SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

Sault College

COURSE OUTLINE

COURSE TITLE:	EMBEDDED CONTROLLERS		
CODE NO. :	CST240	**SEMESTER:**	4
PROGRAM:	COMPUTER ENGINEERING TECHNICIAN /TECHNOLOGY		
AUTHOR:	MARK ALLEMANG		
DATE:	JAN, 2004	**PREVIOUS OUTLINE DATED:**	JAN, 2002
APPROVED:			
	_____		_____
	DEAN		**DATE**
TOTAL CREDITS:	4		
PREREQUISITE(S):	CST202		
HOURS/WEEK:	4		

I. COURSE DESCRIPTION:

This course introduces the student to embedded controller circuits and subsystems. Microcontroller system components will be studied and practical lab exercises based on the Motorolla 6811 will reinforce the theory. Digital electronics is studied in the context of building microcontroller-based circuits to control and sense real world devices such as lamps, relays, motors, proximity and temperature sensors.

II. LEARNING OUTCOMES AND POTENTIAL ELEMENTS OF THE PERFORMANCE:

A. Learning outcomes:

1. Describe the organisation of typical microcontroller systems as implemented with address, data and control busses.
2. Connect and write software to control various types of devices including lights, motors, temperature sensors keypads etc.
3. Implement I/O interfacing techniques including handshaking, polling and interrupts, and describe the operation of the devices used to support these methods.
4. Describe and utilize the microcontroller timer/counter subsystem
5. Utilize schematics and a logic analyser to analyse the subsystems within a complete computer system such as the Handyboard.

Learning Outcomes and Potential Elements of the Performance:

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

1. Describe the organisation of typical microcontroller systems as implemented with address, data and control busses.

Potential Elements of the Performance:

- Describe the general nature and detailed operation of address, data and control busses in a microcontroller system.
- Describe and construct circuits that utilize flip-flops, buffers and transceivers in computer systems.
- Discuss the need for 3-state logic and the use of 3-state devices in computer systems in general.
- Describe and construct an address bus decoder, input port and output port.
- Analyze the memory address decoder used in an example microcontroller based system

This learning outcome will constitute approximately 25% of the course.
Reference: Text chapt 8.

2. Connect and write software to control various types of devices including lights, motors, temperature sensors keypads etc.

Potential Elements of the Performance:

- Connect LEDs to the microcontroller and write software to control them
- Connect electrical switches/keypads to the microcontroller and write software to make decisions based on their settings
- Connect a temperature sensor to the analog input port of a microcontroller and write software to read its value and convert to engineering units.

This learning outcome will constitute approximately 25% of the course.
Reference: Text Chap. 9,11

3. Implement I/O interfacing techniques including handshaking, polling and interrupts, and describe the operation of the signals used to support these methods.

Potential Elements of the Performance:

- Describe the need for handshaking when performing parallel data transfer
- Write software to poll an input device for input and then
- Use an interrupt to accomplish the same result in a more efficient manner
- Describe how handshaking and interrupts can be combined to perform efficient data transfer

This learning outcome will constitute approximately 20% of the course.
Reference: Text Chap. 10

4. Describe and utilize the microcontroller timer/counter subsystem

Potential Elements of the Performance:

- Describe the operation of the timing subsystem for the microcontroller
- Describe how input events can be timed and counted
- Describe how output events can be made to occur at specific times
- Utilize the timer counter to implement a pulse width modulated signal and describe how that can be used to control motor speed

This learning outcome will constitute approximately 20% of the course.
Reference: Text Chap. 12

6. Utilize schematics and a logic analyser to analyse the subsystems within a complete computer system such as the Handyboard.

Potential Elements of the Performance:

- Using the Handyboard schematics, describe the operation of the data bus, address bus and decoder, memory expansion,
- Utilize a logic analyser to capture various related signals in the handyboard

This learning outcome will constitute approximately 10% of the course.
Reference: Instructor handouts.

III. TOPICS TO BE COVERED:

1. The bus subsystem
2. Simple Input/Output programming
3. Polling, Interrupts and handshaking
4. The Timer subsystem.
5. The Handyboard

IV. REQUIRED STUDENT RESOURCES/TEXTS:

1) TEXT BOOK: **"The Technicians guide to the 68HC11 Microcontroller"**
by Daniel J. Black

V. EVALUATION PROCESS/GRADING SYSTEM:

3 WRITTEN TESTS	60%
LAB PROJECTS	35%
QUIZZES/ASSIGNMENTS	5%

(The percentages shown above may vary slightly if circumstances warrant.)
Special Note: It is necessary for students to have a passing grade in the written test portion of the course before they will be eligible to pass the course.
The following semester grades will be assigned to students in postsecondary courses:

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:

Special Needs:
If you are a student with special needs (e.g. physical limitations, visual impairments, hearing impairments, or learning disabilities), you are encouraged to discuss required accommodations with your professor and/or the Special Needs office. Visit Room E1101 or call Extension 493 so that support services can be arranged for you.

Retention of Course Outlines:
It is the responsibility of the student to retain all course outlines for possible future use in acquiring advanced standing at other postsecondary institutions.

Plagiarism:
Students should refer to the definition of “academic dishonesty” in *Student Rights and Responsibilities*. Students who engage in “academic dishonesty” will receive an automatic failure for that submission and/or such other penalty, up to and including expulsion from the course/program, as may be decided by the professor/dean. In order to protect students from inadvertent plagiarism, to protect the copyright of the material referenced, and to credit the author of the material, it is the policy of the department to employ a documentation format for referencing source material.

Course Outline Amendments:
The professor reserves the right to change the information contained in this course outline depending on the needs of the learner and the availability of resources.

Substitute course information is available in the Registrar's office.

VII. PRIOR LEARNING ASSESSMENT:

Students who wish to apply for advanced credit in the course should consult the professor. Credit for prior learning will be given upon successful completion of a challenge exam or portfolio.

VIII. DIRECT CREDIT TRANSFERS:

Students who wish to apply for direct credit transfer (advanced standing) should obtain a direct credit transfer form from the Dean’s secretary. Students will be required to provide a transcript and course outline related to the course in question.