



## COURSE OUTLINE: ELR223 - ROBOT/PLC CONTROL SY

Prepared: Chris Beauchamp

Approved: Corey Meunier, Chair, Technology and Skilled Trades

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| <b>Course Code: Title</b>  | ELR223: ROBOTIC AND PLC CONTROL SYSTEMS  |
| <b>Program Number: Name</b>  | 4026: ELECTRICAL TN-PROC<br>4029: ELECTRICAL TY-PROCES<br>4127: ELECTRICAL TN-TRADES   |
| <b>Department:</b>   | ELECT./INSTRUMENTATION PS  |
| <b>Semesters/Terms:</b>  | 21W  |
| <b>Course Description:</b>   | This course will introduce the student to control and programming fundamentals used in various automation and robotic controllers while reinforcing them using programmable logic controller applications. The student will develop a general understanding of PLCs and both the hardware and software associated with Allen Bradley ControlLogix 5000 platform. PLC programming techniques using computer based software will be used to design, document and commission basic to intermediate PLC lab assignments. The student will learn how to interface a PLC with a HMI to control selected lab equipment as the final lab assignment. This course will require the student to work independently and/or in groups during lab times. The student will also be required to work independently on assigned work outside of class time and access information from help files, manuals, and the internet as necessary to solve PLC related work problems. This course will prepare the student for basic PLC job related tasks. |
| <b>Total Credits:</b>  | 6  |
| <b>Hours/Week:</b>   | 5  |
| <b>Total Hours:</b>  | 75   |
| <b>Prerequisites:</b>  | ELR232   |
| <b>Corequisites:</b>   | There are no co-requisites for this course.  |
| <b>This course is a pre-requisite for:</b>   | ELR320, ELR325, ELR326   |
| <b>Vocational Learning Outcomes (VLO's) addressed in this course:</b>                                | <b>4026 - ELECTRICAL TN-PROC</b>   |
| <b>Please refer to program web page for a complete listing of program outcomes where applicable.</b> | VLO 1 Interpret and produce electrical and electronics drawings including other related documents and graphics.  |
|  | VLO 2 Analyze and solve routine technical problems related to electrical systems by applying mathematics and science principles.   |
|  | VLO 4 Assemble, test, modify and maintain electrical circuits and equipment to fulfill requirements and specifications under the supervision of a qualified person.  |
|  | VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person.   |
|  | VLO 7 Analyze, assemble and troubleshoot control systems under the supervision of a qualified person.  |
|  | VLO 8 Use computer skills and tools to solve routine electrical related problems.  |

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- VLO 10 Prepare and maintain records and documentation systems.
- VLO 12 Apply health and safety standards and best practices to workplaces.
- VLO 16 Select electrical equipment, systems and components to fulfill the requirements and specifications under the supervision of a qualified person.

#### **4029 - ELECTRICAL TY-PROCES**

- VLO 1 Analyze, interpret, and produce electrical and electronics drawings, technical reports including other related documents and graphics.
- VLO 2 Analyze and solve complex technical problems related to electrical systems by applying mathematics and science principles.
- VLO 4 Design, assemble, test, modify, maintain and commission electrical equipment and systems to fulfill requirements and specifications under the supervision of a qualified person.
- VLO 6 Design, assemble, analyze, and troubleshoot electrical and electronic circuits, components, equipment and systems under the supervision of a qualified person.
- VLO 7 Design, install, analyze, assemble and troubleshoot control systems under the supervision of a qualified person.
- VLO 8 Use computer skills and tools to solve a range of electrical related problems.
- VLO 10 Prepare reports and maintain records and documentation systems.
- VLO 12 Apply and monitor health and safety standards and best practices to workplaces.
- VLO 16 Select and recommend electrical equipment, systems and components to fulfill the requirements and specifications under the supervision of a qualified person.

#### **4127 - ELECTRICAL TN-TRADES**

- VLO 1 Interpret and produce electrical and electronic drawings including other related documents and graphics.
- VLO 2 Analyze and solve routine technical problems related to electrical systems by applying mathematics and science principles.
- VLO 4 Assemble, test, modify and maintain electrical circuits and equipment to fulfill requirements and specifications under the supervision of a qualified person.
- VLO 6 Verify acceptable functionality and apply troubleshooting techniques for electrical and electronic circuits, components, equipment, and systems under the supervision of a qualified person.
- VLO 7 Analyze, assemble and troubleshoot control systems under the supervision of a qualified person.
- VLO 8 Use computer skills and tools to solve routine electrical related problems.
- VLO 10 Prepare and maintain records and documentation systems.
- VLO 12 Apply health and safety standards and best practices to workplaces.
- VLO 16 Select electrical equipment, systems and components to fulfill the requirements and specifications under the supervision of a qualified person.

#### **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.
- EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective

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- communication.
- EES 3 Execute mathematical operations accurately.
  - EES 4 Apply a systematic approach to solve problems.
  - EES 5 Use a variety of thinking skills to anticipate and solve problems.
  - EES 6 Locate, select, organize, and document information using appropriate technology and information systems.
  - EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.
  - EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.
  - EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.
  - EES 10 Manage the use of time and other resources to complete projects.
  - EES 11 Take responsibility for ones own actions, decisions, and consequences.

**Course Evaluation:**

Passing Grade: 50%, D

A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.

**Other Course Evaluation & Assessment Requirements:**

The student must pass both the theory portion, the practical portion, demonstrate all labs and pass a minimum of one of the two practical tests in order to pass the course.

Smart watches, smart phones and similar devices are not allowed during tests or quizzes and must be removed. Smart phones are not acceptable for use as a calculator during a test or quiz.

