EE 3170
Microcontroller Applications

Lecture 1 – Overview & Course Logistics

Based on slides for ECE3170 by Profs. Sloan, Davis, Kieckhafer, Tan, and Cischke

Goals for week 1: Course Overview

- Present course logistics.
- Discuss presumed background.
- Introduce embedded microcomputer systems.

About Me

- Dr. Tricia Chigan
- cchigan@mtu.edu -best contact
  - When e-mailing cchigan@mtu.edu, please include
  - the course (EE3170)
  - your name, and
  - if discussing a grade, your four digit Tech ID number
- http://www.ece.mtu.edu/ee/faculty/cchigan
- EERC 712; Phone 487-2494(o)
- Office hours:
  - MWF: 9:05am-9:55am
  - other time by e-mail appointment
- My Background.....

Course Outline

- This course is a co-requisite course for the junior level core labs (e.g., EE3306).
  - A number of topics which will be covered to facilitate the lab, such as 68HC11 Operation, Assembly language & I/O.
- Required text covers material required for the Lab, and general/applied usage of microcontrollers, but does not adequately cover all material.
  - later in the semester (Weeks 12-15?) supplemental materials will be assigned.
- The last few weeks will be "high altitude" coverage of Computer Engineering terminology & concepts.
  - just enough information to allow students to understand discussions on tradeoffs between various computer system architectural decisions
  - not intended to prepare the students to participate in the design process.
- Those interested in a more in-depth examination of computer architecture are encouraged to enroll in EE3173, EE4271, CS3421 or CS4431.
Course Mission

- This course is designed to provide you with an understanding of the application of embedded microcontrollers.
- Introduces the concept, analysis, design, and application of microprocessor-based digital systems.
- Topics include microprocessor architecture, pipelining concepts, software design, input/output principles, instruction set architecture interface and ASICs.

Course Goals

- **Mastery** of the topics associated with using a microcontroller in an embedded system environment.
- **Familiarity** with differences between instruction sets, characteristics of instruction sets, RISC vs. CISC distinction and attributes.
- **Application** of 68HC11 assembly language programming including but not limited to addressing modes, polled interrupt and DMA I/O, interrupt service routines, and using on-board I/O systems.
- **Exposure** to integrated circuit design and manufacture, focused on ASICS and microprocessors.

Prerequisites by Topics

- **Mastery** of combinational logic design by Karnaugh map of 4- to 5- variable functions.
- **Mastery** of number representation in binary, octal and hexadecimal, two’s complement addition, binary multiplication and BCD addition.
- **Familiarity** with synchronous sequential logic design with D flip-flops, including finite state machines.
- **Exposure** to multiplexers, decoders, encoders and code converters.

PreReq Assessment Announcement

- Study – text/notes/exam(s) from EE2170/EE2171/EE2173, chapter 1 of Miller
- Prepare for an assessment covering
  - Combinational logic design,
  - Boolean algebra,
  - Binary and hexadecimal arithmetic,
  - Synchronous sequential logic design, incl. FSM
  - Use of hardware description languages (HDL)
- This will be assigned on Monday Sept 8th as homework and due the following Monday Sept 15th.
Texts, References, Software, etc.

- You'll also be using Motorola HC11 reference texts.
- Simulation software THRSim11 68HC11 Simulator
  - @ all ECE computer labs
  - For personal computer: email Mr. Kit Cischke (cmcischk@mtu.edu)
    (phone: 487-2011)
    (office: EERC 222)

Course Topics (I): Assembly Language

- Theory of Microprocessors (Fetch-execute cycle, pipelining)
- 68HC11 Instruction Set, Addressing Modes
- The assembly process - features of assemblers, compilers and linkers
- Stacks, subroutines, parameters and recursive programming
- Software engineering - appropriate flowcharting, documentation and project management

Course Topics (II): Embedded System Design Concepts

- System hierarchy - memory and interconnect, functional blocks, differences among microprocessors, microcontrollers, ASICS and System-On-a-Chips
- Clocks, Timers, Real-time Interrupts and Real-time operating systems
- Interrupt, Polled and DMA I/O
- Interrupt Service Handlers
- Parallel vs. Serial I/O
- Analog-to-Digital and Digital-to-Analog conversion

