Western Technical College

31414396 Digital & PLC Ladder Logic

Course Outcome Summary

Course Information

Description	This course introduces digital number systems and logic functions as applied to the use of programmable logic controllers. An introduction to PLC Ladder Logic programming using LogixPro Simulation Software is also included. Basic programming instructions will include; XIO, XIC, OTE, OTL, OTU, Timers, Counters, Move, and Comparison Instructions.
Career Cluster	Science, Technology, Engineering and Mathematics
Instructional Level	Technical Diploma Courses
Total Credits	2

Textbooks

Programmable Logic Controllers. 5th Edition. Copyright 2017. Petruzella, Frank D. Publisher: McGraw-Hill Publishing Company. **ISBN-13**: 978-0-07-337384-3. Required.

Learner Supplies

LogixPro PLC Simulator 500 CD-ROM. **Vendor:** www.TheLearningPit.com. Required.

Core Abilities

1. **Apply mathematical concepts.**
2. **Demonstrate ability to think critically.**
3. **Demonstrate ability to value self and work ethically with others in a diverse population.**
4. **Make decisions that incorporate the importance of sustainability.**
5. **Transfer social and natural science theories into practical applications.**
6. **Use effective communication skills.**

7. Use technology effectively.

Course Competencies

1. Compare analog and digital quantities.

Assessment Strategies

1.1. Answers questions related to the learning objectives on a unit quiz.

Learning Objectives

1.a. List examples of analog quantities.
1.b. List examples of digital quantities.
1.c. Describe the difference between analog and digital quantities.
1.d. Explain the need to represent analog quantities in digital form.

2. Analyze digital number systems.

Assessment Strategies

2.1. Answers questions related to the learning objectives on a unit quiz.

Learning Objectives

2.a. Compare the binary, decimal, hexadecimal & BCD number systems.
2.b. Convert quantities between binary, decimal, BCD & hexadecimal number systems.
2.c. Define the terms bit, byte, word, least significant bit and most significant bit as they apply to binary memory locations.
2.d. Add and compare binary numbers.
2.e. Differentiate between RAM and ROM types of digital memory.

3. Analyze basis digital logic gates.

Assessment Strategies

3.1. Demonstrates performance in a lab exercise.
3.2. Answers questions related to the learning objectives on a unit quiz.

Learning Objectives

3.a. Describe the operation of the INVERTER, AND and OR logic gates.
3.b. Describe the operation of the NAND and NOR logic gates.
3.c. Describe the operation of the EXCLUSIVE OR and EXCLUSIVE NOR logic gates.
3.d. Develop the Boolean equation for the INVERTER, AND and OR logic gates.
3.e. Develop the Boolean equation for the NAND and NOR logic gates.
3.f. Develop the Boolean equation for the EXCLUSIVE OR and EXCLUSIVE NOR gates.
3.g. Complete the output Truth Table for the INVERTER, AND and OR logic gates.
3.h. Complete the output Truth Table for the NAND and NOR logic gates.
3.i. Complete the output Truth Table for the EXCLUSIVE OR and EXCLUSIVE NOR logic gates.
3.j. Build single gate logic circuits utilizing INVERTER, AND and OR logic gates.
3.k. Build single gate logic circuits utilizing NAND and NOR logic gates.
3.l. Build single gate logic circuits utilizing EXCLUSIVE OR and EXCLUSIVE NOR logic gates.

4. Develop combinational logic circuits utilizing basic logic gates.

Assessment Strategies

4.1. Demonstrates performance in a lab exercise.
4.2. Answers questions related to the learning objectives on a unit quiz.

Learning Objectives

4.a. Write Boolean equations for combinational logic circuits.
4.b. Draw a combinational logic circuit corresponding to a Boolean equation.
4.c. Test combinational logic circuits developed from a Boolean equation.
4.d. Convert between a relay ladder logic diagram and a gate logic representation.
4.e. Design a simple combinational logic circuit that represents a real world industrial application.

5. Investigate the basic operation and components of a Programmable Logic Controller.

Assessment Strategies

5.1. Written Objective Test

Learning Objectives

5.a. Discuss the basic function of a Programmable Logic Controller (PLC).
5.b. Identify the function of each component of a Programmable Logic Controller (PLC).
5.c. Discuss the Input/Output (I/O) structure of various PLCs.
5.d. Examine various types of PLC Input and Output devices.

6. Program basic PLC file addressing and bit instructions using LogixPro PLC Simulation Software.

Assessment Strategies

6.1. Skill Demonstration

Learning Objectives

6.a. Discuss proper File / Word / Bit addressing using LogixPro PLC Simulation Software.
6.b. Investigate basic PLC programming functions utilizing "examine-if-closed", "examine-if-open" and "output energize" instructions.
6.c. Apply "output latch" and "output unlatch" instructions.
6.d. Develop fundamental PLC application programs using basic relay type instructions.
6.e. Download and test your fundamental PLC application programs using LogixPro PLC Simulation Software.

7. Analyze PLC Timer instructions.

Assessment Strategies

7.1. Skill Demonstration
7.2. Written Objective Test

Learning Objectives

7.a. Examine the operation of PLC on-delay and off-delay timer instructions.
7.b. Discuss the differences between retentive and non-retentive timers.
7.c. Investigate the process of resetting various PLC timer instructions.
7.d. Apply timers in PLC programs using LogixPro PLC simulation software.

8. Analyze PLC Counter Instructions.

Assessment Strategies

8.1. Skill Demonstration
8.2. Written Objective Test

Learning Objectives

8.a. Examine the operation of PLC Counter instructions.
8.b. Compare the output status bit states during the operation of a PLC Count-Up and Count-Down instruction.
8.c. Investigate methods of resetting of a PLC counter instruction.
8.d. Explore applications of PLC up/down counter instructions.
8.e. Apply counters in PLC programs using LogixPro PLC simulation software.

9. Explore the utilization of the "one-shot" instruction in PLC programming.

Assessment Strategies

9.1. Skill Demonstration
9.2. Written Objective Test

Learning Objectives

9.a. Discuss the operation of the one-shot PLC instruction.
9.b. Investigate applications of the one-shot PLC instruction.
9.c. Apply the one-shot instruction in PLC programs using LogixPro simulation software.

10. Investigate PLC data manipulation instructions.

Assessment Strategies

10.1. Skill Demonstration
10.2. Written Objective Test

Learning Objectives

10.a. Discuss the operation of PLC data transfer instructions.
10.b. Investigate PLC data transfer instruction applications.
10.c. Apply PLC data transfer functions to common industrial control applications.
10.d. Discuss the operation of PLC comparison instructions.
10.e. Investigate PLC comparison instruction applications.
10.f. Apply PLC comparison functions to common industrial applications.
10.g. Apply the Move, Masked Move and Clear instructions in PLC programs using LogixPro simulation software.
10.h. Apply the Move, Masked Move and Clear instructions in PLC programs using RSLogix software.

11. Analyze PLC Math operation instructions.

Assessment Strategies

11.1. Skill Demonstration
11.2. Written Objective Test

Learning Objectives

11.a. Discuss the operation of basic PLC math instructions.
11.b. Investigate basic PLC math instruction applications.
11.c. Apply basic math instructions in PLC programs using LogixPro PLC simulation software.
11.d. Examine the need for BCD conversion instructions.
11.e. Discuss BCD conversion instruction operations.
11.f. Apply BCD conversion instructions using LogixPro PLC simulation software.