ECE 4510/5530 MICROCONTROLLER APPLICATIONS
SPRING 2012

Instructor: Dr. Janos Grantner
Lecture: MWF 3:30- 4:20pm, Room C-122
Labs: M 6:30- 9:20pm, Room B-214 (Mr. Lalith Narasimhan)
R 12:30- 3:20pm, Room B-214 (Mr. Lalith Narasimhan)
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Hours: MW 4:30- 5:20pm, or by appointment

Prerequisites: ECE 2210 Electronics I
ECE 2510 Introduction to Microprocessors
Recommended: ECE 3550 Digital Design
ECE 3570 Computer Architecture

Required Materials:

Han-Way Huang, HCS12/9S12: An Introduction to Software and Hardware Interfacing, 2nd Ed., Delmar (Cengage Learning), 2010, ISBN 13: 978-1-4354-2742-6, available in the University Bookstore, Bernhard Center.

Instructor's Lecture Notes, posted on the Class Web Page.

MC9S12DP256B Advance Information Rev. 1.1 by Motorola, **required**, available for loan through your lab instructor.

Reference Manual for **all** MC9S12DP256/512 Internal Modules, **required**, students can download it from Freescale's Web site at http://www.freescale.com, or through the Class Web Page.

Adapt9S12DP512 Data Sheet by Technological Arts, **required**, it is available through the Class Web Page, or the Technological Arts Web Page.

In order to work on lab and homework assignments as well as projects, students are **required** to have an **Adapt9S12DP512 EVB Kit** (or an Adapt9S12DP256 EVB Kit) **by Technological Arts (customized for this class as WMU2)**, a 6-month, stand-alone student license of the **ICC12 V7 IDE software by ImageCraft**, a **large solderless breadboard** and a set of electronic parts (**ECE 4510/5530 Parts Kit**). With respect to the breadboard and the parts, students can either place an order with the IEEE Student Branch to get them, or can purchase them by themselves. Students should contact **directly** Technological Arts and ImageCraft to purchase the EVB board and the ICC12 software, respectively. There is also a possibility that students who took the class already will offer their boards and parts for sale.

Recommended Texts:

Jean L. Labrosse, *MicroC/OS – II The Real Time Kernel*, 2nd Ed., CMP Books, ISBN 1-57820-103-9, available through amazon.com, or from the publisher

Jonathan W. Valvano, *Introduction to Embedded Microcomputer Systems: Motorola 6811 and 6812 Simulation*, Thomson, 2003, ISBN 0-534-39177-x

Course Description

The primary emphasis of the course will be microcontroller architecture, firmware and embedded software design but hardware interface design issues will also be extensively covered. Students are expected to show expertise in both areas.

Topics to be tentatively covered in this course include:

- Introduction to the Motorola 9S12 Microcontroller Family
- MC9S12DP512 Architecture and Memory Map
- CPU12 Programmer's Model and Basic Assembly Language Programming
- C Programming with the ICC12 IDE Environment
- uC/OS-II Real Time Kernel Concepts
- Interfacing to the Parallel I/O Ports
- Programming the Flash Memory
- MC9S12DP512 Interrupts
- Programming the Timer Module
- Input Capture and Output Compare
- Programming the PWM Module
- Analog Input and Output Interface
- Asynchronous Serial Communications Interface
- SPI Interface
- CAN Interface
- Advanced I/O Interfacing Techniques
- Design of Static Memory Systems
- Interfacing Static Memory to the MC9S12DP512 External Bus
- 8 or 16-Bit Memory Modules, Critical Timing Analysis

Lab Work

The hardware platform in the lab is the Adapt9S12DP512 Board by Technological Arts. Programs will be created, compiled, and downloaded to the board using the ICC12 IDE environment and the NOICE12 BDM (Background Debug Module) and software by **noicedebugger.com**. A networked version of the ICC12 V7 will be running in the Microcomputer Lab. Students are required to work with their **own Adapt boards** in the lab. **Outside** of the scheduled and open lab hours students should use their **own copy of the ICC12 V7 software along with their Adapt boards** to work on the course assignments. Debugging of the user's code can be done by using the D-Bug12 V.4.4 Monitor that has been preloaded in the flash memory of the 9S12DP512 microcontroller on the Adapt board. In addition, an extra Adapt board can be converted to a BDM module to have the same advanced debug capabilities that are provided in the lab. The 6-month student license for ICC12 can be extended indefinitely by

paying off the balance of the full price.

For the laboratory you will need a thumb drive, a large solderless breadboard and the Parts Kit as published on the Class Web Page. You will work in the lab in teams. A team is usually made up of two students, however, **each student is required to have a Microcontroller EVB by Technological Arts, the ICC12 V7 IDE software, a breadboard, and a Parts Kit**. Work will be done simultaneously on lab and homework assignments and the design projects.

