Microcontrollers

Mechanical and Transportation Technology

Course Number: ELN9203	**Contribution to Program:** Vocational		**Normative Hours:** 60
Applicable Program(s): 0550X01FWO EME Technician - Robotics	**AAL:** 3	**Core/Elective:** Core	**Approval Date:** 21/06/2013
Prepared by: Stephen Ryan Coordinator			**Approved by:** Misheck Mwaba, PhD., P.Eng. Chair, Mechanical and Transportation Technology
Co-Requisites N/A			**Approved for Academic Year:** 2013-2014
Pre-Requisites ELN9192			

COURSE DESCRIPTION

The microcontroller is one of the most comprehensive and versatile self-contained electronic control components in existence. Working as a tiny dedicated computer, this chip is perfect for applications requiring mobility. As a result, an understanding of the microcontroller is vital to any study of robotics. A PIC microcontroller and assembly language are used to expose the student to various fundamental programming and interfacing techniques. Analytical and troubleshooting skills are further developed through experiments with the PIC and its associated components.

RELATIONSHIP TO VOCATIONAL LEARNING OUTCOMES

This course contributes to your program by helping you achieve the following Vocational Learning Outcomes:

EME Technician - Robotics 0550X01FWO

2	Interpret and produce electrical, electronic, and mechanical drawings and other related documents and graphics to appropriate engineering standards.(T,A,CP)
3	Select and use a variety of troubleshooting techniques and test equipment to assess electromechanical circuits, equipment, processes, systems, and subsystems.(T)
9	Install and troubleshoot basic computer hardware and programming to support the electromechanical engineering environment. (T,A,CP)

T: Teach **A:** Assess **CP:** Culminating Performance

ESSENTIAL EMPLOYABILITY SKILLS

The course contributes to your program by helping you achieve the following Essential Employability Skills:

4	Apply a systematic approach to solve problems.(T,A,CP)
7	Analyze, evaluate and apply relevant information from a variety of sources.(T,A,CP)
8	Show respect for diverse opinions, values, belief systems and contributions of others. (T,A,CP)

T: Teach **A:** Assess **CP:** Culminating Performance

COURSE LEARNING REQUIREMENTS/EMBEDDED KNOWLEDGE AND SKILLS

COURSE LEARNING REQUIREMENTS **When you have earned credit for this course, you will have demonstrated the ability to:**	**EMBEDDED KNOWLEDGE AND SKILLS**
1. Understand the basics for dealing with microcontrollers in terms of definition, flowcharting, troubleshooting, and basic numbering systems.	- Explain microprocessors and microcontrollers and the difference between the two - Create flowcharts from a worded description or from a program using all of the appropriate boxes including terminal, decision, operation, connector and subroutine - Explain the different numbering systems including binary, hexadecimal, and decimal; explain how to convert back and forth between all of them. Explain assembly language vs. machine code and the ASCII code.

	ı Explain the ALU and processor control ı Give an overview of the microcontroller and demonstrate programming through a given simulation exercise ı Properly document your flowcharting and troubleshooting procedures ı Demonstrate how to calculate the 1s and 2s complement for binary, hex and decimal number systems
2. Understand and explain the basics of the PIC microcontroller in terms of real circuits, including labels, equates, logic, and timing	ı Create a basic PIC program in Assembly language and transfer to a working circuit ı Create, edit, analyze, assemble, simulate, download and test a PIC program ı Demonstrate how logic is processed with a PIC microcontroller including AND, OR and XOR logic ı Demonstrate the troubleshooting process and explain how to set up a circuit for easier troubleshooting Employ all of the hardware troubleshooting setup techniques on all circuits: i.e. labelling pinouts, neat and consistent wiring, measuring power and ground at all points, and testing all hardware I/O . ı Organize programs to emulate a C type format using the proper order of program components such as equates, includes, initializations, subroutines and the main section. ı Explain and demonstrate the CALL and GOTO instructions, subroutines, and interrupts; also explain and demonstrate the three return instructions RETFIE, RETLW and RETURN, and when to use each. ı Explain how to use and calculate values for the STATUS, INTCON and OPTION registers
3. Understand and explain how a PIC can be used to drive various types of motors.	ı Explain and demonstrate how to drive a basic DC motor ı Explain and demonstrate how to drive a DC motor using PWM control; including defining duty cycle and how it is calculated ı Explain and demonstrate how to program and run a stepper motor in wave, half and full stepping as well as reversed rotation ı Explain and demonstrate how to drive a servo motor and all the programming steps required ı Troubleshoot and solve issues with all of the motor types
4. Demonstrate the use of 7-segment displays and ICP in a PIC circuit.	ı Explain and demonstrate how to wire and run a program using a 7 segment display, and explain the 7 segment display in terms of common cathode, common anode, active high and active low ı Explain and demonstrate look up tables for displays and how they work ı Explain and demonstrate the use of ICP (in circuit programming).

