

Western Technical College

31414390 Introduction to PLC Systems

Course Outcome Summary

Course Information

Description	This course will cover PLC hardware and I/O wiring of an Allen Bradley PLC. More advanced programming instructions such as Bit Shift and Sequencer will be investigated along with PLC/PC drivers and communications with RSLinx. Analog inputs and outputs will be addressed along with an introduction to Touch Screen/HIM applications.
Career Cluster	Manufacturing
Instructional Level	Technical Diploma Courses
Total Credits	3.00
Total Hours	108.00

Types of Instruction

Instruction Type	Credits/Hours
Lecture	1.2 CR / 43 HR
Lab	1.8 CR / 65 HR

Course History

Last Approval Date	8/17/2015
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Pre/Corequisites

Pre/Corequis 31414395 PLC Ladder Logic Fundamentals
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Textbooks

Programmable Logic Controllers. 4th Edition. Copyright 2011. Petruzella, Frank D. Publisher: McGraw-Hill Publishing Company. **ISBN-13:** 978-0-07-351088-0. Required.

Learner Supplies

Apply mathematical concepts.
Demonstrate ability to think critically.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 1.1. Skill Demonstration
- 1.2. Written Objective Test

Criteria

Performance will be satisfactory when:

- 1.1. learner recognizes the difference in addressing schemes between the RSLogix simulated PLC environment and the MicroLogix 1500 lab training station.
- 1.2. learner compares the modular I/O structure of the RSLogix simulated PLC environment to the fixed I/O structure of the basic Micrologix 1500 lab training station.
- 1.3. learner explains the display differences between and N7 Integer file and a B3 Binary file in an actual versus simulated PLC program.
- 1.4. learner performs all aspects of commissioning, downloading, running and monitoring an actual PLC program on the RSLogix500 / MicroLogix 1500 lab training station.
- 1.5. learner compares the available Input and Output devices of the MicroLogix 1500 training station to that of the simulated environment of LogixPro.
- 1.6. learner produces basic control, sequencing, timing and counting programs as directed on the MicroLogix 1500 training station.

Learning Objectives

- 1.a. Discuss the difference in addressing schemes between the simulated and actual PLC system.
- 1.b. Compare the I/O structure of the simulated and actual PLC environment.
- 1.c. Investigate the difference between how a Binary File is displayed in an instruction in a simulated and actual PLC system.
- 1.d. Identify the operational differences between commissioning, downloading, running and monitoring a PLC program in a simulated and actual PLC system.
- 1.e. Analyze the input and output device characteristics of the lab PLC training station.
- 1.f. Develop programs on an actual PLC using basic bit, timer and counter instructions.

2. Analyze the PLC Bit Shift instruction.

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Applying</i>	<i>Status</i>	<i>Active</i>
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Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 2.1. Skill Demonstration
- 2.2. Written Objective Test

Criteria

Performance will be satisfactory when:

- 2.1. learner describes the operation of the Bit Shift Right (BSR) and Bit Shift Left (BSL) PLC instructions.
- 2.2. learner differentiates between a time driven and event driven Bit Shift application.
- 2.3. learner differentiates between recirculating and external input Bit Shift applications.
- 2.4. learner develops a PLC program as directed utilizing an external input Bit Shift operation on a simulated bottle line application.
- 2.5. learner develops a light sequence PLC program as directed utilizing a recirculating Bit Shift operation in both a simulated and actual PLC environment.

Learning Objectives

- 2.a. Discuss the operation of PLC Bit Shift instructions.
- 2.b. Investigate applications of Bit Shift PLC instructions.
- 2.c. Apply Bit Shift instructions in recirculating and external input PLC program applications.

3. Analyze the PLC Sequencer Output instruction.

Domain Cognitive Level Applying Status Active

Linked Core Abilities

Apply mathematical concepts.
Demonstrate ability to think critically.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 3.1. Skill Demonstration
- 3.2. Written Objective Test

Criteria

Performance will be satisfactory when:

- 3.1. learner describes the operation of a PLC Sequencer Output (SQO) instruction.
- 3.2. learner defines the parameters of the PLC Sequencer Output (SQO) instruction.
- 3.3. learner differentiates between a time driven and event driven Sequencer Output (SQO) application.
- 3.4. learner contrasts the bit level operation of a Bit Shift instruction to the word level function of a Sequencer.
- 3.5. learner develops a light sequence PLC program as directed utilizing a Sequence Output (SQO) instruction in both a simulated and actual PLC environment.

