

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-2007

Course Format

And Credit Hours:

3 hr Lecture, 3 hr Credit

Webpage: www.ecampus.wvu.edu

Pre-requisites:

CpE-310, CpE-311 (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 G39, ESB

Instructor:

Powsiri **Klink**hachorn

Office: 927 Engineering Science Building

Tel: 293-0405 x2522

Email: klink@csee.wvu.edu

Office Hours:

10-12 MWF, 1-2:00 MWF

See me if you need to talk whenever I'm in the office

**Required Text /
MCUSLK**

The HCS12/9s12: An Introduction to Software & Hardware Interfacing, by H. Huang, Thomson Delmar Learning, ISBN 1-4018-9812-2

Students are encouraged to purchase the Freescale Semiconductor's Microcontroller (MCU) Student Learning Kit (SLK), which contains a project board that can be used in conjunction with a wide selection of MCU development boards and CodeWarrior™ development tools. The kit comes with a CSM12C32 (HCS12) Application Module that plugs directly into the project board MCU connector. The MCUSLK will be used for class assignments and the CpE313 lab experiment. The MCUSLK can be obtained at a discounted price from the department (no marked-up cost). 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) interface memory and input/output devices to any microprocessor bus (8/16/32/...).
- 2) draw a detailed architecture diagram of the 9S12 microcontrollers
- 3) write a program in C/assembly language for the 9S12 microcontrollers, i.e. know all addressing modes and full instruction of the 9S12 microcontrollers.
- 4) design and use interrupt as an integral part of the microcontroller.
- 5) design and use programmable timers as an integral part of the microcontroller.
- 6) design and use input/output ports as an integral part of the microcontroller.
- 7) interface and develop software to output a wide-range of process control signal (DC, AC, high power, variety of voltage/current compatible levels, I²C LCD, Keyboards, and etc.).
- 8) design and use Pulse-Width-Modulation (PWM) as an integral part of the microcontroller.
- 9) understand the basic operation and use of Analog to Digital Converter (A/D) and Digital to Analog converter (D/A) with microcontroller.
- 10) understand the basic operation of commonly used sensors/transducers.

Grading:

Best of the following 3 options

Option 1	Without Comprehensive Final Exam	
	Attendance, Quizzes, and Homework	15%
	Hour Exams (3)	85%
Option 2	With Comprehensive Final Exam	
	Attendance, Quizzes, and Homework	15%
	Best 2 out of 3 Hour Exams	50%
	Final Exam (Comprehensive)	35%
Option 3	Project	
	Best of Option 1 or Option 2	75%
	Final Project	25%

A - 90 - 100

B - 80 - 89

D - 60 - 69

C - 70 - 79

F - 59 and below

**Attendance
Quizzes
Homework:**

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 (5%) will also be used to determine students' attendance.

Homework (10%) 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 or 3.

Final Exam:

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

Final Project (Optional):

Prior to the start of the optional final project, normally about 4 to 6 weeks before the final, the student must submit a written proposal with specific descriptions and objectives of the project to the instructor. The instructor will provide any necessary feedback and may ask the student to modify or rewrite the proposal as agreed upon. In addition to the work proposed, the student must also turn in a written final report in the standard formal form that will be specified by the instructor.

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 (80x86/88) Interfacing
 - * Bus Structure
 - Memory Interface
 - I/O Interface
 - Wait States Generation
- Introduction to Microcontroller
 - * Motorola/Freescale
 - * Intel
 - * PIC - Microchip
- 9S12 Microcontroller Framework
 - * Freescale Microcontrollers
 - * Freescale Development Tools
- CPU Architecture and Instruction Set
 - * Processor, memory, I/O, timer, A/D, etc.
 - * 9S12 Registers
 - * Memory Addressing Modes
 - * Instruction queue/Execution cycle
 - * Instruction Set
- 9S12 Hardware/Software Tools
 - * MCUSLK/CSM12C32 (HCS12) Application Module
 - * CodeWarrior IDE / Background debug mode (BDM)
 - * Assembly language
 - * 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
 - * Serial communication Interface (SCI)
 - * LCD Display
 - * Keypad
 - * 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)
- I²C 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

West Virginia University is committed to social justice. I concur with that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700).

Academic Dishonesty

As a student in the Lane Department of Computer Science and Electrical Engineering, you are expected to behave ethically and professionally in part by refraining from academic dishonesty, including plagiarism and cheating. If you submit any work under your name (homework, report, thesis, exam, quiz, etc.) that has been reproduced in whole or in any part from the work of others without specifically indicating that it is the work of others, you are being academically dishonest. You are also being dishonest if you allow your work to be copied and submitted without acknowledgment of your work.

Consequences and procedures for dealing with cases of academic dishonesty are outlined in the WVU Student Code of Rights and Responsibilities.

I have read the description of academic dishonesty above.

Signature

Student Number

Date