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.

**Books and Required Resources:**

Technician`s Guide to Programmable Controllers by Terry Borden, Richard Cox  
Publisher: Delmar Cengage Learning Edition: Sixth  
ISBN: 978-1-111-54409-6

**Course Outcomes and Learning Objectives:**

| Course Outcome 1  | Learning Objectives for Course Outcome 1             |
|-------------------|--|
| 1. Identify basic | 1.1 State the major advantages of a typical PLC over |

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|  | programmable logic controller (PLC) hardware and software.  | conventional hardwired relay systems.<br>1.2 Identify the four major components of a typical PLC and describe the function of each.<br>1.3 Define the term discrete.<br>1.4 Define the term analog.<br>1.5 Identify different types of programming devices.<br>1.6 Describe the I/O section of a PLC.<br>1.7 Define the term interposing relay.<br>1.8 Define the term optical isolation.<br>1.9 Describe how basic AC and DC input and output modules work.   |
|  | <b>Course Outcome 2</b>   | <b>Learning Objectives for Course Outcome 2</b>  |
|  | 2. Develop an understanding of basic PLC ladder logic instructions, numbering systems and demonstrate wiring techniques for Allen Bradley ControlLogix 5000 PLCs. | 2.1 Describe the proper wiring connections for input and output devices and their corresponding modules.<br>2.2 Explain why a hard-wire emergency-stop function is desirable.<br>2.3 Describe the function of the PLC processor.<br>2.4 Identify the two distinct types of memory.<br>2.5 Explain the term on-line programming.<br>2.6 Understand decimal, binary, hexadecimal, binary coded decimal (BCD) numbering systems.<br>2.7 Identify a wiring diagram.<br>2.8 Understand the examine ON, examine OFF, timer, counter, move, limit test, sequencer instructions and use of internal storage bits.<br>2.9 Describe basic programming techniques.<br>2.10 Describe the Force On and Force Off features and the hazards that could be associated with both. |
|  | <b>Course Outcome 3</b>   | <b>Learning Objectives for Course Outcome 3</b>  |
|  | 3. Develop and demonstrate basic programming techniques for Allen Bradley ControlLogix 5000 PLCs using computer based programming software.                       | 3.1 Demonstrate the ability to program and configure basic PLC functions offline.<br>3.2 Demonstrate the ability to program PLCs to control.<br>3.3 Demonstrate the ability to wire PLC inputs and outputs to field equipment.<br>3.4 Demonstrate the ability to add accurate and effective documentation to a PLC program.  |
|  | <b>Course Outcome 4</b>   | <b>Learning Objectives for Course Outcome 4</b>  |
|  | 4. Develop and demonstrate the ability to write basic PLC programs to control various electrical equipment in the lab and run the programs on a PLC in the lab.   | 4.1 Demonstrate the ability to download a program to a PLC attached to a PC.<br>4.2 Demonstrate the ability to download a program to a PLC from a remote PC over Ethernet.<br>4.3 Demonstrate the ability to edit programs online.<br>4.4 Demonstrate the ability to upload a program to a PC from a PLC.<br>4.5 Demonstrate the ability to program basic PLC functions online.<br>4.6 Demonstrate the ability to write a PLC program to control equipment such as motors, traffic lights, etc.<br>4.7 Demonstrate the ability to download a program to a local  |

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|   | PLC and run the program.<br>4.8 Demonstrate the ability to download a program to a particular remotely located PLC over the Ethernet network and run the program.  |
| <b>Course Outcome 5</b>   | <b>Learning Objectives for Course Outcome 5</b>  |
| 5. Develop and demonstrate the ability to connect a PLC in the lab to control various electrical equipment then run and troubleshoot the program. | 5.1 Demonstrate the ability to wire PLC I/O cards to field equipment.<br>5.2 Use available resources such as internet, manuals, help files, and handbooks to aid in project troubleshooting.<br>5.3 Apply problem-solving techniques and use the knowledge of computer systems and application software to resolve technical problems associated with assigned PLC projects.<br>5.4 Use appropriate application software for programming, communication and troubleshooting projects.<br>5.5 Determine, wire, configure and test the electrical and automation control system equipment such as PLC modules, motor controls, traffic lights, etc. required for assigned projects.<br>5.6 Apply, install, test and troubleshoot PLC project related equipment, systems and tasks. |
| <b>Course Outcome 6</b>   | <b>Learning Objectives for Course Outcome 6</b>  |
| 6. Communicate information effectively and accurately by producing PLC related electrical and equipment drawings and other related documentation. | 6.1 Apply standards and standard symbols in the production of drawings.<br>6.2 Use computers and selected tools and equipment to produce or reproduce drawings in CAD.<br>6.3 Use and produce graphical information such as single line drawings, schematic drawings etc. as necessary to interpret and convey technical information for the associated projects assigned.<br>6.4 Use available resources such as internet, manuals, help files and handbooks to aid in accurate project documentation.<br>6.5 Establish and document procedures required to successfully complete assigned projects<br>6.6 Document all work and produce a complete project manual  |

**Evaluation Process and Grading System:**

| <b>Evaluation Type</b> | <b>Evaluation Weight</b> |
|------------------------|--------------------------|
| Attendance and Quizzes | 5%                       |
| Lab Demonstrations     | 5%                       |
| Lab Write-ups          | 10%                      |
| Practical Test 1       | 20%                      |
| Practical Test 2       | 30%                      |
| Take-Home Assignment 1 | 2%                       |
| Take-Home Assignment 2 | 2%                       |
| Written Test 1         | 13%                      |
| Written Test 2         | 13%                      |

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**Date:** September 2, 2020

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

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