Learning Objectives

- 3.a. Discuss the operation of the PLC Sequencer Output (SQO) instruction.
- 3.b. Compare the operation of the Bit Shift and Sequencer PLC instructions.
- 3.c. Investigate applications of the PLC Sequencer Output (SQO) instruction.
- 3.d. Apply the Sequencer Output (SQO) instruction in simulated and actual PLC environments.

4. Analyze PLC Program Control Instructions.

Domain Cognitive Level Applying Status Active

Linked Core Abilities

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

Linked Program Outcomes

Adhere to proper safety practices and procedures.

Exhibit professionalism.

Perform preventative maintenance.

Maintain electrical and electronic devices and systems.

Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

4.1. Skill Demonstration

4.2. Written Objective Test

Criteria

Performance will be satisfactory when:

4.1. learner describes the operation of the Master Control Reset (MCR) PLC instruction.

4.2. learner contrasts the capabilities of an MCR software instruction and a hardwired MCR safety circuit.

4.3. learner develops a PLC program as directed utilizing an MCR instruction in both a simulated and actual PLC environment.

4.4. learner describes the function of the Jump and Label program control instructions.

4.5. learner defines the addressing criteria of Jump/Label instructions.

4.6. learner develops a PLC program as directed utilizing Jump/Label instructions in both a simulated and actual PLC environment.

4.7. learner describes the operation of Subroutine functions (SBR, SUB and RET) in PLC programs.

4.8. learner describes appropriate applications for Subroutine functions in PLC programs.

4.9. learner develops a PLC program utilizing Subroutine instructions for immediate switching between subroutines.

4.10. learner develops a PLC program that will switch between subroutines only upon completion of the current subroutine.

Learning Objectives

4.a. Discuss the operation of the Master Control Reset (MCR) PLC instruction.

4.b. Apply the MCR instruction in simulated and actual PLC programs.

4.c. Discuss the operation of the Jump and Label program control instructions.

4.d. Apply the Jump and Label instructions in simulated and actual PLC programs.

4.e. Discuss the operation of the Subroutine function in PLC programs.

4.f. Apply Subroutine functions in simulated and actual PLC programs.

5. Explore PLC software drivers required for communication with a personal computer.

Domain Cognitive Level Applying Status Active

Linked Core Abilities

Demonstrate ability to think critically.

Demonstrate ability to value self and work ethically with others in a diverse population.

Use effective communication skills.

Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.

Exhibit professionalism.

Maintain parts and equipment inventory including service documentation.

Maintain electrical and electronic devices and systems.

Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

5.1. Skill Demonstration

5.2. Written Objective Test

Criteria

Performance will be satisfactory when:

5.1. learner describes the basic function and characteristics of a PLC software driver.

- 5.2. learner selects the proper PLC driver for a given configuration.
- 5.3. learner transfers a functional PLC program from a MicroLogix 1000 to a MicroLogix 1500.
- 5.4. learner connects a PLC to a personal computer and installs/configures the drivers for proper communication utilizing RSLinx software.
- 5.5. learner utilizes the "RS Who" function of RSLinx to verify PLC communication.

Learning Objectives

- 5.a. Discuss the basic function and characteristics of a PLC software driver.
- 5.b. Determine the correct PLC driver for a given hardware configuration.
- 5.c. Investigate RSLinx software and its ability to install and configure PLC drivers.
- 5.d. Transfer a PLC program from one type of PLC to another.
- 5.e. Connect a PLC to a personal computer and install/configure the drivers for proper communication.
- 5.f. Investigate methods of verifying PLC communication.

6. Connect input devices to the PLC following standard input installation guidelines.

Domain Psychomotor Level Practicing Status Active

Linked Core Abilities

- Demonstrate ability to think critically.
- Demonstrate ability to value self and work ethically with others in a diverse population.
- Make decisions that incorporate the importance of sustainability.
- Transfer social and natural science theories into practical applications.
- Use effective communication skills.
- Use technology effectively.

