

# EET-2520: PROGRAMMABLE LOGIC CONTROLLERS

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## Cuyahoga Community College

**Viewing: EET-2520 : Programmable Logic Controllers**

**Board of Trustees:**

October 2018

**Academic Term:**

Fall 2020

**Subject Code**

EET - Electrical/Electronic Engineer

**Course Number:**

2520

**Title:**

Programmable Logic Controllers

**Catalog Description:**

Introduction to programmable logic controller terminology, architecture, input/output modules and memory. Relay schematics and ladder logic diagrams and programming of programmable logic controllers are covered and reinforced in practical laboratory experiments. Sensing devices as limit switches, on/off electrical devices, temperature switches, timing and counting devices as well as event-driven and time-driven sequences are also included.

**Credit Hour(s):**

3

**Lecture Hour(s):**

2

**Lab Hour(s):**

2

## Requisites

**Prerequisite and Corequisite**

EET-1220 Circuits and Electronics; or EET-1210 AC Electric Circuits and EET-1241 Digital Circuits/Microprocessors I.

## Outcomes

**Course Outcome(s):**

Explain the architecture of a Programmable Logic Controller (PLC), and explain the concept and use of inputs, outputs, instructions, and Decimal, Binary, and Hexadecimal numbering systems in PLC Ladder Logic.

**Essential Learning Outcome Mapping:**

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

**Objective(s):**

1. Explain the architecture of a programmable logic controller including the Central Processing Unit, memory and inputs/outputs.
2. Explain relay-type instructions, internal bits, ladder logic diagrams and rung notation.
3. Explain the different types of input and output devices and their use.
4. Explain the use of basic instructions such as timers, counters, math instructions, data handling, program flow, shift registers and sequencers.
5. Explain Decimal, Binary and Hexadecimal numbering systems, and their application and use in PLC Ladder Logic.

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**Course Outcome(s):**

Given a written Sequence of Operations or a Relay Logic Diagram, and a data set where applicable, be able to program that data into PLC Ladder Logic such that it will control a physical process.

**Essential Learning Outcome Mapping:**

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

**Objective(s):**

1. Demonstrate the ability to apply and use Boolean Logic.
  2. Demonstrate through programming on a PLC the proper use and proper function of inputs, outputs and internal bits.
  3. Demonstrate through programming on a PLC the application and use of Decimal, Binary and Hexadecimal numbering systems
  4. Demonstrate through programming on a PLC the ability to take a written Sequence of Operations or a Relay Logic Diagram and control a process using all of the following instruction types: timers, counters, math instructions, data handling, program flow control, shift registers, and sequencers.
  5. Demonstrate the ability to troubleshoot a PLC and PLC Ladder Logic program.
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**Methods of Evaluation:**

1. Homework
2. Laboratory experiments and reports
3. Midterm examination
4. Final examination
5. Portfolio (required by ABET)

**Course Content Outline:**

1. Overview of programmable logic controller
  - a. Architecture of Programmable Logic Controller (PLC)
  - b. Central Processing Unit (CPU)
  - c. Inputs/outputs
  - d. Memory
2. Number systems and codes
  - a. Decimal system
  - b. Binary system
  - c. Hexadecimal system
  - d. ASCII code
3. Logic fundamentals
  - a. AND function
  - b. OR function
  - c. INVERT function
  - d. Boolean logic and equations
  - e. Conversion of relay type logic to ladder logic
4. Programming of PLC
  - a. Programming languages
  - b. Relay-type Instructions
  - c. Ladder diagrams
  - d. Memory
  - e. Internal bits
5. Input/output devices
  - a. Control relay
  - b. Contactor
  - c. Motor starter
  - d. Manual switches
  - e. Transducers and sensors
  - f. Latching relay
  - g. Analog input/output
  - h. 7-segment displays
6. Timers
  - a. ON Delay timer
  - b. OFF Delay timer
  - c. Retentive timer
  - d. Cascading timer

7. Counters
  - a. UP counter
  - b. DOWN counter
  - c. Counter instructions
  - d. Encoder-counter applications
8. Mathematical instructions
  - a. Addition
  - b. Subtraction
  - c. Multiplication
  - d. Division
  - e. Other instructions
9. Data handling instructions
  - a. Data transfer
  - b. Data compare
  - c. Limit test
  - d. Move and logical instructions
  - e. Data words/registers and files/tables
10. Program flow control
  - a. Jump instructions
  - b. Master Control Reset (MCR)
  - c. Selectable timed interrupt
11. Shift registers and sequencers
  - a. Mechanical sequences
  - b. Sequence instructions
  - c. Sequence programs
  - d. Shift registers
12. PLC installation and troubleshooting
  - a. Grounding
  - b. Leaky inputs and outputs
  - c. Voltage surges
  - d. Preventive maintenance
  - e. Troubleshooting
13. Data acquisition and control
  - a. Continuous process
  - b. Batch production
  - c. Individual product production
  - d. Controllers
  - e. Data acquisition systems
  - f. Computer integrated manufacturing
14. Laboratory experiments
  - a. PLC trainer familiarization
  - b. Relay logic, Sequences of Operations, and PLC Ladder Logic
  - c. Discrete input/output system
  - d. Manual start/stop and Program Flow Control
  - e. Binary digital input and output
  - f. Boolean logic
  - g. Timer circuit
  - h. Shift registers
  - i. Counter circuit
  - j. Time and event driven sequencer
  - k. Data manipulation
  - l. Math instructions
  - m. Final project

## Resources

Petruzella, Frank D. *Programmable Logic Controllers*. 5th ed. New York: McGraw Hill, 2016.

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Rehg, James. "Programmable Logic Controllers" Pearson, 2009.

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Rindell, Jack. "PLC Programming with RSLogix 500" Modern Media & Automation, LLC, 2017.

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Bradley, Allen. Publication 1747-RM001G-EN-P. *SLC 500 Instruction Set* . Rockwell Automation, 2007, 12 31.

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Bradley, Allen. Publication 1747-SG001E-EN-E. *SLC 500 Systems Selection Guide* . Rockwell Automation, 2012, 12 31.

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Bradley, Allen. Publication 1747-Sg001E-EN-E. *RLSLogix 500 Systems Selection Guide* . Rockwell Automation, 2014, 12 31.

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## **Instructional Services**

### **OAN Number:**

Transfer Assurance Guide OET022 and Career Technical Assurance Guide CTEET003

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