ECET 165 Embedded Microcontrollers

Hours: 3/3/0

Prerequisites: ECET 130 Engineering Applications in C, ECET 161 Digital Electronics 1

Short description:
Students will learn to program microcontrollers in both assembly and C programming languages and practice simulation and code development techniques in an embedded environment. They will investigate a variety of peripherals and interface standards. Students will design complete interfaces for LCDs, matrix keyboards and other hardware in the laboratory.

Learning outcomes:
Upon successful completion of this course a student will be able to:

- follow prescribed safety procedures appropriate to an electronics laboratory;
- describe the architecture of a microcontroller;
- program a microcontroller using assembly and C programming languages;
- design, compile and debug a microcontroller program in an integrated development environment (IDE);
- create programs to control hardware devices;
- write an interrupt service routine;
- use a microcontroller to control hardware peripherals;
- design, test, debug and emulate programs for embedded systems.

Course outline:

1. Introduction to a microcomputer **1 hour**

1.1 The history of the computer
1.2 The CPU
1.3 Memory
1.4 Input/output (I/O)
1.5 Speed

2. Microchip microcontroller family **3 hours**

2.1 Product family
2.2 Applications
2.3 Processor architectures
    2.3.1 Harvard
    2.3.2 Von Neumann
2.4 Pipelining

3. Assembly language instruction set **5 hours**

3.1 Accumulator and registers
3.2 Data movement
3.3 Bit manipulation
3.4 Arithmetic
3.5 Conditional branching

4. MPLAB integrated development environment (IDE) **3 hours**

4.1 Editor
4.2 Assembler
4.3 Compiler
4.4 Linker
4.5 Programmer
4.6 Simulator

5. Simple software routines **5 hours**

5.1 Switch debouncing
5.2 LED counter
5.3 LCD display
5.4 Matrix keypads

6. Introduction to MPLAB compiler **1 hour**

6.1 Overview
6.2 Installation
6.3 Integrating with MPLAB IDE

7. Interrupt handling **3 hours**

7.1 Interrupt logic
7.2 Interrupt service routines
7.3 Interrupt constraints

8. Hardware peripherals **12 hours**

8.1 Timers
8.2 Interrupts
8.3 Interfacing LCDs
8.4 Interfacing keypads
8.5 Implementing analog-to-digital converters[1]
8.6 Serial communications and interfacing

8.6.1 RS-232
8.6.2 RS-485

8.7 I^{2}C embedded serial computer bus

9. Developing code for embedded systems 3 hours

9.1 Design and testing methodology
9.2 Writing secure code
9.3 In-circuit emulation (ICE) and component emulation
9.4 Hexadecimal file formats and loaders
9.5 Embedded system testing and debugging

Tests and review 6 hours
Total 42 hours

Notes for instructor:

[1] Students will study the theory of analog-to-digital conversion next semester in Ecet 280 Data Acquisition & PLCs.

Labs:

1. The MPLAB programming environment
2.
3. Switching an LED on and off with PIC 18F4685
4. Switch counter
5. The MPLAB C18 compiler and LCD display control
6. Switch control of LCD
7. Porting the LCD library and testing the LCD
8. Matrix keyboard
9. Real time clock 1
10. Real time clock 2
11. Serial port interface
12.
13.

Textbooks: None. However see hardware requirements.

Hardware Requred: In lieu of a text, all students are required to purchase a development board and LCD display/ interface unit. This combination will give you a unit equivalent if not superior to a PICDEM 2 board.

A flash drive is highly recommended.

Reference: Instructor Handouts
Various Microchip Documents

Evaluation

Mid Term	20 %	Grading is in accordance with College policy.
Final Exam	30%	
Labs	40%	
Quizes	10%	

Note: Plagiarism will not be tolerated no matter from what source. The penalty for plagiarism will be a grade of F in the course. Any code downloaded from websites etc, must be correctly credited. When asked to write your own code, do not share it with others. You can certainly exchange ideas but try not to show your code. This could lead to code that looks like others.
One very important point, make sure you delete any of your code that was saved to the hard drive or network share otherwise someone else might copy it!

Note: It is your responsibility to ensure that all work is backed-up. Loss of data will not be accepted as an excuse for late assignments. Late penalties of 50% will be applied at the instructor's discretion.