to introduce some advanced features of C. Either *Programming in C* (3rd edition) by Stephen Kochan (ISBN 978-0-672-32666-0) or *C Programming* (2nd edition) by K. N. King (ISBN 978-0-393-97950-3) is recommended. However, any other equivalent C textbook is acceptable.

The textbook used in the prerequisite course, ESE 380, *The AVR Microcontroller and Embedded System*, Mazidi, Naimi, and Naimi, Prentice Hall, Copyright 2011, (ISBN 0-13-800331-9) will also be used in this course.

We use the AVR IAR Embedded Workbench IDE for software development. This is a professional level embedded C/C++ and assembler development environment from IAR Systems that targets code to AVR and other microcontrollers.

The full version of this IDE is available in the Embedded Systems Design Laboratory (ESDL). There is a free, code size limited, version called the KickStart Version of IAR Embedded Workbench. You should download this version to your own PC from:

http://supp.iar.com/Download/SW/?item=EWAVR-KS4

Concepts specific to embedded C are covered in the IAR Users Manuals. These are posted on Blackboard and are also available through the development environment.

Manufacturers' application notes, data sheets, and technical papers are also used in this course. These are made available on BlackBoard either directly or via links.

Grades

There will be two exams. Their tentative dates are:
        First Exam   Thursday, March 8th
        Second Exam Thursday, April 26th

Course grade computation:
        Exams   40%
        Laboratory   35%
        Design Documentation and User's Manual   15%
        Class participation   10%

NO LABORATORY WORK IS ACCEPTED LATE. ALL PRELAB SUBMISSIONS MUST BE RECEIVED BY 9:00 PM ON TUESDAY, OR THEY WILL BE CONSIDERED LATE AND WILL NOT BE ACCEPTED.

ANY QUESTIONS RELATED TO LABORATORY OR EXAM GRADES MUST BE RESOLVED WITHIN 7 CALENDAR DAYS FROM THE DAY THE GRADED MATERIAL IS MADE AVAILABLE FOR RETURN.

Academic Dishonesty

Academic dishonesty is taken very seriously in this course. If you are caught cheating on an exam you will get a grade of F for the course and your case will be submitted to the Committee on Academic Standing and Appeals (CASA) of the College of Engineering for further action.

Tentative Lecture Schedule

Lectures are presented based on the assumption that you have completed the assigned reading prior to the lecture. This same assumption applies to exams as well. A tentative schedule of the lecture topics is provided on Blackboard. Each lecture handout will be available on Blackboard at least one week prior to the lecture. It is recommended that you print each lecture handout and bring it to class.

Computers and Other Electronic Devices in Lecture

The use of any type of computing device or other electronic devices by students during lecture is not permitted.

The following statement is included at the request of the Provost.

If you have a physical, psychological, medical or learning disability that may impact on your ability to carry out assigned course work, you are urged to contact the staff in the Disabled Student Services office (DSS), Room 133 Humanities, 632-6748/TDD. DSS will review your concerns and determine, with you, what accommodations are necessary and appropriate.