Linked Program Outcomes

- Adhere to proper safety practices and procedures.
- Exhibit professionalism.
- Perform preventative maintenance.
- Maintain parts and equipment inventory including service documentation.
- Maintain electrical and electronic devices and systems.
- Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 6.1. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 6.1. learner describes types of PLC input devices.
- 6.2. learner properly wires push button and selector switch pilot device inputs to a MicroLogix 1000 PLC.
- 6.3. learner correctly addresses PLC inputs in the fixed I/O environment of a MicroLogix 1000.
- 6.4. learner properly wires push button and selector switch pilot devices in the modular I/O environment of the MicroLogix 1500.
- 6.5. learner correctly addresses PLC inputs in the modular I/O environment of a MicroLogix 1500.
- 6.6. learner contrasts the wiring requirements of sinking and sourcing PLC inputs.
- 6.7. learner properly wires proximity switches and ultrasonic sensors as PLC inputs in the required sinking or sourcing configuration.

Learning Objectives

- 6.a. Examine multiple types of PLC input devices.
- 6.b. Discuss proper wiring techniques to connect input devices to the PLC.
- 6.c. Investigate fixed and modular input installation and addressing.
- 6.d. Compare sinking and sourcing PLC input configurations.
- 6.e. Install various types of PLC input devices on the lab PLC.

7. Connect output devices to the PLC following standard output installation guidelines.

Domain Psychomotor Level Practicing Status Active

Linked Core Abilities

- Demonstrate ability to think critically.
- Demonstrate ability to value self and work ethically with others in a diverse population.

Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Perform preventative maintenance.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

7.1. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 7.1. learner describes types of PLC output devices.
- 7.2. learner properly wires AC indicator lamps and solenoid controlled pneumatic directional control valves as outputs from the MicroLogix 1000 PLC.
- 7.3. learner correctly installs MOV surge suppressors for AC inductive output loads.
- 7.4. learner properly wires DC indicator lamps and control relay outputs from the MicroLogix 1500 PLC.
- 7.5. learner correctly installs Diode surge suppression for DC inductive output loads.
- 7.6. learner compares sinking and sourcing PLC output configurations.
- 7.7. learner properly installs a hardwired MCR circuit for emergency disconnect of power to PLC outputs.

Learning Objectives

- 7.a. Examine types of PLC output devices.
- 7.b. Discuss proper wiring techniques to connect output devices to the PLC.
- 7.c. Investigate fixed and modular output installation and addressing.
- 7.d. Discuss requirements for PLC output voltage surge suppression.
- 7.e. Compare sinking and sourcing PLC output configurations.
- 7.f. Install various types of PLC input devices on the lab PLC.
- 7.g. Review hardwired Master Control Reset circuit function and installation.

8. Analyze PLC maintenance practices.

<i>Domain</i>	<i>Cognitive</i>	<i>Level</i>	<i>Applying</i>	<i>Status</i>	<i>Active</i>
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Linked Core Abilities

Demonstrate ability to think critically.
Demonstrate ability to value self and work ethically with others in a diverse population.
Make decisions that incorporate the importance of sustainability.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Perform preventative maintenance.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

8.1. Written Objective Test

Criteria

Performance will be satisfactory when:

- 8.1. learner lists required maintenance requirements for filters and cleaning of the PLC enclosure.

- 8.2. learner describes the need to keep all PLC wiring connections tight as part of general maintenance.
- 8.3. learner lists requirements with regard to adjustment and preventative maintenance of PLC input and output devices.

Learning Objectives

- 8.a. Describe general PLC maintenance requirements.
- 8.b. Discuss the need to keep PLC components free of dust.
- 8.c. Examine maintenance requirements for PLC input/output wiring connections.
- 8.d. Examine maintenance requirements for PLC input/output devices.

9. Perform PLC Troubleshooting procedures.

Domain Psychomotor Level Practicing Status Active

Linked Core Abilities

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

Linked Program Outcomes

- Adhere to proper safety practices and procedures.
- Exhibit professionalism.
- Maintain parts and equipment inventory including service documentation.
- Maintain electrical and electronic devices and systems.
- Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 9.1. Skill Demonstration

Criteria

Performance will be satisfactory when:

- 9.1. learner properly interprets PLC diagnostic fault indicators.
- 9.2. learner explains the need and circuit configuration for the installation of bleeder resistors for leaky I/O devices.
- 9.3. learner utilizes I/O forcing to perform PLC input/output troubleshooting.
- 9.4. learner properly applies the Temporary End instruction to perform PLC program Troubleshooting.
- 9.5. learner narrows PLC malfunctions to major categories.
- 9.6. learner describes proper signal cable/power cable routing and grounding techniques to minimize intermittent problems caused by electromagnetic interference.
- 9.7. learner performs troubleshooting procedures to determine the source of a PLC system operational fault given various scenario parameters.

