Catalog Course Description:

Basic Microprocessor architecture with particular emphasis on the Motorola MC68HC11. Topics include assembly language programming, C programming, branching, stacks, interrupts, and interfacing techniques with many commonly used integrated circuits, interface chips, e.g., the PIA (Parallel Interface Adapter), ACIA (Asynchronous Communication Interface Adapter), and programmable timers.

Entry Level Standards:

The student must have an understanding of number systems, basic logic gates, combinational logic circuits, flip-flops, and sequential circuits.

Prerequisites:

EET 1310

Textbook(s) and Other Course Materials:


I. Week/Unit/Topic Basis:

The following is intended as a guide to the instructor. The material covered in this course may be changed by the instructor depending upon the progress, etc., of the class.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>1-2</td>
<td>Introduction to the MC68HC11.</td>
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<td>3-4</td>
<td>68HC11 Assembly Language Programming.</td>
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<tr>
<td>5-6</td>
<td>Data Structures and Subroutine Calls.</td>
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<td>7-8</td>
<td>C Programming Language.</td>
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<tr>
<td>9-10</td>
<td>Operation Modes and Memory Expansion.</td>
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<td>11</td>
<td>Interrupts and Resets.</td>
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<td>12</td>
<td>Parallel I/O Ports.</td>
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<tr>
<td>13</td>
<td>68HC11 Timer Functions.</td>
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</tbody>
</table>
II. Course Objectives*:

A. Understand the basic architecture of microprocessors. A, B, C, D, E
B. Understand the instruction set of microprocessors. A, B, C, D, E
C. Understand the function of all control bus lines. A, B, C, D, E
D. Understand the various addressing modes. A, B, C, D, E
E. Understand the function and operation of interrupts. A, B, C, D, E
F. Understand the function and operation of the stack. A, B, C, D, E
G. Program an EPROM and interface it to the CPU. A, B, C, D, E
H. Interface switches and LEDs to the CPU. A, B, C, D, E
I. Understand the advantages of the PIA, interface it with the CPU, and write programs which utilize the PIA. A, B, C, D, E
J. Demonstrate, as an individual and as a team member, library/information skills, time management skills, problem-solving skills, material management skills, and communication skills. D, F, G, H, I, J, K

* Letters after course objectives reference EET Program Outcomes (as required by ABET).

III. Instructional Processes*:

Students will:

1. Participate in classroom discussions which challenge their abilities to think creatively and visualize complex spatial and mathematical relationships to solve problems. Mathematics Outcome

2. Work in teams to conduct laboratory experiments and also to solve special problem assignments. These activities are designed to foster interpersonal skills in teamwork and develop and enhance leadership skills, students’ abilities to express ideas, and students’ abilities to reach consensus solutions for the team through negotiation. Communication Outcome; Mathematics Outcome; Active Learning Strategy

3. Use electronic test equipment to test electrical circuits constructed from schematics in the laboratory and to acquire data. Use computers with applications software to simulate, analyze, and predict the behavior of electrical circuits. Compare expected responses to experimental responses of electrical circuits. Use the Internet for special assignments such as locating data sheets on electronic components. Use computers with word processing software to prepare reports. Technological Literacy Outcome; Mathematics Outcome

4. Prepare reports on laboratory experiments which include methodology, mathematical analyses of electrical circuit models, a comprehensive comparison of calculated results with experimental results, and conclusions. Communication Outcome; Mathematics Outcome; Technological Literacy Outcome
5. Discuss the importance of personal qualities such as personal responsibility, time management principles, self-esteem, sociability, self-management, integrity and honesty in school and in the workplace, and dynamics of change in the workplace. Social and Behavioral Science Outcome; Transitional Strategy

*Strategies and outcomes listed after instructional processes reference TBR's goals for strengthening general education knowledge and skills, connecting course work to experiences beyond the classroom, and encouraging students to take active and responsible roles in the educational process.

IV. Expectations for Student Performance*:

Upon successful completion of this course, the student should be able to:

1. Define the terms: microprocessor, microcomputer, input, output, I/O, I/O device, I/O port, instruction, program, stored program concept, word, byte, MPU, ALU, operand, memory, read, write, RAM, fetch, execute, MPU cycle, mnemonic, opcode, and bus.  

2. Explain the purpose of the following circuits in a typical microprocessor; accumulator, program counter, instruction decoder, controller sequencer, data register, and address register.  

3. Use a simplified block diagram of a microprocessor, trace the data flow that takes place between the various circuits during the execution of a simple program.  

4. Describe the difference between inherent, immediate, and direct addressing.  

5. Write simple, straight-line programs that can be executed by the Microprocessor Trainer.  


7. Explain the purpose of conditional and unconditional branching.  

8. Trace the data flow during the execution of a branch instruction when using the block diagram of a microprocessor.  

9. Compute the proper relative address for branching forward or backward from one point to another in a program.  

10. Explain the purpose of the carry, negative, zero, and overflow flags. Give an example of a situation that can cause each to be set and another example that will cause each to clear. List eight instructions that test one of these flags.  

