SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	EMBEDDED MICROCONTROLLERS I		
CODE NO. :	ELN335	**SEMESTER:**	5
PROGRAM:	ELECTRICAL ENGINEERING TECHNOLOGY – PROCESS AUTOMATION		
AUTHOR:	Mark Allemang		
DATE:	May 2016	**PREVIOUS OUTLINE DATED:**	June 2015
APPROVED:	*"Corey Meunier"*		May 2016
	CHAIR		**DATE**
TOTAL CREDITS:	3		
PREREQUISITE(S):	ELN115 – Digital Integrated Electronics		
HOURS/WEEK:	3		

I. COURSE DESCRIPTION

This course introduces students to Assembly Language Programming for the Motorola MC68HC11 Microcontroller. As a first course in assembly language programming it is necessary to study the fundamentals of microprocessor architecture in addition to the specific registers, addressing modes and instructions of the microcontroller. Initially the concentration is on the development of simple instruction sequences using a PC based assembler and microcontroller simulator. Later, the students will download and test their programs on a functioning 68HC11 microcontroller board

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. Describe the architecture of the 68HC11 microcontroller including its registers, memory organization, the stack and internal organization.

Potential Elements of the Performance:

- Sketch the Software model of the 68HC11 Microcontroller.
- List and explain the nature and functioning of the 68HC11 internal registers.
- Explain the nature of memory and memory variables including addresses and data.
- Utilize the stack as a temporary storage mechanism

Reference: Text Chapt. 1,6.

2. Demonstrate the use of the assembler and simulator to assemble, load, save, unassemble, single step, examine and troubleshoot simple instruction sequences.

Potential Elements of the Performance:

- Compare and contrast machine code and assembly language
- Explain and demonstrate the method of converting assembly language instructions to machine language.
- Demonstrate the use the simulator to:
- examine and modify the contents of memory and registers
- Assemble and Unassemble machine instructions
- execute and single-step through programs and other tasks required in program debugging.

Reference: Text Appendix A.

3. Write assembly language programs utilizing the subset of

commonly used 68HC11 instructions and memory addressing modes to solve simple problems.

Potential Elements of the Performance

The student will write code which demonstrates the operation of the following groups of instructions:

		Text Reference
a)	Data transfer instructions	3.2,
b)	Arithmetic instructions	3.3, 3.4
c)	Logic instructions	3.5
d)	Shift and rotate instructions	3.6
e)	Flag-control instructions	3.8
f)	Compare instructions	4.4
g)	Branch instructions	4.1,4.2
h)	Subroutine handling	6.

Students will write programs to solve assigned problems using the instructions and addressing modes most appropriate to the task.

4. Write simple programs which utilize the various ports in order to interface to digital hardware.

Potential Elements of the Performance:

- Explain the input/output system of a 68HC11 including basic parallel input/output, analog to digital and if time permits the Timer subsystem
- Write programs to control LED's on the 68HC11 development systems or equivalent simulator
- Write programs to read in and test the status of switches (DIP or otherwise) on the 68HC11 development systems or equivalent simulator.
- Write programs to sense the position of a potentiometer

Reference: Chapt. 9

5. Utilize Interrupts as a way to sense an external event.

Potential Elements of the Performance:

- Use the IRQ interrupt to cause an event to occur while the microcontroller is running another program.
- Write initialization and servicing code to process an interrupt
- Differentiate between EDGE Triggered and Level triggered interrupts.

Reference: Chapt. 10

6. Use the onboard debug monitor program of the microcontroller.

Potential Elements of the Performance:

- Use the BUFFALO monitor to perform various functions in the program development/debug phase.

Reference: Chapt. 1.

III. TOPICS:

1. 68HC11 Organization and Registers.
2. 68HC11 Addressing Modes.
3. The use of the assembler and simulator to assemble and troubleshoot simple programs.
4. Instruction Set of the 68HC11 Microcontroller.
5. Input/output programming.
6. Interrupts
7. Buffalo Monitor

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

TEXT BOOK:

"The Technicians guide to the 68HC11 Microcontroller"
by Daniel J. Black., Delmar Publishing ISBN 07668-1715-6

V. EVALUATION PROCESS/GRADING SYSTEM:

3 WRITTEN TESTS	65%
LAB PROJECTS/ASSIGNMENTS	35%

NOTE: It is required to achieve a passing grade (50%) in both the theory and the lab part of this course. For example, it is not possible to pass the course if a student has a failing average in the three written tests but is passing the lab portion, (or vice versa). Written tests constitute the theory portion of the mark.

The following semester grades will be assigned to students:

Grade	**Definition**	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded

	subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Attendance:

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

Other (course specific):

It is acceptable that students consult with each other in relation to their assigned problems. However, it is unacceptable to copy programs written by someone else and submit them as your own work. Where plagiarism or copying is found and it is impossible to determine whose original work it is, a mark of zero will be assigned to all assignments involved.

Attendance to scheduled lab activities is compulsory, unless permission has been granted by the instructor. Lab attendance and final grade are directly related. If a student arrives late for, or is not continuously present and actively participating at (scheduled breaks excepted), a scheduled lab class he/she will be considered absent for the entire class and will not be permitted to submit the associated lab report.

The student must maintain a minimum 50% average in **both** the **theory** portion **and lab** portion of the class in order to receive a passing grade. If a student misses a test/lab he/she must have a valid reason (i.e. medical or family emergency – documentation may be required). In addition, the instructor **must** be notified **prior** to the test or lab sitting. If this procedure is not followed the student will receive a mark of zero on the test/lab with no make-up option. Students may not submit lab reports for labs in which they were not in continuous attendance. Lab reports not submitted by the assigned deadline will receive a grade of 0.

Make-ups for up to 2 missed labs (only with valid reason and documentation) will be done as a lab test based on lab exercises done throughout the semester so that the same test may be used for multiple students who may have missed different labs. This lab test will be done during the last week of the semester. If more than two labs are missed (with valid reason and documentation) the instructor may use a lab test as outlined above or assign an X grade. The decision of lab test or X grade will be made solely by the instructor. Make-ups for missed tests (only with valid reason and documentation) will be written the week following the end of the semester. If this is not practical for the instructor an X grade may be issued.

If a student misses class time due to sickness, family emergency or other reason beyond his/her control the student must at his/her first opportunity meet with the course faculty to discuss if the missed time has placed the student at an increased risk of failing. The student must follow up the meeting by emailing the faculty with a summary of the meeting's discussions. Documentation validating the missed time may be required.

Use of cell phones/PDAs for any form of communication (voice, text…) during class or lab time is strictly prohibited. Cell phones/PDAs must be silenced during regular class and lab times and *must be turned off and kept out of sight during test (and quiz) sittings. Failure to follow the latter requirement during a test sitting will result in a grade of 0 being assigned.*

Students may not wear earphones of any kind (i.e. for play back of recorded music/voice) during lab activities or test sittings. This does not include hearing aids required for hearing impaired.

Students are expected to maintain an active Sault College email account. They are required to check this email account daily. The instructor may announce details of lab and test requirements and scheduling through the Sault College email system (as well as sharing other important information).

VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located in D2L and on the portal form part of this course outline.