Course Topics (III): ASIC Fabrication

- Integrated Circuit (IC) Costs - impact of volumes and commonality
- Integrated Circuit feature sizes - impact upon size, clock and timing
- Silicon ingot production
- Lithographic techniques - visible light, UV and beyond
- System-on-a-Chip design methodology
Course Website

- [http://www.ece.mtu.edu/ee/faculty/cchigan/EE3170/](http://www.ece.mtu.edu/ee/faculty/cchigan/EE3170/)
- Course Website is where you'll find:
  - Course Syllabus
  - Lecture Notes
  - Assignments
  - Solutions
  - Grades
  - Other Useful Stuff
  - Pretty much everything you need to be successful in this class

Course Evaluation/Grading

- Homework, Programming Assignments, Quizzes: 40% (drop lowest quiz score)
- Midterm 1: 15%
- Midterm 2: 15%
- Final Exam: 30%

Grades and Grading

- Your grades on each homework & test will be online ([http://www.ece.mtu.edu/ee/faculty/cchigan/EE3170/](http://www.ece.mtu.edu/ee/faculty/cchigan/EE3170/))
  - Please check your grades (last digits of your M number) at least weekly and let me know promptly of any errors.
    - Errors must be reported within one week.
    - Show hard copy of mis-recorded grades.
- Final grade scale
  - 92.0 – 100% - A
  - 88.0 – 91.9% - AB
  - 82.0 – 87.9% - B
  - 78.0 – 81.9% - BC
  - 72.0 – 77.9% - C
  - 68.0 – 71.9% - CD
  - 60.0 – 67.9% - D
  - < 60% - F

Homework Assignments

- ~ Every other week per HW assignment
  - Programming assignment will be part of the HW
- Assigned on Web, announced in class/email
- Help you engage in course material
- Give you practical experience in assembly language programming
- You are strongly encouraged to discuss with others on homework.
  - Ask classmates who sit near you or
  - try the Learning Center (EERC 123) to find students for a study group.
  - However, copying homework is NOT ALLOWED.
Homework Submission/Solutions/Return

- Homework is due at 9 a.m., in class
  - Grading alternative 1: HW assignments will be graded out of 10 points -- 5 points for the correctness of one problem, 5 points for completeness of the rest.
  - Grading alternative 2: all problems will be graded (if there is a grader)
  - Homework 1 will be the prerequisite assessment
  - No late homework will be accepted
- Homework solutions will be posted on the web, usually by noon of the due date
- Homework will be returned in class
  - Unclaimed homework will be brought to class twice before the paper is recycled.

Quiz & Midterms & Final

- Pop quiz (~once every 2 weeks)
  - Last 5–10 minutes of the class
  - Content related to homework & reading assignments
- There will be two midterms (in EERC 214)
  - Midterm 1 - 6 p.m., Wednesday, Oct. 8
  - Midterm 2 - 6 p.m., Wednesday, Nov. 12
- The final exam will be comprehensive
  - Schedule will be announced by the registrar’s office.
  - The final exam will not be given earlier than the official time.
  - Plan to be here for your final exam
- All tests will be taken individually and will be closed book, closed notes

Help in This Course

- cchigan@mtu.edu any time
- Dr. Chigan in EERC 712, 9:05-9:55 MWF or by e-mail appointment
- Working with other students outside of class is highly encouraged and likely to benefit your grade. Try
  - Study groups
  - ECE Learning Center (EERC 123)
    - Need to check the schedule
    - STRONGLY RECOMMENDED

Succeeding in EE3170

- This is a difficult course.
  - It has gotten considerably better. Don’t get discouraged.
- Keep up with the course.
  - Attend class. (even at 8 a.m.)
  - Study the texts and notes.
  - Do assigned homework and programs.
  - Study with others.
  - Ask questions.
  - Get THRSim11 set up on your personal computers.
  - Go to http://www.textpad.com and download TextPad
Why Take This Class?
- Short answer: It’s required for a BSEE.
- But why, other than torture, is it required?
- Microcomputers are everywhere and every EE should understand
  - How to use them
  - What they’re good at and
  - What they’re not good at.

So Why are Microcomputers Everywhere?
- We can break this into four parts.
  - Why does electricity control everything?
  - Why use chips?
  - Why use processors?
  - Why use microcomputers?