Programmable Controllers (RBTC 1401)

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

Prerequisite/Co-requisite: None required

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
   a. ISBN number is 978-0-07-351088-0
   a. ISBN number is 978-0-07-330342-1
3. Scientific Calculator

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

Approved mm/yyyy
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 Evaluation
Final grades will be calculated according to the following criteria:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework/Labs</td>
<td>10%</td>
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<tr>
<td>Quizzes</td>
<td>10%</td>
</tr>
<tr>
<td>Major Test</td>
<td>50%</td>
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<tr>
<td>Final</td>
<td>30%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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</tbody>
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Late Penalties will be assessed on all work turned in late. 5 points per day

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.

**Attendance Policy:**
1. Missing more than 20% of classes will result in an automatic “F” for the course.
2. Absences are counted for unexcused, excused and coming to class late.
3. Missing more than 20% of a class period will count as an absence.
4. Being tardy 3 times equals 1 absence.

**Course Policies**
1. No food, drinks, or use of tobacco products in class.
2. No foul or harsh language will be tolerated
3. Turn off all Cell Phones during lectures
4. Headphones may be worn only upon Instructor approval
5. Do not bring children to class.
6. No Cheating of any kind will be tolerated. Students caught cheating or helping someone to cheat can and will be removed from the class for the semester. Cheating can result from expulsion from LIT.
7. If you wish to drop a course, the student is responsible for initiating and completing the drop process. If you stop coming to class and fail to drop the course, you will earn an ‘F’ in the course.

**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 office in Student Services, Cecil Beeson Building.
**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**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Reference</th>
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<tbody>
<tr>
<td>1</td>
<td>Course introduction, policies and PLC’s</td>
<td>Handouts</td>
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<tr>
<td></td>
<td>• Lecture</td>
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<tr>
<td></td>
<td>• Lab: Allen Bradley PLC’s</td>
<td>SLC 100 &amp; 1000</td>
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<tr>
<td>2</td>
<td>Overview of PLC’s.</td>
<td>Chapter 1</td>
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<td>• Lecture</td>
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<td></td>
<td>• Lab: Activities Manual exercises</td>
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<tr>
<td>3</td>
<td>PLC Instruction Sets</td>
<td>Chapter 1</td>
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<td>• Lecture</td>
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<td>• Lab: Place controller in program mode and enter program into memory. Place controller in run mode and run the program.</td>
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<td>4</td>
<td>PLC Hardware</td>
<td>Chapter 2</td>
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<td></td>
<td>• Lecture</td>
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<td></td>
<td>• Lab: Chapter Exercises and Activity Manual exercises</td>
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<td>• Test 1</td>
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<tr>
<td>5</td>
<td>Number Systems</td>
<td>Chapter 3</td>
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<td></td>
<td>• Lecture</td>
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<td></td>
<td>• Lab: Conversions and Radix Function</td>
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<td>6</td>
<td>Codes</td>
<td>Chapter 3</td>
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<tr>
<td></td>
<td>• Lecture</td>
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<td></td>
<td>• Lab: Chapter and activity manual Exercises</td>
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<tr>
<td>7/8</td>
<td>Logic</td>
<td>Chapter 4</td>
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<td>• Lecture</td>
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<td></td>
<td>• Lab: Activity manual Exercises Boolean Algebra.</td>
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<td>• Test 2</td>
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<td>Date</td>
<td>Topic</td>
<td>Notes</td>
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| 9/10 | Programming Basics | • Lecture  
• Lab: Activity manual Exercises  
• Entering basic Programs, editing, and running programs using SLC 100  
|       |       | Chapter 5 |
| 11   | Fundamental PLC Wiring Diagrams | • Lecture  
• Lab: Activity manual exercises and sequential and combination processes Programming.  
• Test 3  
|       |       | Chapter 6 |
| 12/13| Programming Timers | • Lecture  
• Lab: Activity manual Exercises  
• Analyze and interpret timer ladder Logic programs  
• Program control of outputs using Timer control bits  
|       |       | Chapter 7 |
| 14/15| Programming Counters | • Lecture  
• Lab: Activity manual Exercises  
• Analyze and interpret counter ladder Logic programs  
• Apply counter function and circuitry To control systems  
|       |       | Chapter 8 |
| 16   | Combination counter and timers applied To control systems | • Lecture  
• Test 4  
• Review for Final  
|       |       | Comprehesive |