

## Programmable Controllers (RBTC 1401)



**Credit:** 4 semester credit hours (3 hours lecture, 4 hours lab)

**Prerequisite/Co-requisite:** CETT-1405

### Course Description

A study in programmable controllers (PLC). Topics include processor units, numbering systems, memory organization, relay type devices, timers, counters, datamanipulators, and programming.

### Required Textbook and Materials

1. *Programmable Controllers, 4th Edition*, by Frank Petruzella, McGraw-Hill
  - a. ISBN number is 978-0-07-351088-0
2. *Programmable Controllers 4<sup>th</sup> Edition Activities Manual*
  - a. ISBN number is 978-0-07-330342-1
3. Scientific Calculator
4. Notebook.

### Course Objectives

Upon completion of this course, the student will be able to:

1. Demonstrate a knowledge of programming basics for PLCs.
2. Demonstrate integration of PLCs into systems.
3. Diagnose faults in PLC programming.
4. Write working programs using ladder logic.

### Course Outline

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|---|----------------------------------|
| A. Programmable Logic Controllers (PLCs): An Overview | 8. Programming Devices           |
| 1. Programmable Logic Controllers                     | 9. Recording and Retrieving Data |
| 2. Parts of a PLC                                     | 10. PLC Workstations             |
| 3. Principles of Operation                            | C. Number Systems and Codes      |
| 4. Modifying the Operation                            | 1. Decimal System                |
| 5. PLC's versus Computers                             | 2. Binary System                 |
| 6. PLC Size and Application                           | 3. Negative Numbers              |
| B. PLC Hardware Components                            | 4. Octal System                  |
| 1. The I/O Section                                    | 5. Hexadecimal System            |
| 2. Discrete I/O Modules                               | 6. BCD System                    |
| 3. Analog I/O Modules                                 | 7. Gray Code and ASCII Code      |
| 4. Special I/O Modules                                | 8. Parity Bit                    |
| 5. I/O Specifications                                 | 9. Binary Arithmetic             |
| 6. The CPU  | D. Fundamentals of Logic         |
| 7. Memory Design and Types                            | 1. The Binary Concept            |
|   | 2. AND, OR, and NOT Functions    |

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3. Boolean Algebra
4. Developing Circuits
5. Producing the Boolean Equation
6. Hardwired Logic/ Programmed Logic
7. Word Level Instructions
- E. Basics of PLC Programming
  1. Processor Memory Organization
  2. Program Scan
  3. PLC Programming Languages
  4. Relay Type Instructions
  5. Instruction Addressing
  6. Branch Instructions
  7. Internal Relay Instructions
  8. Entering the Ladder Diagram
  9. Modes of Operation
- F. Developing Wiring Diagrams and Ladder Logic
  1. Control Relays
  2. Contactors and Motor Starters
3. Manually and Mechanically Operated Switches
4. Transducers and Sensors
5. Output Control Devices
6. Seal-In Circuits
7. Latching Relays
8. PLC Ladder Programs
- G. Programming Timers
  1. Mechanical Timing Relay
  2. Timer Instructions
  3. On-Delay Timer Instruction
  4. Off-Delay Timer Instruction
  5. Retentive Timer
  6. Cascading Timers
- H. Programming Counters
  1. Counter Instruction
  2. Up-Counter
  3. Down-Counter
  4. Cascading Counters
  5. Incremental Encoder-Counter Applications

**Grade Scale**

90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
0 – 59	F

**Course Requirements**

1. Identify the main parts of a PLC and describe their function.
2. Describe the basic circuitry and applications for I/O modules and interpret I/O and CPU specifications.
3. Define the decimal, binary, octal, and hexadecimal, numbering systems and explain BCD, Gray, and ASCII Codes and be able to convert from one numbering or coding system to another.
4. Convert relay ladder schematics to ladder logic programs and program instructions that perform logical operations.
5. Write and enter ladder logic programs and use internal relay instructions.
6. Explain the operation of sensors and output control devices commonly found in PLC installations.
7. Analyze and interpret typical PLC timer ladder logic programs.
8. Analyze and interpret typical PLC counter ladder logic programs.

9. Apply combinations of counter and timers to control systems.

### Disabilities Statement

The Americans with Disabilities Act of 1992 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. Among other things, these statutes require that all students with documented disabilities be guaranteed a learning environment that provides for reasonable accommodations for their disabilities. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409) 880-1737 or visit the online resource:

<http://www.lit.edu/depts/stuserv/special/defaults.aspx>

### Student Code of Conduct Statement

It is the responsibility of all registered Lamar Institute of Technology students to access, read, understand and abide by all published policies, regulations, and procedures listed in the *LIT Catalog and Student Handbook*. The *LIT Catalog and Student Handbook* may be accessed at [www.lit.edu](http://www.lit.edu) or obtained in print upon request at the Student Services Office.

### Course Schedule

Week	Topic	Reference
1	Course introduction, policies and PLC's <ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Allen Bradley PLC's</li></ul>	Handouts SLC 100 & 1000
2	Overview of PLC's. <ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activities Manual exercises</li></ul>	Chapter 1
3	PLC Instruction Sets <ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Place controller in program mode and enter program into memory. Place controller in run mode and run the program..</li></ul>	Chapter 1
4	PLC Hardware <ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Chapter Exercises and Activity Manual exercises</li><li>• Test 1</li></ul>	Chapter 2
5	Number Systems <ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Conversions and Radix Function</li></ul>	Chapter 3

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6	Codes	Chapter 3
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Chapter and activity manual Exercises</li></ul>	
7/8	Logic	Chapter 4
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activity manual Exercises Boolean Algebra.</li><li>• Test 2</li></ul>	
9/10	Programming Basics	Chapter 5
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activity manual Exercises</li><li>• Entering basic Programs, editing, and running programs using SLC 100</li></ul>	
11	Fundamental PLC Wiring Diagrams	Chapter 6
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activity manual exercises and sequential and combination processes Programming.</li><li>• Test 3</li></ul>	
12/13	Programming Timers	Chapter 7
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activity manual Exercises</li><li>• Analyze and interpret timer ladder Logic programs</li><li>• Program control of outputs using Timer control bits</li></ul>	
14/15	Programming Counters	Chapter 8
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Lab: Activity manual Exercises</li><li>• Analyze and interpret counter ladder Logic programs</li><li>• Apply counter function and circuitry To control systems</li></ul>	

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16	Combination counter and timers applied To control systems	Comprehensive
	<ul style="list-style-type: none"><li>• Lecture</li><li>• Test 4</li><li>• Review for Final</li></ul>	

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