LEARNING RESOURCES

MPLab software (Microchip)

ET-PGM PIC USB PIC programmer (available in bookstore)
Electronics toolkit (Student must purchase)

PIC 16F877A data sheet.
Other data sheets as needed

Online resources and searches

Other materials as instructed by Professor

LEARNING ACTIVITIES

During this course, you are likely to experience the following learning activities:

A large portion of this course is achieved by hands on practical experience. Some peer teaching and collaborated learning may be involved. Research on the internet is required. A complete list of required labs is available on blackboard.

EVALUATION/EARNING CREDIT

The following will provide evidence of your learning achievements:	**This activity validates the following Course Learning Requirements and/or Essential Employability Skills:**
Tests .....86% 4 Tests, 1 per CLR @ 21.5% each	ı Understand and explain the basics of the PIC microcontroller in terms of real circuits, including labels, equates, logic, and timing - [CLR 2] ı Understand the basics for dealing with microcontrollers in terms of definition, flowcharting, troubleshooting, and basic numbering systems. - [CLR 1] ı Understand and explain how a PIC can be used to drive various types of motors. - [CLR 3] ı Demonstrate the use of 7-segment displays and ICP in a PIC circuit. - [CLR 4] ı Analyze, evaluate and apply relevant information from a variety of sources. - [EES 7] ı Apply a systematic approach to solve problems. - [EES 4] ı Show respect for diverse opinions, values, belief systems and contributions of others. - [EES 8]
Quizzes ..... 4% 4 Quizzes, 1 per CLR @ 1% each	ı Demonstrate the use of 7-segment displays and ICP in a PIC circuit. - [CLR 4] ı Understand the basics for dealing with microcontrollers in terms of definition, flowcharting, troubleshooting, and basic numbering systems. - [CLR 1] ı Understand and explain how a PIC can be used to drive various types of motors. - [CLR 3] ı Understand and explain the basics of the PIC microcontroller in terms of real circuits, including labels, equates, logic, and timing - [CLR 2] ı Apply a systematic approach to solve problems. - [EES 4] ı Analyze, evaluate and apply relevant information from a variety of sources. - [EES 7] ı Show respect for diverse opinions, values, belief systems and contributions of others. - [EES 8]
Labs ..... 10% Lab Sign Off Sheet, encompassing all labs	ı Understand the basics for dealing with microcontrollers in terms of definition, flowcharting, troubleshooting, and basic numbering systems. - [CLR 1] ı Understand and explain how a PIC can be used to drive various types of motors. - [CLR 3] ı Understand and explain the basics of the PIC microcontroller in terms of real circuits, including labels, equates, logic, and timing - [CLR 2] ı Demonstrate the use of 7-segment displays and ICP in a PIC circuit. - [CLR 4] ı Analyze, evaluate and apply relevant information from a variety of sources. - [EES 7] ı Apply a systematic approach to solve problems. - [EES 4] ı Show respect for diverse opinions, values, belief systems and contributions of others. - [EES 8]

