Microprocessor-Based Design – Tentative Syllabus

EECE4534 + Lab EECE4535, Spring 14

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Lectures: **Tuesday, Friday 1:35pm – 3:15pm**
Location: ~~001 Snell Library~~ 236 Forsyth Hall map

Laboratory: TBA: **schedule will be determined during first lecture**
Location: 009 Hayden Hall

Web page: on Blackboard, plus online forum on blackboard Discussion Board

Office Hours: **Tuesday, Friday, 3:30pm – 4:30pm , 328DA**

Course Overview

Embedded systems are omnipresent in our environment, e.g. implementing media players, cell phones, or realizing complex control systems in a car. The majority of embedded systems use one or more microprocessors for control and data processing, which is assisted by some generic or specialized hardware. A successful computer engineer needs to be well versed in both software and hardware aspects to master the design and implementation of such complex embedded systems.

This course (**EECE 4534**) will introduce you to practical microprocessor-based system design issues, such as system specification, understanding hardware capabilities (e.g. embedded processor organization; addressing modes; memory hierarchy; parallel and serial bus protocols), hardware/software co-design aspects, mastering hardware/software interfaces and the design of device drivers.

The course is tightly integrated with the mandatory laboratory (**EECE 4535**) in which you have the opportunity to practically realize the theoretic aspects of the lecture. The lab has two parts. The first portion gradually introduces you to embedded systems through a set of ready made exercises (e.g. light dimmer, controlling a servo motor, voice recorder, real-time voice transmission). These exercises require you to design, construct, and debug hardware and software (C and some assembly) that runs on a common embedded platform using the BlackFin BF527 microprocessor. The second portion of the lab allows you to explore a project of your own

choosing within a team. Each team will specify, design and implement a complete embedded system, integrating hardware and software.

Topics

- Intro, Organization, Syllabus
- Embedded System Overview
  - Characteristics, Challenges, Requirements
- From Requirements to a Modular Maintainable Implementation
  - SYSTEMatic Engineering
  - Embedded System Specification, Models of Computation (MoC)
    - FSM + StateCharts / Process Models
  - Modular Design in C
  - Layered Architecture
- Embedded Systems Architecture
  - Generic + Blackfin Architecture
- Embedded Processing
  - Synchronization (e.g. Interrupts)
  - Operation Modes
  - Power Management
- Communication Systems
  - Common parallel and serial bus systems
  - Topology, Arbitration, Synchronization
- Memory Hierarchy for Performance Improvement
  - Caches, Scratch Pad, DMA
- Embedded Systems in a Loop
  - Sensors
  - Analog to Digital Conversion
  - Control Algorithm
  - Digital to Analog Conversion
  - Actuators
- Embedded Computation Optimizations

Prerequisites

- EECE 3324 - Computer Architecture and Organization
- Working knowledge of C, algorithms and data structures. A review of basic C programming is highly recommended. See for example "Thinking in C".

Textbooks

- Frederick M. Cady , **Microcontrollers and Microcomputers Principles of Software and Hardware Engineering** , Second Edition. Oxford University Press, ISBN 978-0-19-537161-1
- Resources on the web, see Course Material on Blackboard

Recommended Additional Books

- Peter Marwedel, **Embedded System Design**, Springer, 2006, ISBN 978-0-387-29237-3
- Frank Vahid, Tony Givargis, **Embedded System Design: A Unified Hardware/Software Introduction**, Wiley, Oct. 2001, ISBN 978-0471386780 link

- Wayne Wolf, **Computers as Components**, 2nd Edition, Morgan Kaufmann, 2008 link

Reference

- Michael Barr, **Programming Embedded Systems in C and C++**, O'Reilly, 1999. Online available at: Safaribooks
- Kernighan; Dennis M. Ritchie, **The C Programming Language** (2nd ed.), Prentice Hall, ISBN 0-13-110362-8 link

Homework Assignments

This course will include weekly or bi-weekly homework assignments. The homework assignments will be discussed in class and distributed on blackboard. Although discussion with your class mates is encouraged, you are expected to solve the homework assignments on your own. Please refer to the Academic Honesty section for details. Homework solutions will be collected via blackboard. They are due on 12 noon on the due date. The submission site will automatically close based on the blackboard server's time. Late assignments can not be accepted and will receive 0 points.

Labs

The course is tightly integrated with the mandatory laboratory (**EECE 4535**). Every student must have a lab partner to work during the labs. The grades for the lab reports are shared by weight. The first lab (since it is shorter) is shared equally. Each student must author two of the remaining lab reports, and co-author the other two. An authored lab report counts in full, whereas a co-authored counts 1/4th. Hence you have a chance for distinguishing yourself with your report, but are still co-responsible for your partners report.

Project

This course will include a final project about an embedded design project of your own choosing. Each student group is expected to complete an *individual* project and must include a comprehensive final report. The project report is due at the start of finals week. Intermediate milestones and deadlines will be defined. The details of the final project will be discussed in class.

Midterm

We will have a closed book midterm in class on TBA.

Final

The course will have a project final. It consists of two portions:

1. Project presentation and demonstration in last week of classes
2. Final report due in finals week

Grading

Both the **EECE 4534 – Lecture** and **EECE 4535 – Lab** receive identical grades as both components are tightly integrated. The weight distribution is as follows:

Homework Assignments:	15%
Midterm:	30%

Pre-lab Assignments:	10%
Lab Reports:	15%
Project:	30%

No makeup exams will be given. If you miss the midterm, or final you will receive 0 points. Depending on the overall performance, this will either lead to a "I" or "F" grade.

Late submissions will receive 0 points from the time the reference solution has been posted. Otherwise, a late penalty applies dependent on the submission delay as following:

< 01 hour	5%
< 24 hours	15%
< 48 hours	30%
< 72 hours	50%
>= 72 hours	100%

Academic Honesty

Plagiarism, cheating, and any form of unauthorized collaboration will not be tolerated and will be handled in accordance with University policies described in the Student Handbook. You are expected to be familiar with the University's policies about academic honesty: http://www.northeastern.edu/osccr/academichonesty.html.
Although students are encouraged to discuss some homework assignments and work together to develop a deeper understanding of the topics presented in this course, submission of others' work, efforts, or ideas as your own is not permitted. Each student is expected to prepare and submit his/her own programs, reports, drawings, and other materials unless otherwise designated as collaborative work.
Copying and sharing of student work such as computer files, documents, spreadsheets, or drawings is not allowed. If multiple students' work is suspiciously similar, a penalty may be assessed to all students involved. If a situation arises in which you are uncertain whether cooperation with another student would constitute cheating or some other violation of the honor code, please ask the instructor for guidance and clarification of these rules. Any evidence of cheating will be referred to the Office of Student Conduct.

[Thanks to Prof. Leeser for the academic honesty policy.]

Other Class Policies

For questions about class material including assignments, please use the Discussion Board on Blackboard. You may get an answer sooner, and it gives your fellow classmates the opportunity also benefit from your learning experience. I highly encourage you to read the Discussion Board and also answer questions to help your classmates.
The issuance of incomplete grades will strictly follow the College of Engineering guidelines. An incomplete will only be given for missed work at the end of the term due to illness. A request for an incomplete grade must be made two weeks before the final.

Enjoy the course!
Please contact me if you find any errors or have any constructive suggestions.