

## ECE 2510: Introduction to Microprocessors, Fall 2012

<b>WMU Catalog:</b>	<p>Introduction to Microprocessors (3-1)</p> <p>Credit Hours: 4</p> <p>Prerequisites: ECE 2500, CS1060 or CS 1110 or CS 2060. Basic programming knowledge.</p> <p>Machine and assembly language programming of small computers. Introduction to microcomputer architecture and interfacing.</p>
<b>Class Schedule:</b>	<p>Lecture: TR 8:30-9:45 AM, Room CEAS D-201</p> <p>Lab: T 10:30-1:20 PM or R 2:30-5:20 PM, Room CEAS B-115.</p>
<b>Instructor:</b>	<p>Lecture/Course: Dr. Bradley J. Bazuin, Associate Professor, ECE, CEAS A-241  <a href="mailto:brad.bazuin@wmich.edu">brad.bazuin@wmich.edu</a>  <a href="http://homepages.wmich.edu/~bazuinb/">http://homepages.wmich.edu/~bazuinb/</a></p> <p>Lab: Mr. Lalith Narasimhan  <a href="mailto:lalith.narasimhan@wmich.edu">lalith.narasimhan@wmich.edu</a></p>
<b>Required Textbook and Materials:</b>	<ol style="list-style-type: none"> <li>1. The HCS12/9S12: An Introduction to Software &amp; Hardware Interfacing, 2<sup>nd</sup> ed., Han-Way Huang, Delmar, CENGAGE Learning, 2010, ISBN: 978-1-4354-2742-6.</li> <li>2. Prelabs and Laboratory Experiments posted on the class webpage.</li> <li>3. USB Memory Stick.</li> </ol>
<b>Supplemental Textbooks/Materials:</b>	<ol style="list-style-type: none"> <li>1. 68HC12 Microcontroller Theory and Applications, Daniel J. Pack, Steven F. Barrett, Prentice Hall, 2002, ISBN 0-13-033776-5.</li> <li>2. Introduction to Embedded Systems: Interfacing to the Freescale 9S12, Jonathon W. Valvano, CENGAGE Learning, 2010. ISBN: 978-0-495-41137-6.</li> <li>3. CPU12 Reference manual</li> <li>4. MC9S12DP256B Device User's Manual.</li> <li>5. Instructor's Lecture Notes, posted on the class webpage</li> </ol> <p>(Note: Items 3 and 4 will be available in the lab during semester or may be downloaded from the web.)</p>

**Prerequisites by topic:**

1. A fundamental understanding of analysis and design of combinational and sequential logic systems
2. Basic knowledge in programming digital computers.
3. Analysis of problems and development of correct procedures for their solution.
4. An ability to develop algorithmic solutions to problems in a structured high level computer language.
5. The ability to solve both numerical and non-numerical problems using computer programs.

**Course Topics (Expected):**

Introduction to the microprocessors, microprocessors and basic computer definitions.  
Introduction to Motorola 68HC12 and HC12/HS12 hardware, instruction set, and addressing modes.

Assembly language programming using the HC12/HS12 instruction set.

The debug, a software development program, ICC12 IDE environment and D-Bug12

Embedded programming for the HC12/HS12 in assembly and "sequential C".

MC68HC812A4, MC68HC912B32, and MC9S12DP256 parallel input output interfaces, and real-time synchronization

MHC12/HS12 interrupts, interrupt vectors, interrupt priorities, nonmaskable interrupt, external interrupt sources, and more advanced interrupts

M68HC12 Memory Map, MC68HC912B32 Flash EEPROM, Flash EEPROM hardware interlocks, expansion memory and interfacing to the external bus

Introduction to MHC12/HS12 timers, basic timer, sixteen-bit free-running TCNT register, real-time interrupt, external interrupts using timer interrupts.

**Course Objectives:**

1. Understand components of the computers, microprocessors and microcontrollers (a, b, c, e, k).
2. Learning role of CPU, registers, and modes of operation of HC12/HS12/68HC12 (a, b, c, e, k).
3. Understand concept of memory mapping (a, c, e, k).
4. Learning addressing modes (Immediate, direct, extended, indexed, indexed-indirect, inherent and relative addressing modes) (a, b, c, e, k).
5. Learning Motorola HC12/HS12/68HC12 instruction sets (Load, store, transfer, move, arithmetic, logic conditional and unconditional branch, loop, condition code, interrupt Instructions) (a, b, c, e, k).
6. Learning how to write program in assembly language using HC12/HS12/68HC12 assembler and debugging (a, b, c, e, k).

7. Learning assembly-programming styles, structured assembly language programming (a, b, c, e, k).
8. Learning if-then-else decision, while-do and do-while repetitions (a, b, c, e, k).
9. Learning and programming parallel input/output ports of M68HC12 (a, b, c, e, k).
10. HC12/HS1268HC12 memory system design, memory capacity, and control signals, memory technologies, linear memory expansion, memory layout design, timing analysis and electrical compatibility, memory paging (a, b, c, e, k).
11. Learning interrupt vectors, interrupt process, interrupt priorities, external and advanced interrupts (a, b, c, e, k).
12. To assess ABET outcomes h, i and k.

### **Laboratory Work:**

The platform in the lab is the Adapt9S12DP256 Board by Technological Arts. Programs will be created, compiled, and downloaded to the board using the ICC12 IDE environment and D-Bug12 debug Monitor that has been preloaded in the flash memory of the 9S12DP256 microcontroller on the Adapt board.

We will be using standard scientific/engineering procedure regarding laboratory reports. This means that you are expected to come to class prepared. Prelab and Lab Assignments will be posted on the Class Web Page. The objective and design sections (the latter contains pseudocode of software, circuit schematic diagrams, timing diagrams, math formulas, etc.) of your lab report should be completed before lab as a draft. The finalized design, data/results and conclusion sections of the Team's Lab Report should be completed either during the lab session, or shortly thereafter. In the conclusion section you will describe major concepts observed/discovered, discuss any anomalies and suggest what caused them.

Prelab Assignments will be checked by the lab instructor at the beginning of each lab. Missing, or insufficient Prelabs will be penalized by losing up to 3 pts (out of 12 pts) for the lab. Lab reports may be done in pencil but typed reports using a word processor are highly recommended. It is also recommended that you save and organize your lab C and assembly language programs. The penalty will be severe for illegible writing, sloppy schematics and drawings. Lab reports are due during the beginning of the next lab session. Failing so may result in a grade of 0 pts for the lab report. Lab reports are an individual's responsibility, **one lab report per person ... not one per team!**

If you don't show up for a lab, you forfeit the points associated with it and cannot later make up the lab. Exceptions may be made only for those individuals who contact the course instructor and their lab instructor/TA before the lab and have an excused absence.

There will be a Lab Final, with a point total equal to three regular labs (36 pts).

**Note:** You must achieve a passing grade in the lab (total 60% out of 100%) in order to pass the class. Lab team collaboration on labs and lab reports is expected; however, plagiarism and/or thoughtless copying/duplication of another student's, or team's designs or written reports is not and may result in a zero scores for the lab, or homework, or design project for all individuals involved.