COLLEGE GRADING NUMERICAL EQUIVALENT TABLE

Final Grade	Mark Equivalent	Numeric Value	Final Grade	Mark Equivalent	Numeric Value
A+	90-100%	4.0	C+	67-69%	2.3
A	85-89%	3.8	C	63-66%	2.0
A-	80-84%	3.6	C-	60-62%	1.7
B+	77-79%	3.3	D+	57-59%	1.4
B	73-76%	3.0	D	53-56%	1.2
B-	70-72%	2.7	D-	50-52%	1.0
			F	0-49%	0
			FSP	0	0

OTHER COURSE INFORMATION

Students are required to respect the confidentiality of employer, client and/or patient information, interactions, and practices that occur either on Algonquin College premises, or at an affiliated clinical/field/co-op placement site. Concerns regarding clients, patients, and/or employer practices are to be brought to the attention of the program coordinator, or designated field/clinical/co-op placement supervisor so that they may be resolved collaboratively. Such concerns are not to be raised publically either verbally, in writing, or in electronic forums. These matters are to be addressed through established program communication pathways.

PRIOR LEARNING ASSESSMENT AND RECOGNITION

Students who wish to apply for prior learning assessment and recognition (PLAR) need to demonstrate competency at a post-secondary level in all of the course learning requirements outlined above. Evidence of learning achievement for PLAR candidates includes:

- Portfolio
- Challenge Exam
- Performance Test
- Project/Assignment

RELATED INFORMATION

The following information is course-specific:

Required Equipment:

Safety Glasses
Closed-toed shoes
Electronics toolkit consisting of cutters, wire strippers, needlenose pliers, protoboard, small electronic screwdriver kit, 2 oscilloscope leads, 2 BNC to alligator leads and 3 sets of metre leads.

Refer to your CSI under Course Information on Blackboard for the updated Lab and Testing Policy.

If you are a student with a disability please identify your needs to the professor and/or the Centre for Students with Disabilities (CSD) so that support services can be arranged for you. You can do this by making an appointment at the CSD, Room C142, Ottawa, 727-4723, Ext 7683 or arranging a personal interview with the professor to discuss your needs.

Respect for Confidentiality

Students are required to respect the confidentiality of employer, client and/or patient information, interactions, and practices that occur either on AlgonquinCollege premises, or at an affiliated clinical/field/co-op placement site. Concerns regarding clients, patients, and/or employer practices are to be brought to the attention of the program coordinator, or designated field/clinical/co-op placement supervisor so that they may be resolved collaboratively. Such concerns are not to be raised publically either verbally, in writing, or in electronic forums. These matters are to be addressed through established program communication pathways.

The following information is school/department-specific:

GENERAL CLAUSES - School of Advanced Technology

Harassment/Discrimination/Violence will not be tolerated. Any form of harassment (sexual, racial, gender or disability-related), discrimination (direct or indirect), or violence, whether towards a professor or amongst students, will not be tolerated on the college premises. Action taken will start with a formal warning and proceed to the full disciplinary actions as outlined in Algonquin College Policy - HR22.

Harassment means one or a series of vexatious comment(s) or conduct related to one or more of the prohibited grounds that is known or ought reasonably to be known to be unwelcome/ unwanted, offensive, intimidating, derogatory or hostile.

This may include, but is not limited to: gestures, remarks, jokes, taunting, innuendo, display of offensive materials, offensive graffiti, threats, verbal or physical assault, academic penalties, stalking, slurs, shunning or exclusion related to the prohibited grounds.

For further information, a copy of the official policy statement can be obtained from the Student Association.

The Use of Electronic Devices , with the sound turned on, during classes is strictly prohibited. In particular, cell phones are not to be used to communicate during a class. The use of any electronic devices during exams and mid-term tests, other than those sanctioned by the faculty in charge of the examination, is strictly prohibited.

Anyone caught using a prohibited device will be considered to have plagiarized, and will be treated as such in accordance with College Plagiarism Policy. For further details on this directive, consult the Algonquin College Policy AA32 on the use of Electronic Devices in Class and Exams.

