ECE/CSE 4720/5720 Microprocessor-Based System Design

Winter 2018
Course Outline

Instructor
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Course URL
The course webpage will be hosted on Moodle (https://moodle.oakland.edu). It will contain announcements, lectures, homework, lab assignments, grades, and links to external content relevant to the course.

Meeting Time
Lectures: Tuesday and Thursday 5:30 pm – 7:17 pm in EC 275.
Labs: Fridays 9 am – 11:59 am (undergrad students) in EC 461.
Fridays 1 pm – 3:59 pm (undergrad students) in EC 461.
Fridays 6 pm – 8:00 pm (graduate students) in EC 461.

Prerequisites
(ECE 278 or ECE 2700) or (ECE 378 or ECE 3710), and major standing. Note that Credits cannot be received for more than one of ECE 4720, ECE 5720, CSE 4720 and CSE 5720.

Reading Materials and Hardware

Required:

-Textbook: Mazidi & Causey, HCS12 Microcontrollers and Embedded Systems using Assembly and C with CodeWarrior, 1st edition, Prentice Hall, 2009, ISBN-10: 0136072291
- **Hardware**: Dragon12 development board with SERIAL MONITOR (Dragon12-xxxx-SM) installed in the flash memory. To order the board, visit the moodle for the link.
- **MC9S12DG256**: 16-bit microcontroller datasheets from Freescale (available as a PDF online) in additional to other online reference materials that will be specified throughout the semester.

Additional References:
-H.-W. Huang, *The HCS12/9S12: An Introduction to Software and Hardware Interfacing*, Thomson Delmar Learning, 2nd edition, 2010, ISBN-13: 978-1-4354-2742-6
- S. F. Barrett and D. J. Pack, *Embedded Systems Design and Applications with the 68HC12 and HCS12*, Prentice Hall, 2005.
- F. M. Caddy, *Software and Hardware Engineering: Assembly and C Programming for the Freescale HCS12 Microcontroller*, 2nd Ed., Oxford University Press, 2007.
- J. Pack and S. F. Barrett, *68HC12 Microcontroller: Theory and Applications*, Prentice Hall, 2002.
- K. A. Smith, *Teamwork and Project Management*, 3rd Ed., McGraw-Hill, 2004.

Course Description
Applications of microprocessors and microcomputers to the solution of problems; interfacing microprocessors with external systems such as sensors, actuators, displays and keyboards; programming considerations; microcomputer system and memory system design. This is a laboratory and design oriented course. Students have to complete several laboratory assignments and one group design project. Written report and oral presentation are required. Prerequisite: CSE/ECE 378 or 3710.

Course Objectives
- Programming the HCS12 microcontroller using assembly and C languages
- Write assembly language subroutines and call them as functions from a C program
- Use an A/D converter to read analog signals into a microcontroller
- Describe the output compare and input capture operations in a timer module of a microcontroller
- Generate pulse-width modulation (PWM) signals on a microcontroller suitable for controlling the speed of a DC motor or the position of a servo
- Describe how hardware interrupts work in a microcontroller
- Describe how serial data can be sent from one microcontroller to another using SCI module, SPI module, or IIC module.
- Demonstrate the ability to interface external devices (including sensors) to a microcontroller
- Work in a team environment to design a microprocessor-based system and communicate the results in a written report and an oral presentation

ABET/Program Outcomes
The Program Outcomes are a set of skills that assure the achievement of the program educational objectives. Before graduating, SECS students will demonstrate their skills in the following key areas:

a) an ability to apply knowledge of mathematics, science, and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multi-disciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

ABET outcomes addressed by this course: a, b, c, e, g, i, k.

Course Contents
The primary objective of the course is to learn how to design hardware and software for Microprocessor-based systems. As a medium for learning we will mainly use Motorola's HCS12 microcontroller. The concepts learned in the course can be adapted to other microcontrollers. The course will cover the following topics:

1) Review of Number Systems and BCD Arithmetic
2) HCS12 Processor Features - Overview

3) HCS12 Instruction Set and Addressing Modes
4) Assembly Language Programming
5) C Language Programming
6) Interrupts and Exceptions
7) Parallel I/O
8) Timer Functions
9) Analog Interfaces (ADCs and DACs)
10) Pulse Width Modulation (PWM) and DC Motor
11) Serial Communication (SCI, SPI, and/or I2C)

Grading
Students will be evaluated based on the following components with the given weights:

Lab Assignments	30%
Exam 1	25%
Exam 2	25%
Design Project	20%

The total for the course will be converted to a final grade out of 4.0 using the conversion below. Missing of exams or not completing the design project will result in a 0.0 final grade.

90 to 100%	~ 3.6 to 4.0
80 to 89%	~ 3.0 to 3.5
70 to 79%	~ 2.0 to 2.9
60 to 69%	~ 1.0 to 1.9
<60%	~ 0.0

Assignments
Understanding of the design principles and concepts discussed in the course can only be reinforced by solving problems. Students are expected to solve all the homework/lab assignments. Late HW will be penalized 10% for each day delay.

Students must perform the work on their own development boards. The lab can be used at any time it is open and available. Lab assignment will however only be checked by the teaching assistant during the regularly scheduled lab period or by appointments and will have to answer questions. Lab reports are required.

Exams
There will be ***two*** exams. The dates and format will be announced in class.

Design Project
Students will be expected to work on a design project; they will work in groups. Each project will go through the following key steps: group formation, presentation, demonstration, and final report submission. Each group is required to submit one report.

Academic Conduct Policy
Cheating on examinations, plagiarism, falsifying reports/records, and unauthorized collaboration, access, or modifying of computer programs is considered serious breaches of academic conduct. The Oakland University Academic Conduct Policy will be followed with no exceptions. It is explained on page

93 of Oakland University 2007-'08 Undergraduate catalog and page 24 of Oakland University 2005-07 Graduate catalog. It may also be found on the OU website.

Other Policies for this Course

- It is the responsibility of the student to routinely check the course webpage for announcements, assignment, reading assignments, quizzes, etc.
- Email broadcasts will be sent through the Moodle system. Each student should ensure that these messages are sent to their current email address.
- Grades will be kept on Moodle. It is the responsibility of a student to raise any issues as soon as they occur. No changes will be made after the final project presentations.
- Permission for exceptions from the normal class work schedule must be requested in advance. Absolutely no exceptions will be made after the fact.
- Graduate students are expected to have more sophisticated final projects.
- Class grades may be curved. We reserve the right to adjust the grades of the whole class upwards or downwards by up to 20% based on class attendance, participation, and performance. Individual grades may be adjusted downwards for lack of contribution to team/group assignments. These individual grade adjustments would be based on peer evaluations completed by the students in each team.