DC and AC Motor Controls

Mechanical and Transportation Technology

Course Number: ELN9211	**Contribution to Program:** Vocational		**Normative Hours:** 45
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

DC and AC motors are an intricate part of any industrial process. A thorough knowledge of how motors are controlled is a great asset to any electro-mechanical technician. Various motors and their control circuits are examined. The student gains practical experience wiring and troubleshooting single and three phase circuits using logic control, forward/reverse starters, multiple motor control, relays and timers.

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,A,CP)
7	Analyze, build, and troubleshoot logic and digital circuits, passive AC and DC circuits, and active circuits.(T,A)
8	Apply, install, test, and troubleshoot a variety of mechanical, electrical, and electronic control systems.(T,A,CP)
14	Perform all work in accordance with relevant law, policies, codes, regulations, safety procedures, and standard shop practices.(T,A)

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)
5	Use a variety of thinking skills to anticipate and solve problems.(T,A,CP)
9	Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals. (T,A,CP)
10	Manage the use of time and other resources to complete projects.(T,A,CP)
11	Take responsibility for one's own actions, decisions and consequences.(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. Work safely in an electrical environment.	ı measuring voltages in a three phase environment ı tag and lockout procedures ı safe operation of meters

	ı identify need for protective equipment ı identify need and procedures for grounding of equipment
2. Communicate effectively using the terminology of the electrical industry.	ı answer technical questions using the correct terminology
3. Design and analyze circuit schematics, component layouts and connection wiring diagrams.	ı analyse reduced voltage and reduced current starter circuits ı design circuits to meet given control requirements
4. Design power circuits for motors in compliance with the Canadian Electrical Code.	ı section 28 CEC ı other sections, such as transfer switches, as applicable
5. Design, install and trouble shoot circuits to control and protect AC motors.	ı no-voltage release circuits ı no-voltage protection circuits ı reversing starter circuits ı timer circuits ı applications combining various circuit elements
6. Develop, test, debug and document PICO relay programming instructions for motor control applications.	ı program control applications from the PICO keypad ı program a PICO from a microcomputer using the PICO software ı document PICO projects

LEARNING RESOURCES

Electro - Mechanical Control Experiments. 2011 edition on Blackboard

Rockis & Mazur Electrical Motor Controls, American Technical Publishers ISBN 0-8269-1671-6

Canadian Standards Association. Canadian Electrical Code Part 1 20 ed. Rexdale Ont. Canadian Standards Association 2006

Gerald A. Moberg AC and DC Motor Control, Peatson Education Canada 2006

Siemens on line course www.enm.com/eandm/training/siemenscourses.asp, specifically the four parts with www.enm.com/eandm/training/siemenscourses/cc_1.pdf

LEARNING ACTIVITIES

During this course, you are likely to experience the following learning activities:
Worksheets, laboratory experiments, demonstrations, practise questions, online searching, ladder diagrams drawing

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:**
Safety Quiz 10% - Mandatory for accessing lab.	ı Work safely in an electrical environment. - [CLR 1] ı Take responsibility for one's own actions, decisions and consequences. - [EES 11]
Labs 30%	ı Communicate effectively using the terminology of the electrical industry. - [CLR 2] ı Work safely in an electrical environment. - [CLR 1] ı Design power circuits for motors in compliance with the Canadian Electrical Code. - [CLR 4]

	ı Design and analyze circuit schematics, component layouts and connection wiring diagrams. - [CLR 3] ı Design, install and trouble shoot circuits to control and protect AC motors. - [CLR 5] ı Develop, test, debug and document PICO relay programming instructions for motor control applications. - [CLR 6] ı Apply a systematic approach to solve problems. - [EES 4] ı Use a variety of thinking skills to anticipate and solve problems. - [EES 5] ı Interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals. - [EES 9] ı Manage the use of time and other resources to complete projects. - [EES 10] ı Take responsibility for one's own actions, decisions and consequences. - [EES 11]
Midterm 20%	ı Design and analyze circuit schematics, component layouts and connection wiring diagrams. - [CLR 3] ı Design, install and trouble shoot circuits to control and protect AC motors. - [CLR 5] ı Design power circuits for motors in compliance with the Canadian Electrical Code. - [CLR 4] ı Communicate effectively using the terminology of the electrical industry. - [CLR 2] ı Apply a systematic approach to solve problems. - [EES 4]
Practical Tests 20%	ı Design power circuits for motors in compliance with the Canadian Electrical Code. - [CLR 4] ı Design and analyze circuit schematics, component layouts and connection wiring diagrams. - [CLR 3] ı Design, install and trouble shoot circuits to control and protect AC motors. - [CLR 5] ı Work safely in an electrical environment. - [CLR 1] ı Manage the use of time and other resources to complete projects. - [EES 10] ı Take responsibility for one's own actions, decisions and consequences. - [EES 11] ı Use a variety of thinking skills to anticipate and solve problems. - [EES 5]
Final Exam 20%	ı Design and analyze circuit schematics, component layouts and connection wiring diagrams.

- [CLR 3]

- Design, install and trouble shoot circuits to control and protect AC motors.

- [CLR 5]

- Communicate effectively using the terminology of the electrical industry.

- [CLR 2]

- Develop, test, debug and document PICO relay programming instructions for motor control applications. - [CLR 6]

- Apply a systematic approach to solve problems. - [EES 4]

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
Steel toed shoes/boots

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 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.

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/)**