

ECE 451/595 MICROCONTROLLER APPLICATIONS

Fall 2004

Instructor: Professor Janos Grantner
Lecture: MW 3:00- 3:50pm, Room D-204
Labs: T 6:30- 9:20pm, Room B-214 (Mr. Ramakrishna Gottipati)
R 8:00- 10:50am, Room B-214 (Mr. Ramakrishna Gottipati)

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Hours: MW 4:00- 4:50pm, or by appointment

Prerequisites: ECE 221 Electronics I
ECE 251 Introduction to Microprocessors
Recommended: ECE 355 Digital Design
ECE 357 Computer Architecture

Required Materials:

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

CPU12 Reference Manual by Motorola, **required**, available for loan through your lab instructor

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

Adapt9S12DP256 Data Sheet by Technological Arts, **required**, it is available at <http://www.technologicalarts.com/myfiles/data/ad9s12dp256pins1.pdf>, or on the Class Web Page

In order to work on lab and homework assignments and projects, students are **required** to have an **Adapt9S12DP256 EVP Kit by Technological Arts (customized for this class)**, a 6-month, stand-alone student license of the **ICC12 IDE software by ImageCraft**, a **large solderless protoboard** and a set of electronic parts (**ECE 451/595 Parts Kit**). With respect to the protoboard 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 board and the software, respectively. There is also a possibility that students who took the class already will offer their boards and parts for sale.

Recommended Texts:

Frederick M. Cady, James M. Sibigtroth, *Software and Hardware Engineering Motorola M68HC12*, Oxford University Press, 2000, ISBN 0-19-512469-3, available in the University Bookstore, Bernhard Center

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 HC12/HS12 Microcontroller Families
- MC9S12DP256 Architecture and Memory Map
- CPU12 Programmer's Model and Assembly Language Programming
- C programming with the ICC12 IDE Environment
- Interfacing to the Parallel I/O Ports
- MC9S12DP256 Interrupts
- Programming the Timer
- Input Capture and Output Compare
- Programming the PWM Module
- Analog Input and Output Interface
- Serial Communications Interface
- CAN Interface
- MC9S12DP256 Memories
- Design of Static Memory Systems
- Interfacing Static Memory to the MC9S12DP256 External Bus
- 8 or 16-Bit Memory Modules, Critical Timing Analysis

Lab 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 the NOICE12 Debug Module and software by **noicedebugger.com**. A networked version of the ICC12 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 software along with their Adapt boards to work on the course assignments. Debugging of the user's code will be done by using the D-Bug12 V.4.4 Monitor that has been preloaded in the flash memory of the 9S12DP256 microcontroller on the Adapt board. The 6-month license for ICC12 can be extended indefinitely by paying off the balance of the full price.

For the laboratory you will need a 3.5" computer diskette (HD), a large solderless prototyping board 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 by two students, however, each student should have a Microcontroller

Kit by Technological Arts, the ICC12 software, a protoboard, 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 5pm, Friday (Tuesday Lab) and 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 five 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 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 595 Section** will be assigned an **extra midterm project** in addition to a final Lab Project that should be done by both sections. A Lab 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 **3:00pm, on Tuesday, October 26, 2004**, and the **Lab Design Project** is due **3:00pm, on Tuesday, November 23, 2004**.

Late projects will be accepted up to **three** 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 **3:00-3:50pm, on Monday, October 11, 2004**, and the **Final Exam** is scheduled for **2:45-4:45pm, on Monday, December 6, 2004**. The **lab final exams** are scheduled for **Tuesday, November 30, 2004**, and **Thursday, December 2, 2004**, respectively.

The Final Exam is comprehensive over all course material, 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 before 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 451 Section		ECE 595 Section	
Homework	5%	Homework	5%
Lab Work	30%	Lab Work	30%
PROJECT	15%	PROJECT 1	5%
MIDTERM	15%	PROJECT 2	15%
FINAL	35%	MIDTERM	15%
		FINAL	30%

The break up for the letter grades is as follows:

A:	89 - 100%
BA:	84 - 88%
B:	74 - 83%
CB:	69 - 73%
C:	59 - 68%
D:	49 - 58%
E:	<49%

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 451/595 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.

You are responsible for making yourself aware of and understanding the policies and procedures in the Undergraduate (pp. 268-270) Catalog, and in the Graduate (pp. 24-26) Catalog,

respectively, that pertain to Academic Honesty. These policies include cheating, fabrication, falsification and forgery, multiple submission, plagiarism, complicity and computer misuse. If there is reason to believe you have been involved in academic dishonesty, you will be referred to the Office of Student Conduct (previously Office of Student Judicial Affairs). 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 the course instructor if you are uncertain about an issue of academic honesty prior to the submission of an assignment or test.