ECE 242 - Digital Computers and Computing

Credits: 3, **Contact Hours:** Two 75 minute lecture sessions per week.

Coordinator: S. Borkar, Senior Lecturer of ECE

Textbook: T. Harman and D. Hein, *The Motorola MC68000 Microprocessor Family*, Prentice-Hall, 2nd Edition, 1996.
Robert Britton, MIPS Assembly Language Programming, Prentice Hall, 2004, ISBN 0-13-142044-5

2019 Catalog Data: ECE 242: Digital Computers and Computing Basic concepts in computer architecture, organization, and programming, including: integer and floating point number representations, memory organization, computer processor operation (the fetch/execute cycle), and computer instruction sets. Programming in machine language and assembly language with an emphasis on practical problems. Brief survey of different computer architectures. Motorola 68000 (CISC) microprocessor and MIPS (RISC) processor instruction set and programming models. Prerequisites: CS 105, ECE 218. (3-0-3)

Prerequisites or co-requisites by topic: Digital Hardware Design, Basic Software Programming

Enrollment: Required course for CPE and EE majors

Specific outcomes of instruction:
After completing this course, the student should be able to do the following:

1. List the essential parts of a typical digital computer processor unit.
2. Describe the format of a typical digital computer instruction (Machine code).
3. State the process of instruction execution.
4. Write programs in assembler language.
5. Use subroutines for repetitive tasks.
6. Utilize indirect addressing in various program applications (pointers, etc.)
7. Describe the importance of an operating system.
8. Write programs to convert numbers between bases to prepare for input and output.
9. Use input and output functions of a computer operating system.

Relationship of ECE 242 specific outcomes of instruction to student outcomes:

	Student Outcomes	**Course Goals**
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1, 2, 3, 4, 5, 7
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	1, 5, 6, 8
3	An ability to communicate effectively with a range of audiences	3, 4
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	1, 3, 4, 5, 6, 8, 9

Topics:

- Introduction, Number Systems (0.5 week)
- Basic Computer Organization, MC68000 Microprocessor (0.5 week)
- MC68000 Registers, Memory, Instructions (0.5 week)
- Machine Code (0.5 week)
- Addressing Modes (0.5 week)
- Simulator, Machine-code Program (0.5 week)
- Source-code Program, Assembler (0.5 week)
- Program Counter (0.5 week)
- Assembly-language Program, Assembler Directives, .LIS and .H68 Files (0.5 week)
- Arithmetic and Logic Operations (0.5 week)
- Jump and Branch Instructions (0.5 week)
- Status Register (0.5 week)
- Conditional Branch Instructions (0.5 week)
- Compare and Test Instructions (0.5 week)
- Indirect Addressing, Move and Add Variations (0.5 week)
- Stack Pointer (0.5 week)
- Subroutines (0.5 week)
- Operating System and its Subroutines (0.5 week)
- Shift and Rotate Instructions (0.5 week)
- Conversions between Number Bases (0.5 week)
- Vector Table, Traps, Interrupts (0.5 week)
- Intro to RISC and MIPS Architectures (0.5 week)
- RISC and CISC comparison (0.5 week)
- RISC Architecture (Registers, Integer multiply unit and Registers) (0.5 week)
- Programming Model (Addressing Modes, Data types in Memory and Registers) (0.5 week)
- MIPS Instruction Set Overview (0.5 week)
- The SPIM Assembler and Simulator Usage (Segment and Linker Directives, Data Directives, SPIM syscalls) (0.5 week)
- The MIPS Instruction Set (Load, Store, and Data Movement, Arithmetic Instructions, Comparison Instructions, Branch and Jump Instructions) (0.5 week)
- Exception Handling & Interrupts (0.5 week)
- Address Space (Kernel vs. User Privilege Level) (0.5 week)

Laboratory topics: Not / Applicable

Prepared by: S. Borkar **Date:** February 27, 2020