West Virginia University
College of Engineering and Mineral Resources
Lane Department of Computer Science and Electrical Engineering

CpE 312 Microcomputer Structures and Interfacing

Semester: SPRING-2015

Course Format And Credit Hours: 3 hr Lecture, 3 hr Credit
Webpage: ecampus.wvu.edu

Pre-requisites: CpE-310, CpE-311, EE252, EE252 (Co-requisites : CpE-313)
It is assumed that the student has a background in the following areas:

1) Digital logic design
2) Electric circuits
3) Op-Amp
4) Basic Digital Electronics
5) Basic Microprocessor hardware/software
6) Familiar with Assembly and C language

Meeting Time: MWF 12:00-12:50

Meeting Location: Room 251, ESB

Instructor:
Powsiri **Klink**hachorn
Office: 927 Engineering Science Building
Tel: 293-9696
Email: Powsiri.klinkhachorn@mail.wvu.edu

Office Hours: 9-10 MWF, 11-12 MWF
See me if you need to talk whenever I'm in the office or by appointment (please call or e-mail to make sure that I will be in my office.)

Required Text: The HCS12/9s12: An Introduction to Software & Hardware Interfacing 2nd Edition, by H. Huang, Thomson Delmar Learning, ISBN 1-4354-2742-4.

Students are encouraged to purchase the DragonFlyBot Board (DFB). The DFB will be used for class assignments and the CpE313 lab experiment. Please contact the instructor for additional info.

References

Designing with Microcontrollers -- The 68HCS1, by Tom A ISBN 1-4116-5593-1, http://hcs12text.com/printed.html

68HC12 Microcontroller – Theory and Applications, by D. J. Pack and S. F. Barrett, Prentice Hall, ISBN 0-13-033776-5

Documentation on the HCS12 Families by Freescale Semiconductor - Application Notes, Brochure, Datasheets, Engineering Bulletin, Errata Fact Sheets, Product Change Notices, Reference Manual, Roadmap, Selector Guide, Supporting Information, Training Reference Manual, User's Guide (WWW.Freescale.com)

Course Objectives:

To expand the student's knowledge of microprocessor design and interfacing beyond CpE310. The student will learn how to design and interface a computer to memory and Input/Output devices. Additionally, the student will also learn how to design "smart" microcontroller-based devices that can be applied or tailored to most applications. Freescale's HCS12/ 9S12 will be used as case studies with an emphasis on interface hardware including communications, high power interface devices, line driver/receiver circuits, A/D and D/A devices, and utilization of software techniques for programming the devices.

Expected Outcomes:

At the end of this course, a student should be able to:

1) draw a detailed architecture diagram of the 9S12 microcontrollers
2) write a program in C/assembly language for the 9S12 microcontrollers, i.e. know all addressing modes and full instruction of the 9S12 microcontrollers.
3) design and use interrupt as an integral part of the microcontroller.
4) design and use programmable timers as an integral part of the microcontroller.
5) design and use input/output ports as an integral part of the microcontroller.
6) interface and develop software to output a wide-range of process control signal (DC, AC, high power, variety of voltage/current compatible levels, I^2C LCD, Keyboards, and etc.).
7) design and use Pulse-Width-Modulation (PWM) as an integral part of the microcontroller.
8) understand the basic operation and use of Analog to Digital Converter (A/D) and Digital to Analog converter (D/A) with microcontroller.
9) understand the basic operation of commonly used sensors/transducers.

Grading: Best of the following 2 options

Option 1	Without Comprehensive Final Exam	
	Attendance, Quizzes, and Homework	10%
	Hour Exams (3)	90%

Option 2	With Comprehensive Final Exam	
	Attendance, Quizzes, and Homework	10%
	Best 2 out of 3 Hour Exams	50%
	Final Exam (Comprehensive)	40%

A - 90 - 100
B - 80 - 89
C - 70 - 79
D – 60-69
F – 59 and below

Attendance (2.5%), Quizzes (2.5%), Homework (5%): It will be very difficult to pass this course without attending class. ***There will be a quiz at the end of almost every class***. Quizzes will also be used to determine students' attendance.

Homework will be assigned and given every week. You are required to do all homework. All homework will be due at the beginning of class on the instructor's desk. Late homework will not be accepted.

Hour Exams: 3 Hour Exams will be given through the semester. The 2 highest scores from the exams will be counted in Option 2. ***There will be no makeup exam***. If you miss an exam your grade will be calculated solely on Option 2.

Final Exam: The Final Exam is optional (see Option 1) and will be Comprehensive, i.e. cover everything we have done during the semester.

Plagiarism: You are encouraged to consult the instructors or TAs if you have any questions about the homework or exams. The homework and exams are expected to be individual work. Handing in work that was jointly prepared and/or copied will be considered plagiarism and will be handled according to the WVU academic dishonest policy.

Class distractions: Cell phones, pagers, etc. must be turned OFF during class. These are distracting for all.

COURSE OUTLINE

- Introduction to microcomputer
  - * Bus Structure: Memory+ I/O Interface
- Introduction to Microcontroller
- 9S12 Microcontroller Framework
  - * Freescale Microcontrollers + Development Tools
- CPU Architecture and Instruction Set
  - * Processor, memory, I/O, timer, A/D, etc.
  - * 9S12 Registers, Instruction queue, Execution cycle
  - * Instruction Set
- 9S12 Hardware/Software Tools
  - * MCUSLK/CSM12C32 (HCS12) Application Module
  - * CodeWarrior IDE / Background debug mode (BDM)
  - * Assembly/C language
- Interrupt, Clock Generation, Resets and Operation Modes
  - *Fundamental Concepts of Interrupt
  - *Clock and Reset Generation Block
  - *Resets
- I/O Ports
  - * Parallel Input/Output Port, LCD Display, Key Pad
  - * Serial communication Interface (SCI)
  - * interfacing with a D/A converter, stepper motor, and etc.
- Timers/Event Counter
  - * Programmable Timer/Event counter (Input-Capture Mode/ Output-Compare Mode)
  - * Pulse-Width-Modulated Outputs
  - * DC Motor Control
- Serial Peripheral Interface (SPI)
- I^2C Bus for Peripheral Chip Access
- Processes, measurements, and signal processing
  - * Process-related peripheral including real-time clock, A/D, D/A, and I/O
  - * Transducer and transmitter
  - * Final control elements
- Noise and noise reduction techniques
  - * Grounding and shielding practice