We will be using standard scientific/engineering procedure regarding laboratory reports. This means that **you are expected to come to class prepared**. **Prelab 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 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. The penalty will be severe for illegible writing, sloppy schematics and drawings. **Lab reports are due no later than 5:00pm, Thursday (Monday Lab) and 5:00pm, Monday (Thursday Lab), respectively, following the lab**. **Late lab reports** will be penalized by **-10% for each day** they are tardy, or will receive a grade **0 after three days** unless **prior** arrangements have been made. Lab reports should be dropped off on the desk of the lab instructor. If you don't show up for a lab, you forfeit the points associated with it and cannot later make up the lab. Exceptions will be made only for those individuals who contact their lab instructor before the lab, giving an adequate reason why they cannot attend that day. **Note: you must achieve a passing grade in the lab (total 60% out of 100%) in order to pass the class. Plagiarism and/or the copying/duplication of another student's, or team's designs or written reports will result in zero scores for the lab, or homework, or design project for all individuals involved**.

There will be a **Lab Final** (worth of **three** regular labs).

Open Lab
Extended Lab Hours will be posted on the Class Home Page. Students are advised to use the B-214 Lab's resources, as well as their own boards, parts and software when the lab is closed to complete their lab reports, prepare for the next lab, and work on homework assignments and the design project.

Homework
There will be regular homework assignments. **Late homework submissions will not be accepted and receive a 0 score**.

Design Projects
The **ECE 5530 Section** will be assigned an **extra midterm project** (**Project #1**) in addition to a final **Lab Design Project** that should be done by **both** sections. The Lab Design Project will be assigned to control a model of a technological process, and will be done using the Parts Kit and equipment readily available in the lab. Projects will be carried on in teams of two students, or may be worked on individually. The demonstration of the projects working correctly will be worth up to 40% of the credit assigned.

Project #1 is due **4:00pm, on Tuesday, February 28, 2012**, and the **Lab Design Project** is due **2:00pm, on Tuesday, April 17, 2012.**

Late projects will be accepted up to **four business days** after due date (not after the Final Exam, though) but will be penalized by **-10% for each day** that is tardy! Failure to work on or submit the project will result in an **X grade** for the course.

Exams:
There will be one in-class midterm, a lab final exam, and a two-hour Final Exam. All exams are **open book and open notes**. The **Midterm Exam** is scheduled for **3:30-4:20pm, on Wednesday, February 22, 2012**, and the **Final Exam** is scheduled for **2:45-4:45pm, on Monday, April 23, 2012**. **Lab Final Exams** are scheduled for **Monday, April 16, 2012**, and **Thursday, April 12, 2012**, respectively.
The Final Exam is a comprehensive test, however, more weight will be allocated to course material subsequent to the Midterm Exam. Students are required to attend **all exams as scheduled**, failure to do so will result in an **X grade** for the course (if an emergency arises, you must contact the instructor **prior to** the examination). There will be no make up exams unless in extreme circumstances.

Grading Policy:
Grades will be determined on the basis of the following:

ECE 4510 Section	
Homework	10%
Lab Work	30%
PROJECT	10%
MIDTERM	15%
FINAL	35%

ECE 5530 Section	
Homework	10%
Lab Work	30%
PROJECT 1	5%
PROJECT 2	10%
MIDTERM	15%
FINAL	30%

The break up for the letter grades is as follows:

A:	**85 - 100%**
BA:	**80 - 84%**
B:	**70 - 79%**
CB:	**65 - 69%**
C:	**55 - 64%**
D:	**45 - 54%**
E:	**<45%**

In borderline cases, the Final Exam may be given a higher weight, up to the instructor's discretion.

Codes, Policies, Processes and Procedures:
The ECE 4510/5530 Web Home Page will be used as official communications media for the class.

The WMU College of Engineering and Applied Sciences Honesty Code will apply in this course.

Homework is individual work! Students may discuss with their classmates the basic approaches to arrive at the solutions in principle. However, they are not allowed to share schematic diagrams, calculations, program files, and the like. Similarly, there must not be leaks of concrete design information among lab and project teams, respectively.

You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate and Graduate Catalogs that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. The policies can be found at http://catalog.wmich.edu under Academic Policies, Student Rights and Responsibilities. If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct. You will be given the opportunity to review the charge(s). If you believe you are not responsible, you will have the opportunity for a hearing. You should consult with your instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.

Furthermore, students are encouraged to visit to http://osc.wmich.edu and www.wmich.edu/registrar to access the Code of Honor and general academic policies on such issues as diversity, religious observance, student disabilities, etc.