ECE 252

ECE 252 Microprocessors
3.0 credits
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Office Hours: WF 12:00-1:00 PM, and by appointment (e-mail). Room ECEC 310
Textbook: Daniel W. Lewis, *Fundamentals of Embedded Software with the ARM® Cortex-M3*, Second Edition, Pearson, 2013
Development Tools: Keil, a Windows-oriented and freely distributed tool can be used for assembling and emulating programs.
Course Description: An introduction to microprocessor system organization and assembly language programming. The course covers the architecture, instruction set and assembly language of the ARM® Cortex-M3 microprocessor. Other topics included are memory organization, input/output interfacing, interrupt processing as well as exception processing. The problems associated with the design of a single board computer are also covered. Co-listed as CoE 252.
Prerequisite: ECE 251. Required course.

Specific course learning outcomes
Upon successfully completing the course a student is able to:

#	Outcome
1	Write simple programs in ARM® assembly language.[1]
2	Read and understand the logic flow in a processor board schematic.
3	Read and understand Motorola HEX S-files.
4	Hand-assemble op-codes into machine language form.
5	Understand and use ARM® addressing modes.
6	Understand and use ARM® conditional and unconditional branch instructions.
7	Understand and use shift and rotate instructions for bit manipulations.
8	Understand and use AND and OR instructions for bit masking.
9	Understand the distinctions between ASCII, BCD and packed BCD data.
10	Understand the function and use of the stack.
11	Understand exception processing, both software and hardware.
12	Understand and use number base conversions and IEEE floating-point format.
13	Understand and use memory address decoding conventions. Includes unique and non-unique decoding.
14	Understand and use timing diagrams and wait states.
15	Understand and use serial port data transmission and implementation.

[1]Using Keil assembler and emulator

General student outcomes addressed by the course

(a) An ability to apply knowledge of mathematics, science and engineering (1-15)

(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 (1, 2, 5-11, 13-15)

(e) An ability to identify, formulate, and solve engineering problems (1-15)

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (1-15)

Schedule:

Week	Topics	Book Sections
1	Installation of Keil tools. Introduction to ARM® architecture. Familiarization with ASCII table and Motorola HEX. Show use of two-pass assembler. Demonstrate simple hand-assembly.	
2	Assembler directives, labels, opcodes and operands. ARM® instruction set. Addressing modes. Difference between arithmetic and logic instructions and their effects on the flags.	
3	Continue with addressing modes, sign extension, looping, and other matters pertaining to assembly language programming. Introduction to stack operation and subroutine calls and returns.	
4	Emphasize distinction between signed and unsigned comparison branches. Review for Exam 1.	
5	Exam 1. Start exception processing, the supervisor and user modes. Study MONITOR program exception structure.	
6	Exception handling and hardware. Introduction to the 74LS148 decoder chip.	
7	Conversion from ASCII to BCD and Packed BCD and back again.	
8	Packed BCD arithmetic. Review for Exam 2. Exam 2	
9	Numerical base conversions and IEEE floating point standard.	
10	Proper subroutine parameter handling. Reentrancy and the use of stack frames.	
11	Hardware interfacing in the context of the SBC schematic.	
12	Continue with non-unique (partial) address bus decoding.	
13	External interface timing diagrams. WAIT state generation.	
14	Serial port interface and its clock requirements. Other serial interfaces (USB). Review for Final	

Homework Policy

The list of problems for each assignment is posted to Moodle. A significant number of problems are assigned each week. They consist of questions from the text and programming examples.

Grading Policy

1. Homework 10%
2. Exam 1 30%
3. Exam 2 30%
4. Final Exam 30%

Tests and final exam are closed book and notes. Students will be given a handout containing all information necessary to solve the problems.

Test grading: Full credit – for a detailed correct solution showing all steps. Partial credit – for partial answers. Answers with no work (even if correct) will receive minimal or no credit.

Honor Code

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