COURSE OUTLINE: ELR223 - ROBOT/PLC CONTROL SY

Prepared: Chris Beauchamp
Approved: Corey Meunier, Dean, Technology, Trades, and Apprenticeship

Course Code: Title	ELR223: ROBOTIC AND PLC CONTROL SYSTEMS
Program Number: Name	4026: ELECTRICAL TN-PROC 4029: ELECTRICAL TY-PROCES 4127: ELECTRICAL TN-TRADES
Department:	ELECT./INSTRUMENTATION PS
Academic Year:	2024-2025
Course Description:	This course will introduce the student to the programming and control fundamentals used in various PLC and robotic automation controllers, reinforced using PLC applications and programming techniques. 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 programs. The student will additionally learn how to interface a PLC with an HMI to control selected lab equipment. 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.
Total Credits:	6
Hours/Week:	5
Total Hours:	70
Prerequisites:	ELR232
Corequisites:	There are no co-requisites for this course.
This course is a pre-requisite for:	ELR320, ELR325, ELR326
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**4026 - ELECTRICAL TN-PROC** 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.

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

	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 lab portion, pass a minimum of one of the two practical tests, and demonstrate all projects 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: Cengage Learning Edition: Seventh ISBN: 9780357622490
Course Outcomes and Learning Objectives:	

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

programmable logic controller (PLC) hardware and software.	conventional hardwired relay systems. 1.2 List the four major components of a typical PLC and describe the function of each. 1.3 Define the terms discrete and analog 1.4 Identify different types of programming devices. 1.5 Describe the I/O section of a PLC. 1.6 Define the terms interposing relay and optical isolation. 1.7 Describe how basic AC and DC input and output modules work.
Course Outcome 2	**Learning Objectives for Course Outcome 2**
2. Understand basic PLC ladder logic instructions, numbering systems and demonstrate wiring techniques for the Allen Bradley ControlLogix 5000 series PLC.	2.1 Describe the proper wiring connections for input and output devices and their corresponding I/O modules. 2.2 Explain why a hard-wire emergency-stop function is desirable. 2.3 Identify and compare wiring and schematic diagrams. 2.4 Describe the function of the PLC processor and identify the two distinct types of memory used in a PLC. 2.5 Understand decimal, binary, hexadecimal, binary coded decimal (BCD) numbering systems. 2.6 Explain the terms off-line and on-line programming. 2.7 Understand and use the examine ON, examine OFF, timer, counter, move, limit test, sequencer instructions and internal storage bit applications. 2.8 Describe basic programming techniques. 2.9 Describe the Force On and Force Off features and the hazards that could be associated with both.
Course Outcome 3	**Learning Objectives for Course Outcome 3**
3. Develop and demonstrate basic programming and configuration techniques for the Allen Bradley ControlLogix 5000 series PLC using computer-based programming software.	3.1 Demonstrate the ability to program and configure basic PLC hardware and functions offline. 3.2 Demonstrate the ability to program PLCs to control. 3.3 Demonstrate the ability to determine appropriate control equipment based on control requirements and specifications. 3.4 Demonstrate the ability to wire PLC inputs and outputs to field equipment. 3.5 Demonstrate the ability to add accurate and effective documentation to a PLC program.
Course Outcome 4	**Learning Objectives for Course Outcome 4**
4. Develop and demonstrate the ability to create basic programs to control various electrical equipment in the lab and run the programs.	4.1 Demonstrate the ability to download a program to a PLC from a PC. 4.2 Demonstrate the ability to upload a program to a PC from a PLC. 4.3 Demonstrate the ability to configure the PLC to run the program. 4.4 Demonstrate the ability to program basic PLC functions and edit programs online. 4.5 Demonstrate the ability to write a PLC program to control equipment such as motors, traffic lights, etc. based on control requirements and specifications. 4.6 Demonstrate the ability to create a basic human machine

	interface (HMI).
Course Outcome 5	**Learning Objectives for Course Outcome 5**
5. Develop and demonstrate the ability to connect to an online running automation system and troubleshoot programs.	5.1 Research using available information resources such the internet, reference manuals, handbooks, quick start guides, knowledge bases and help files to aid in selecting, installing, programming, commissioning, testing, and troubleshooting appropriate electrical equipment and components based on control requirements and specifications. 5.2 Test and troubleshoot PLC project related equipment, software, systems, and tasks. 5.3 Apply problem-solving techniques using computer systems and application software to resolve technical problems associated with PLC and HMI programs. 5.4 Select appropriate application software for troubleshooting programming and communication issues. 5.5 Demonstrate the ability to troubleshoot wiring to PLC I/O cards and field equipment.
Course Outcome 6	**Learning Objectives for Course Outcome 6**
6. Create technical documentation using various computer skills and resources to provide accurate and meaningful documentation of assigned labs so that they may be understood and reproduced by another person.	6.1 Communicate information effectively by producing and maintaining current, clear, and accurate documentation of electrical PLC related equipment using reports, drawings, and other related documentation. 6.2 Use available resources such as internet, manuals, help files and handbooks to aid in creating accurate project documentation. 6.3 Use computers to document the design, commissioning, testing, modification, and implementation of electrical systems to produce a complete project manual. 6.4 Use computers to produce graphics such as single line drawings, schematic drawings, chassis layouts, etc. as necessary to convey technical information for the assigned projects using CAD software. 6.5 Use computer software and other technology to produce diagrams, charts, tables, graphs, and project timelines. 6.6 Apply drawing standards and standard symbols in the production of drawings.

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Assignments and Quizzes	10%
Lab Demonstrations	5%
Lab Write-ups	10%
Practical Test 1	20%
Practical Test 2	25%
Written Test 1	15%
Written Test 2	15%

Date:	August 9, 2024
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.