Fall 2018

ECE 252 - Microprocessors

Mahmoud Al-Quzwini

ECE 252 Microprocessors
3.0 credits

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Office Hours: F 11:00 AM - 1:00 PM, and by appointment (e-mail). Room ECEC 314

Textbook: Yifeng Zhu, *Embedde Systems with ARM® Coetex-M3 Microcontrollers in Assembly Language and C,* Second Edition, E-Man Press LLC, 2015.
(It is not necessary to purchase the textbook as it is not the optimal fit for the class and students' background, lectures and assignments are quite enough)
You can access more details about ARM instructions at the www.arm.com website, use the following link to Cortex M3 documentations
http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.set.cortexm/index.html

Development Tools: KEIL, a Windows-oriented and freely distributed tool can be used for assembling and emulating programs.

Course Description:

This course introduces the students to the assembly language programming of ARM Cortex-M3 microprocessor, it emphasizes the importance of learning assembly programming, and explains microprocessor alphabet and data presentation. Then it discusses topics including ARM instruction format, data processing instructions, memory access instructions, conditional and branching instructions, stacks and subroutine instructions. The course covers also the topics related to input/output operations and programming. The students learn to use a windows based development tool from ARM, called KEIL IDE, to run assembly codes. The course also involves a design project in which the students use the FRDM-KL25Z ARM development board to control a real life process.

Prerequisite: ECE students and none ECE students - ECE 251 **Co-requisite**: none

Computer Usage in Course: latest version of ARM KEIL IDE is used for both simulating assembly programs and to edit, compile, link and download the assembly code to the FRDM-KL25Z board when implementing the course project.

Course Learning Outcomes (CLOs):

The student will be able to:

1. Understand the stages of executing high-level codes all the way down to the machine codes, the importance of assembly programming pertaining to using hardware components more efficiently than high-level codes leading to faster execution.
2. Understand microprocessor alphabet and data presentation. Understand how to utilize microprocessor flags to interpret signed and unsigned numbers.
3. Understand the ARM Cortex-M3 assembly instructions format, understand and utilize data processing, memory access, conditional, branching, subroutines and stack instructions. Understand how to interpret the results of assembly instructions.
4. Understand how to combine assembly instructions to build and run assembly codes to handle basic arithmetic problems.
5. Understand how to configure an ARM based microcontroller for input output operations and utilize this microcontroller to control a real life process.

Relevant Student Outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering (CLOs 1, 2, 3)
(b) an ability to design and conduct experiments, as well as to analyze and interpret data (CLOs 3, 4)
(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 (CLOs 4, 5)
(f) an understanding of professional and ethical responsibility (CLOs 5)
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context (CLO 5)
(i) a recognition of the need for, and an ability to engage in life-long learning (CLOs 1, 4, 5)
(j) a knowledge of contemporary issues (CLO 4, 5)
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (CLOs 4, 5).

Schedule:

Week	Topics	Book Section
1	Introduction to microprocessor systems, embedded systems, examples and applications of embedded systems with ARM microprocessors, memory organization, high level versus assembly languages, assembly language program execution cycle.	Ch.1
1	Data representation, unsigned & signed integers representation, carry, borrow and overflow flags, basic arithmetic operations with signed integers	Ch. 2
2	1- ARM registers, Program Counter and program execution 2- ARM instruction set architecture, ARM instruction format 3- ARM arithmetic and logical instructions, program status register, installation of the ARM Keil simulator.	Ch. 3 Ch.4
3	1- Barrel shifter. 2- Logic Instructions 3- Data movement instructions	
4	1- Immediate numbers, shifting of immediate numbers 2- Masks implementation	
5	Review to midterm exam-1	
6	Midterm exam-1	
7	1- Load and store instructions, pseudo instructions, memory addressing, relative addressing 2- Layout of ARM assembly program, ARM directives	Ch.5
8	Comparison instructions, conditional statements, and branch instructions	Ch.6
9	Loops and repetition	Ch.6
10	Review to midterm exam-2	
11	Midterm exam-2	
12	General Purpose Input Output (GPIO) programming	
13	Stack memory and subroutines	Ch.8
14	Project presentation	

Grading Policy

1. Midterm Exam-1 20%
2. Midterm Exam-2 20%
3. Project 20%
4. Homework 10%
5. Final Exam 30%

- All exams are closed book and closed notes. No electronic devices of any kind (including calculators) is allowed.
- Extra credits for class participation and discussion will be added

Exam Make up

No make up for the midterms is offered. If you miss one midterm exam because of documented excuse, then your grade will be computed as shown below. Documented excuse requires a note from the office of the dean of students. Missed midterm grade= 50% of the other midterm+33% of the final exam.

Homework Assignments

Homework assignment is assigned each week and due one week later at the beginning of the class. Late submittal is not accepted. Solutions to be distributed at that time. Graded homework is returned one week after submission.

Honor Code

The NJIT Honor Code will be upheld, and any violation will be brought to the immediate attention of the Dean of student

Supplementary Reading

Kris Schindler, *Introduction to Microprocessor Based Systems Using The ARM Processor*, Second Edition, Pearson Learning Solutions, 2013.