Learning Objectives

- 9.a. Discuss the major categories of PLC malfunctions.
- 9.b. Investigate PLC diagnostic fault indicators.
- 9.c. Discuss four common uses of the data monitor function.
- 9.d. Examine the need for bleeder resistors for leaky I/O devices.
- 9.e. Discuss how I/O forcing is utilized in PLC input and output operational troubleshooting.
- 9.f. Examine the application of the Temporary End instruction for PLC program troubleshooting.
- 9.g. Discuss possible PLC system operational faults caused by improper wire routing and grounding.
- 9.h. Examine the process of determining the source of a PLC system operational fault given various scenario parameters.

10. Investigate PLC System Analog I/O applications.

Domain Cognitive Level Applying Status Active

Linked Core Abilities

- Apply mathematical concepts.

Demonstrate ability to think critically.
Demonstrate ability to value self and work ethically with others in a diverse population.
Make decisions that incorporate the importance of sustainability.
Transfer social and natural science theories into practical applications.
Use effective communication skills.
Use technology effectively.

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 10.1. Skill Demonstration
- 10.2. Written Objective Test

Criteria

Performance will be satisfactory when:

- 10.1. learner describes the difference between discrete and analog I/O devices.
- 10.2. learner describes applications of analog input and output PLC control.
- 10.3. learner properly wires a VFD to a PLC for discrete operational control.
- 10.4. learner correctly programs the VFD and PLC for discrete operational control.
- 10.5. learner properly wires a VFD to a PLC for analog input control and output monitoring.
- 10.6. learner correctly programs the VFD and PLC for analog input control and output monitoring.

Learning Objectives

- 10.a. Compare Digital and Analog PLC input and output devices.
- 10.b. Discuss PLC analog input/output applications.
- 10.c. Review installation and operational characteristics of Variable Frequency Drives(VFDs).
- 10.d. Investigate the discrete and analog I/O features of a VFD.
- 10.e. Interface a VFD to a PLC to demonstrate discrete and analog I/O control applications.

11. Explore Human Machine Interface (HMI) touch screen PLC applications.

Domain Cognitive Level Applying Status Active

Linked Core Abilities

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

Linked Program Outcomes

Adhere to proper safety practices and procedures.
Exhibit professionalism.
Maintain parts and equipment inventory including service documentation.
Maintain electrical and electronic devices and systems.
Build or assemble electrical, electronic and mechanical hardware under the guidance of a journeyman electrician or electromechanical technician.

Assessment Strategies

- 11.1. Skill Demonstration
- 11.2. Written Objective Test

Criteria

Performance will be satisfactory when:

- 11.1. learner describes HMI features and applications.

- 11.2. learner properly connects an HMI to a PLC to provide communication capability.
- 11.3. learner performs the required wiring and programming functions to provide HMI input control and output status display of a standard start/stop 3-wire PLC control function.
- 11.4. learner describes the function of the PLC "Scale with Parameters" instruction for analog HMI/VFD I/O applications.
- 11.5. learner performs the required wiring and programming functions to provide HMI input control and output status display of discrete start, stop and directional PLC control of a VFD.
- 11.6. learner properly wires and programs a HMI/PLC/VFD system to provide HMI input control and output status display of analog VFD speed control via the PLC.
- 11.7. learner creates a complete wiring diagram for an HMI/PLC/VFD system application including all elements as directed.

Learning Objectives

- 11.a. Discuss touch screen Human Machine Interface (HMI) features and applications.
- 11.b. Examine the process of connecting an HMI to a PLC to provide communication capability.
- 11.c. Explore the HMI/PLC programming elements required to provide HMI discrete and analog input control to a PLC.
- 11.d. Examine the required HMI/PLC programming to provide HMI display of discrete and analog output status of a PLC.
- 11.e. Examine the interaction of a complete PLC system including an HMI, PLC and VFD.
- 11.f. Investigate the programming required to have a touchscreen provide discrete and analog control of a VFD via a PLC and display the VFD operational status.

- 11.g. Discuss the requirements of a properly drawn wiring diagram for an HMI/PLC/VFD system application.