Comp Eng 213 Digital Systems Design - Syllabus
Winter 2001

Ref No: 22460
Time: MWF, 8:30-9:20
Place: G31 EECH
Instructor: Dr. Hardy J. Pottinger
Office: 130 Emerson Electric Hall
Office Hours: MW 11:00 - 12:00. (Other times by appointment)

Text: I. Scott MacKenzie, *The 8051 Microcontroller*, 3rd Edition, Prentice Hall

References:

1) IC20: 80C51 Based 8-bit Microcontrollers, Philips Semiconductors, 1997. (vendor supplied on CDROM)
2) B. Kernighan, D. Ritchie, *The C Programming Language*, 2nd ed, Prentice Hall, 1988.
3) http://www.ece.umr.edu/~hjp/cpe213
4) Instructor handouts as appropriate

Prerequisites: CpE 111 and a C programming course. CpE 214 taken in conjunction with 213 is strongly encouraged but not required except for CpE majors.

Prerequisites by topic:

1. Familiar with C programming of a desktop computer
2. Use of Windows 95 or later
3. Function of NAND, NOR, decoders, multiplexors, and similar combinational logic
4. Function of D flip flops, registers, counters, and similar sequential logic

Material Covered: ISM Chapters 1-10, Gnome handout, C-programming examples (handouts), 8051 family data sheets.

Course Objectives: At the end of this semester, you will be able to:

- Analyze and design hardware and software for simple digital systems that use an 8051 microcontroller.
- Describe the fundamentals of computer organization and operation. Show the transfer of data at the register transfer level that occurs in a simple hypothetical processor during execution of each of its instructions. Modify the processor to perform new functions.
- Describe the process through which the 8051 interacts with external hardware. Analyze and design digital systems incorporating the 8051 and common peripherals such as RAM, ROM, LCDs, keyboards, switches, lights, sensors, and actuators. Explain the operation of parts of the 8051 including digital I/O ports, register banks, special function registers, internal and external memory spaces, timers, counters, and interrupt subsystem, and be able to apply this knowledge in simple programs.
- Define the operations performed by each assembly (ASM) language instruction for the 8051. Analyze and design ASM programs. Develop, simulate, and debug ASM programs for the 8051 using commercial software development tools.
- Understand the operation of common C-language constructs on the 8051. Analyze and design C programs for real time control applications involving the 8051. Develop, simulate, and debug C programs for the 8051 using a commercial software development toolchain (Keil μvision2)
- Describe the reasons for using tools such as functions, modules, libraries, and headers when developing microcontroller software. Develop mixed C/ASM software for long-term or multi-programmer use with these tools.
- Explain what occurs within the 8051 during an interrupt. Write programs using interrupts to perform a task at regular intervals using timers, communicate between processors serially, and provide immediate service to external requests. Describe and build a task scheduler. Describe the operation of a typical real-time operating system (RTOS) and implement simple programs with these systems.
- Describe the differences among various 8051 family members, and between the 8051 family and other popular microcontrollers (PIC and 68HC11).

Grading: Grades will be based on the results of three 50 minute exams, a final exam, homework, and my evaluation of your performance using the following scale:

Item	Date	Points	Percentage of grade
Exam 1	2/5	100	14
Exam 2	3/2	100	14
Exam 3	4/13	100	14
Final	5/17	200	28
Homework		200	28
Evaluation		14	2
	Total	714	100

Performance evaluation points will be based on attendance, class participation, and other non-graded criteria.

Exams and quizzes: Exams will be closed book, however a single front and back, 8.5x11" crib sheet will be allowed. Exam dates are firm and no makeups will be given. If for some reason or other you miss an exam or score unusually low I will drop the lowest of the three exam scores and calculate your grade based on a total of 614 points. Exams will be based on reading material, lecture material, and homework assignments. They will typically consist of approximately five problems of equal value and similar to text examples and homework assignments.

Homework: All homework and programming assignments must be clearly identified with your name, CpE 213, and the date in the upper right hand corner of the first page. Multiple pages may be stapled in the upper left corner only. Each problem must be clearly identified and include a problem statement. Isolated answers without a problem statement will not be given credit. Programming assignments will be assigned every 1 to 2 weeks and you will typically have 2 weeks to work through them. Keil's C51 and dScope software will be used for all programming assignments. This software is available for use in ECE 105 CLC. Alternately there is a demonstration version that is sufficient for most of these exercises. You will need access to a Win95/98/NT system with a cdrom drive. All programming assignments will typically require a compiled listing and a brief report of your procedure. Source code and machine generated output is **never** sufficient by itself. You must always explain your work in plain English. Specific requirements will accompany each assignment.

There are 156 end-of-chapter problems in the text, some of which will be assigned and collected. Some of these are simple short answer type questions while others are design or programming type problems that are more involved. You are expected to read the material and work the short answer type problems BEFORE we discuss the material in class. That way you will be able to ask questions about the problems AFTER you've had a chance to think about them. If you at least attempt an answer on your own, I'll have some evidence that you've put some thought into it and some idea of what your thought process is regarding the topic. An honest attempt at an answer will be given full credit. You should also work through all of the examples in the text to be sure you understand them. You should keep up with all assignments. Late homework will not be accepted.

I strongly encourage students to study together. However there are correct ways and incorrect ways to do this. Simply copying another's work is the incorrect way. It's a form of cheating and is to be avoided. Working independently and comparing answers after making an honest attempt at the solution is a correct way. Be sure you understand everything you turn in. If you cannot adequately explain the basis of your answer at a later date, you will not be given credit for it even though the answer may be correct.

Design Project: An in-depth design project and formal report will be required. This will count as part of your homework assignment score. This will consist of both hardware and software design requiring verification via simulation. No actual hardware will be involved. If you want to work with 'real' hardware, you will need to take CpE 214. Design project details will be provided later in the semester.

Partial Credit: Design problems rarely have a single 'correct' answer. There are often many solutions to a problem, some better than others, but all 'correct'. Accordingly, exam problems will seldom be graded as all or nothing. Emphasis will be placed on proper understanding of the concepts, then on proper application of those concepts, and lastly on 'the right answer'. You will not be severely penalized for minor, non-conceptual errors. For example, a concept might involve forcing a computer pin to a '1', proper application of that concept would be to use a pullup resistor to supply the '1', and the 'right answer' might be to use a 10k ohm pullup resister. Leaving off the 10k is a 'minor' error, while forcing the pin to a '0' by grounding it would be a conceptual error. If you think you deserve more credit than was given for a

problem you must submit your request in writing no sooner than 24 hours after an exam or assignment is handed back and no later than 30 days. The request for extra credit must include the amount of credit desired and the reason(s) why. It should be in the form of a letter memo like the one you would use when communicating between professionals on the job. The original exam or assignment must be attached.

Attendance: You are expected to attend each class, to arrive on time, and to remain until the end of class. Roll will be taken by attendance sheet. If you are late and miss checking your name off of the attendance sheet, you will be considered absent. Excessive absences may result in your being dropped from class. Any unexcused absence will result in a decrease in your performance evaluation.

Cheating: Don't do it. Department policy is that you will receive an F in class on your first offence and be expelled from the department on your second.