# COURSE OUTLINE: ELN335 - MICROCONTROLLERS I

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Approved: Corey Meunier, Chair, Technology and Skilled Trades

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| **Course Code: Title** | ELN335: EMBEDDED MICROCONTROLLERS I |
| **Program Number: Name** | 4029: ELECTRICAL TY-PROCES |
| **Department:** | ELECT./INSTRUMENTATION PS |
| **Academic Year:** | 2023-2024 |
| **Course Description:** | Students will study the architecture and low level programming of embedded microcontrollers in computer interfacing applications. Lab activities involving computer interfacing to hardware and the associated software requirements will support the theory. |
| **Total Credits:** | 3 |
| **Hours/Week:** | 3 |
| **Total Hours:** | 42 |
| **Prerequisites:** | ELN115 |
| **Corequisites:** | There are no co-requisites for this course. |
| **This course is a pre-requisite for:** | ELN340 |
| **Vocational Learning Outcomes (VLO's) addressed in this course:**<br>**Please refer to program web page for a complete listing of program outcomes where applicable.** | **4029 - ELECTRICAL TY-PROCES**<br>VLO 6 Design, assemble, analyze, and troubleshoot electrical and electronic circuits, components, equipment and systems under the supervision of a qualified person.<br>VLO 7 Design, install, analyze, assemble and troubleshoot control systems under the supervision of a qualified person.<br>VLO 8 Use computer skills and tools to solve a range of electrical related problems. |
| **Essential Employability Skills (EES) addressed in this course:** | EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.<br>EES 3 Execute mathematical operations accurately.<br>EES 4 Apply a systematic approach to solve problems.<br>EES 5 Use a variety of thinking skills to anticipate and solve problems.<br>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.<br>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources. |
| **Course Evaluation:** | Passing Grade: 50%, D<br><br>A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation. |
| **Other Course Evaluation &** | It is required to achieve a passing grade (50%) in both the theory and the lab part of this |

**Assessment Requirements:**

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.

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.

**Course Outcomes and Learning Objectives:**

| **Course Outcome 1** | **Learning Objectives for Course Outcome 1** |
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| 1. Describe the architecture of the 68HC11 microcontroller including its registers, memory organization, the stack and internal organization. | 1.1 Sketch the Software model of the 68HC11 Microcontroller.<br>1.2 List and explain the nature and functioning of the 68HC11 internal registers.<br>1.3 Explain the nature of memory and memory variables including addresses and data.<br>1.4 Utilize the stack as a temporary storage mechanism |
| **Course Outcome 2** | **Learning Objectives for Course Outcome 2** |
| 2. Demonstrate the use of the assembler and simulator to assemble, load, save, unassemble, single step, examine and troubleshoot simple instruction sequences. | 2.1 Compare and contrast machine code and assembly language<br>2.2 Explain and demonstrate the method of converting assembly language instructions to machine language.<br>2.3 Demonstrate the use the simulator to:<br>2.4 Examine and modify the contents of memory and registers<br>2.5 Assemble and Unassemble machine instructions<br>2.6 Execute and single-step through programs and other tasks required in program debugging. |
| **Course Outcome 3** | **Learning Objectives for Course Outcome 3** |
| 3. Write assembly language programs utilizing the subset of commonly used 68HC11 instructions and memory addressing modes to solve simple problems. | 3.1 The student will write code which demonstrates the operation of the following groups of instructions:<br><br>a) Data transfer instructions<br>b) Arithmetic instructions<br>c) Logic instructions<br>d) Shift and rotate instructions<br>e) Flag-control instructions<br>f) Compare instructions |

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| | g) Branch instructions<br>h) Subroutine handling<br><br>3.2 Students will write programs to solve assigned problems using the instructions and addressing modes most appropriate to the task. |
| **Course Outcome 4** | **Learning Objectives for Course Outcome 4** |
| 4. Write simple programs which utilize the various ports in order to interface to digital hardware. | 4.1 Explain the input/output system of a 68HC11 including basic parallel input/output, analog to digital and if time permits the Timer subsystem<br>4.2 Write programs to control LED`s on the 68HC11 development systems or equivalent simulator<br>4.3 Write programs to read in and test the status of switches (DIP or otherwise) on the 68HC11 development systems or equivalent simulator.<br>4.4 Write programs to sense the position of a potentiometer |
| **Course Outcome 5** | **Learning Objectives for Course Outcome 5** |
| 5. Utilize Interrupts as a way to sense an external asynchronous event. | 5.1 Use the IRQ interrupt to cause an event to occur while the microcontroller is running another program.<br>5.2 Write initialization and servicing code to process an interrupt<br>5.3 Differentiate between EDGE Triggered and Level triggered interrupts. |
| **Course Outcome 6** | **Learning Objectives for Course Outcome 6** |
| 6. Use the Analog input system to read analog input values . | 6.1 Describe the analog input subsystem for the 68HC11.<br>6.2 Utilize the analog input subsystem to read and convert analog values into digital values. |
| **Course Outcome 7** | **Learning Objectives for Course Outcome 7** |
| 7. Use the Timing subsystem of the 68HC11 | 7.1 - Describe the overall timing subsystem of the 68HC11<br>7.2 - Utilize the Real Timed Interrupt subsystem of the 68HC11 to cause timed event.<br>7.3 - Utilize the OUTPUT COMPARE subsystem to control timed digital outputs.<br>7.4 - Implement a Pulse Width Modulated signal using the output compare timing subsystem. |
| **Course Outcome 8** | **Learning Objectives for Course Outcome 8** |
| 8. Use the onboard debug monitor program of the microcontroller. | 8.1 Use the BUFFALO monitor to perform various functions in the program development/debug phase. |

**Evaluation Process and Grading System:**

| Evaluation Type | Evaluation Weight |
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| Labs/Assignments | 40% |
| Tests | 60% |

**Date:** July 14, 2023

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| **Addendum:** | Please refer to the course outline addendum on the Learning Management System for further information. |