ECE 242 - Digital Computers and Computing

2013 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)

Enrollment: Required course for EE majors.


Coordinator: S. Borkar, Senior Lecturer, Department of ECE

Course goals: 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.

Prerequisites by topic:
1. Boolean algebra, Combinational logic design
2. Basic programming

Lecture schedule: Two 75-minute sessions per week.
Laboratory schedule: None.

Topics:
1. Introduction, Number Systems (0.5 week)
2. Basic Computer Organization, MC68000 Microprocessor (0.5 week)
3. MC68000 Registers, Memory, Instructions (0.5 week)
4. Machine Code (0.5 week)
5. Addressing Modes (0.5 week)
6. Simulator, Machine-code Program (0.5 week)
7. Source-code Program, Assembler (0.5 week)
8. Program Counter (0.5 week)
9. Assembly-language Program, Assembler Directives, .LIS and .H68 Files (0.5 week)
10. Arithmetic and Logic Operations (0.5 week)
11. Jump and Branch Instructions (0.5 week)
12. Status Register (0.5 week)
13. Conditional Branch Instructions (0.5 week)
14. Compare and Test Instructions (0.5 week)
15. Indirect Addressing, Move and Add Variations (0.5 week)
16. Stack Pointer (0.5 week)
17. Subroutines (0.5 week)
18. Operating System and its Subroutines (0.5 week)
19. Shift and Rotate Instructions (0.5 week)
20. Conversions between Number Bases (0.5 week)
21. Vector Table, Traps, Interrupts (0.5 week)
22. Intro to RISC and MIPS Architectures (0.5 week)
23. RISC and CISC comparison (0.5 week)
24. RISC Architecture (Registers, Integer multiply unit and Registers) (0.5 week)
25. Programming Model (Addressing Modes, Data types in Memory and Registers) (0.5 week)
26. MIPS Instruction Set Overview (0.5 week)
27. The SPIM Assembler and Simulator Usage (Segment and Linker Directives, Data Directives, SPIM syscalls) (0.5 week)
28. The MIPS Instruction Set (Load, Store, and Data Movement, Arithmetic Instructions, Comparison Instructions, Branch and Jump Instructions) (0.5 week)
29. Exception Handling & Interrupts (0.5 week)
30. Address Space (Kernel vs. User Privilege Level) (0.5 week)
31. Test (1 week)

Computer usage:
Students use an assembler and simulator for the MC68000 and for SPIM which run on PCs.

Laboratory topics: None.

Relationship of ECE 242 Course Goals to Student Outcomes:

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Course Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Apply knowledge of math, engineering, science</td>
<td>1, 2, 3, 4, 5, 7</td>
</tr>
<tr>
<td>b. Design and conduct experiments / Analyze and interpret data</td>
<td></td>
</tr>
<tr>
<td>c. Design system, component, or process to meet needs</td>
<td>4, 6, 8</td>
</tr>
<tr>
<td>d. Function on multi-disciplinary teams</td>
<td></td>
</tr>
<tr>
<td>e. Identify, formulate, and solve engineering problems</td>
<td></td>
</tr>
<tr>
<td>f. Understand professional and ethical responsibility</td>
<td></td>
</tr>
<tr>
<td>g. Communicate effectively (written / oral)</td>
<td></td>
</tr>
<tr>
<td>h. Broad education</td>
<td></td>
</tr>
<tr>
<td>i. Recognize need for life-long learning</td>
<td></td>
</tr>
<tr>
<td>j. Knowledge of contemporary issues</td>
<td></td>
</tr>
<tr>
<td>k. Use techniques, skills, and tools in engineering practice</td>
<td>4, 5, 6, 8, 9</td>
</tr>
</tbody>
</table>

Prepared by: S.R. Borkar
Date: October 16, 2013