11. Write simple programs that use indexed and extended addressing.  

12. Find the opcode, number of MPU cycles, number of bytes, and effects on the condition code flags of every instruction discussed in this unit, using the MC68HC11 instruction set card as a guide.  

13. Write simple programs that can store data in--and retrieve data from--the stack.  

14. Write programs that use the stack and indexing to move a list from one place in memory to another.  

15. Explain the operations performed by each of the following instructions: PULA, PULB, PSHA, PSHB, DES, INS, LDS, STS, TXS, and TSX.
16. Define stack, subroutine, nested subroutine, interrupt, interrupt vector, and interrupt masking. F

17. Write programs that use subroutines and nested subroutines. F

18. Explain the operations performed by each of the following instructions: JMP, JSR, BSR, and RTS. B

19. Describe how the MC68HC11 MPU performs input and output operations. C

20. Draw flowcharts depicting the sequence of events that occur during reset, non-maskable interrupt, interrupt request, software interrupt, return from interrupt, and wait for interrupt. E

21. Explain the operation performed by each of the following instructions: WAI, SWI, RIT, SEI, and CLI. E

22. Program and EPROM and interface it to the trainer. H

23. Interface Switches and LEDs to the trainer and write a program to read the switches and output to the LEDs. I

24. Interface the PIA to the MC68HC11 so that the PIA port A and B registers are located at consecutive memory addresses. J

25. Write programs to initialize the PIA using the MC68HC11 index register. J

26. Use the PIA control lines to communicate with external devices. J

27. Write programs to initialize the PIA for several I/O control applications (polling, complete handshaking, partial handshaking). J

28. Perform complete input and output handshakes using the PIA control lines. J

*Letters after performance expectations reference the course objectives listed above.

V. Evaluation:

A. Testing Procedures: 80% of grade

The evaluation in the classroom grade will be determined by a combination of tests, homework, and a final exam. Pop quizzes may also be used at the discretion of the instructor. The percentage that each of these factors count and the frequency of quizzes, tests and homework is left to the discretion of the instructor, but the following is offered as a guide:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Tests</td>
<td>40%</td>
</tr>
<tr>
<td>Homework/Quizzes</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>20%</td>
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</table>

B. Laboratory Expectations: 20% of grade

The laboratory grade will be determined by a combination of performance (including teamwork) within the lab and the degree of comprehension demonstrated in the lab report. There will be at least ten labs during the semester to go along with the classroom material. The
following is offered as a guide for the instructor:

- Performance in labs (subjective): 20%
- Lab Reports (neatness and content): 60%
- Computer Program (or application): 10%
- Laboratory Test: 10%

Laboratory topics may vary at the discretion of the instructor, but will be related in a timely manner to the course work.

C. Field Work:

N/A

D. Other Evaluation Methods:

N/A

E. Grading Scale:

- 93 - 100  A
- 88 - 92  B+
- 83 - 87  B
- 78 - 82  C+
- 70 - 77  C
- 60 - 69  D
- Below 60  F

VI. Policies:

A. Attendance Policy:

Pellissippi State Technical Community College expects students to attend all scheduled instructional activities. As a minimum, students in all courses must be present for at least 75 percent of their scheduled class and laboratory meetings in order to receive credit for the course. Individual departments/programs/disciplines, with the approval of the vice president of Academic and Student Affairs, may have requirements that are more stringent.

Unexcused absences and class or lab work not made up in a timely manner may very well result in a reduced grade for the course or in failure of the course. It is the student's responsibility to be present when the instructor informs the class of attendance and work requirements, or otherwise the student must contact the instructor for this information.

**EET Class Attendance for Lab**

Attendance is required to all lab sessions unless excused by the instructor. Students missing more than four unexcused sessions will receive an "F" and no credit will be received. Students tardy past half an hour will be considered absent.

B. Academic Dishonesty:

Academic misconduct committed either directly or indirectly by an individual or group is subject to disciplinary action. Prohibited activities include but are not limited to the following practices: Cheating, including but not limited to unauthorized assistance from material, people,
or devices when taking a test, quiz, or examination; writing papers or reports; solving problems; or completing academic assignments. In addition to other possible disciplinary sanctions that may be imposed as a result of academic misconduct, the instructor has the authority to assign either (1) an F or zero for the assignment or (2) an F for the course.

C. Accommodations for disabilities:

If you need accommodations because of a disability, if you have emergency medical information to share, or if you need special arrangements in case the building must be evacuated, please inform the instructor immediately. Please see the instructor privately after class or in his/her office. Students must present a current accommodation plan from a staff member in Services for Students with Disabilities (SSWD) in order to receive accommodations in this course. Services for Students with Disabilities may be contacted by going to Goins 127 or 131 or by phone: 694-6751(Voice/TTY) or 539-7153.