The School of Advanced Technology' s Standard Operating Procedure on Plagiarism and Academic Honesty defines plagiarism as an attempt to use or pass off as one's own idea or product, work of another without giving credit. Plagiarism has occurred in instances where a student either directly copies another person's work without acknowledgement; or, closely paraphrases the equivalent of a short paragraph or more without acknowledgement; or, borrows, without acknowledgement, any ideas in a clear and recognizable form in such a way as to present them as one's own thought, where such ideas, if they were the student's own would contribute to the merit of his or her own work.

Plagiarism is one of the most serious academic offenses a student can commit. Anyone found guilty will, on the first offense, be given a written warning and an F on the plagiarized work. If the student commits a second offense, an F will be given for the course along with a written warning. A third offense will result in suspension from the program and/or the college.

For further details on this directive, consult the Algonquin College Policy - AA20 and the School of Advanced Technology' s Standard Operating Procedure on Plagiarism and Academic Dishonesty.

Respect for Confidentiality

Students are required to respect the confidentiality of employer, client and/or patient information, interactions, and practices that occur either on AlgonquinCollege premises, or at an affiliated clinical/field/co-op placement site. Concerns regarding clients, patients, and/or employer practices are to be brought to the attention of the program coordinator, or designated field/clinical/co-op placement supervisor so that they may be resolved collaboratively. Such concerns are not to be raised publically either verbally, in writing, or in electronic forums. These matters are to be addressed through established program communication pathways

Disruptive Behaviour is any conduct, or threatened conduct, that is disruptive to the learning process or that interferes with the well-being of other members of the College community. It will not be tolerated.

Members of the College community, both students and staff, have the right to learn and work in a secure and productive environment. The College will make very effort to protect that right.

Incidents of disruptive behaviour must be reported in writing to the departmental Chair as quickly as possible. The Chair will hold hearings to review available information and determine any sanctions that will be imposed. Disciplinary hearings can result in penalties ranging from a written warning to expulsion.

For further details consult the Algonquin College Policy - SA07.

June 15, 2012

The following information is College-wide:

Email
Algonquin College provides all full-time students with an e-mail account. This is the address that will be used when the College, your professors, or your fellow students communicate important information about your program or course events. It is your responsibility to ensure that you know how to send and receive e-mail using your Algonquin account and to check it regularly.

Centre for Students with Disabilities (CSD)
If you are a student with a disability, it is strongly recommended that you identify your needs to the professor and the Centre for Students with Disabilities (CSD) by the end of the first month of the semester in order that any necessary support services can be arranged for you.

Academic Integrity* & Plagiarism*
Adherence to acceptable standards of academic honesty is an important aspect of the learning process at Algonquin College. Academic work submitted by a student is evaluated on the assumption that the work presented by the student is his or her own, unless designated otherwise. For further details consult Algonquin College Policies AA18 **http://www2.algonquincollege.com/directives/files/2012/04/AA18.pdf** and AA20 **http://www2.algonquincollege.com/directives/files/2011/08/AA20.pdf**

Student Course Feedback*
It is Algonquin College's policy to give students the opportunity to complete a course assessment survey in each course that they take which solicits their views regarding the curriculum, the professor and the facilities. For further details consult Algonquin College Policy AA25
http://www2.algonquincollege.com/directives/files/2011/10/AA25.pdf

Use of Electronic Devices in Class*
With the proliferation of small, personal electronic devices used for communications and data storage, Algonquin College believes there is a need to address their use during classes and examinations. During classes, the use of such devices is disruptive and disrespectful to others. During examinations, the use of such devices may facilitate cheating. For further details consult Algonquin College Policy AA32
http://www2.algonquincollege.com/directives/files/2011/11/AA32.pdf

Transfer of Credit
Students, it is your responsibility to retain course outlines for possible future use to support applications for transfer of credit to other educational institutions.

***** College policies (previously called directives) are under review and redesign. The term *directives* is being retired. As such, the policy classification nomenclature is in transition. Students, it is your responsibility to refer to the Algonquin College Directives/Policies website for the most current information available at**:(http://www2.algonquincollege.com/directives/)**