Western Technical College

10664102 Intro to Industrial Control Systems

Course Outcome Summary

Course Information

Description	In this course, learners are introduced to basic concepts of industrial computer-controlled systems. The learner explores various types of programming using robots and PLCs and participates in lab experiments designed to introduce programming principles, electronic inputs and outputs (analog and digital), communication between system components including Ethernet protocols. Upon completion of the course, learners will be able to explain how the control processes are utilized to automate manufacturing facilities.
Career Cluster	Manufacturing
Instructional Level	Associate Degree Courses
Total Credits	2
Total Hours	54

Textbooks

No textbook required.

High Impact Practices

1. Community Engagement - in this course, you will explore and reflect on opportunities presented by the college and the program to become more involved in the community (ex: Employer Spotlights, Volunteerism, Professional Associations, and Community Action Boards)

Course Competencies

1. Investigate fundamentals of industrial control systems.

Assessment Strategies

1.1. Skill demonstration

1.2. In the lab
1.3. Written product

Criteria

You will know you are successful when

1.1. you explain ladder logic
1.2. you relate various PLC components to their associated functions
1.3. you diagram PLC ladder logic.
1.4. you connect the PLC to the Ethernet network

Learning Objectives

1.a. Explore basic hardware components of Programmable Logic Controllers (PLC)
1.b. Describe PLC Input/Output (I/O) addresses and symbols.
1.c. Explore PLC programming concepts and languages.
1.d. Examine program commands and their related functions.
1.e. Describe how to connect the PLC to the Ethernet network.
1.f. Describe how to upload and download a PLC program.
1.g. Configure PLC software to match connected hardware.

2. Investigate basic Ethernet communications.

Assessment Strategies

2.1. Skill demonstration
2.2. In the lab
2.3. Written product

Criteria

You will know you are successful when

2.1. you identify components of an industrial network.
2.2. you differentiate among industrial networks.
2.3. you diagram TCP/IP industrial network.
2.4. you connect to an industrial network using a switch according to instructor specifications.
2.5. you identify the components of an HMI network.
2.6. you connect an HMI panel to the industrial network.

Learning Objectives

2.a. Define the function and components of an industrial network.
2.b. Describe three levels of industrial networks.
2.c. Describe the basic operation of a TCP/IP industrial network.
2.d. Practice connecting to an industrial network using an unmanaged switch.
2.e. Practice connecting to an industrial network using a managed switch.
2.f. Define the function and components of an HMI panel.
2.g. Practice connecting an HMI panel in an industrial network.

3. Explore basic robot programming.

Assessment Strategies

3.1. Skill demonstration
3.2. In the lab
3.3. Written product

Criteria

You will know you are successful when

3.1. you simulate powering up industrial robot controller safely.
3.2. you simulate powering down industrial robot safely.
3.3. you simulate the activation of the emergency stop.
3.4. you simulate the recovery from an emergency stop event.
3.5. you simulate switching between automatic and manual operating modes.
3.6. you simulate enabling the robot in Manual Operating Mode.
3.7. you simulate restarting the main controller.
3.8. you identify robot joint numbers.

3.9. you identify teach pendant features.

Learning Objectives

3.a. Describe industrial robot safety features.
3.b. Relate the use of teach pendant to control robot motion.
3.c. Identify the features of the main controller.
3.d. Describe joints and axes in an industrial robot arm.
3.e. Compare industrial robot Cartesian coordinate vs Joint Motion.
3.f. Describe industrial arm robot mounting.
3.g. Simulate operating an industrial robot.

4. Explore basic CNC programming.

Assessment Strategies

4.1. Skill demonstration
4.2. In the lab
4.3. Written product

Criteria

You will know you are successful when

4.1. you explain the function and operation of a lathe.
4.2. you explain the function and operation of a turning center.
4.3. you explain the function and operation of a milling machine.
4.4. you explain the function and operation of a machining center.
4.5. you contrast dimensional Cartesian coordinate systems.
4.6. you identify three methods of creating a CNC program.
4.7. you develop a basic CNC program.
4.8. you differentiate absolute and incremental CNC position coordinates.
4.9. you explain cutter compensation in a CNC program

Learning Objectives

4.a. Describe basic CNC machining.
4.b. Describe basic and programming.
4.c. Define basic CNC machining workspace.
4.d. Explore CNC programming with circular interpolation.

5. Develop basic Programmable Controller Logic (PCL) programming.

Assessment Strategies

5.1. Skill demonstration
5.2. In the lab
5.3. Written product

Criteria

You will know you are successful when

5.1. you explain the function and operation of a Programmable Logic Controller (PLC).
5.2. you assemble PLC components.
5.3. you diagram basic PLC ladder logic programs according to instructor specifications.
5.4. you connect PLC to the Ethernet network.
5.5. you use software to upload and download PLC projects.
5.6. you interpret a PLC input/output diagram.
5.7. you write a PLC logic program that functions according to instructor specifications.
5.8. you operate a PLC project using an HMI panel according to user specifications.

Learning Objectives

5.a. Describe the function and operation of a Programmable Logic Controller (PLC).
5.b. Describe the basic components of a PLC
5.c. Describe the basic structure of a PLC ladder logic program
5.d. Configure a point-to-point Ethernet network
5.e. Practice using software to download and upload PLC projects.
5.f. Practice interpreting a PLC input/output diagram.
5.g. Write a PLC logic program.

5.h. Describe how to operate a PLC project that uses an HMI panel.
5.i. Practice operating a PLC project that uses an HMI panel.

6. Operate VFD motor control.

Assessment Strategies

6.1. Skill demonstration
6.2. In the lab
6.3. Written product

Criteria

You will know you are successful when

6.1. you relate the operation of an AC variable frequency drive to a single and three-phase motor.
6.2. you connect an AC variable frequency drive to main power and to a single and three-phase motor.
6.3. you use a keypad to operate an AC variable frequency drive according to instructor specifications.
6.4. you apply VFD parameters to an AC variable frequency drive according to instructor specifications.
6.5. you use a PLC-controlled VFD system to drive a single and three-phase motor according to instructor specifications
6.6. you respond to error codes within a VFD in a manner that restores the system according to instructor specifications.

Learning Objectives

6.a. Describe the function and operation of an AC variable frequency drive.
6.b. Interpret the wiring connections to an AC variable frequency drive.
6.c. Identify functions of menus for an AC variable frequency drive.
6.d. Practice using a keypad to operate an AC variable frequency drive.
6.e. Identify types of VFD parameters.
6.f. Practice operating a PLC-controlled VFD system.
6.g. Identify error codes within a VFD.
6.h. Practice resetting a VFD after an error occurs.

7. Explore electronic sensors.

Assessment Strategies

7.1. Skill demonstration
7.2. In the lab
7.3. Written product

Criteria

You will know you are successful when

7.1. you describe the basic function and operation of an electronic sensor.
7.2. you classify digital electronic sensors.
7.3. you classify analog electronic sensors.
7.4. you compare digital and analog electronic sensor applications according to instructor specifications.
7.5. you interface an electronic sensor input with a PLC according to instructor specifications.
7.6. you determine whether input is within specification using performance measurement characteristics of the various electronic sensors according to instructor specifications.

Learning Objectives

7.a. Describe the basic function and operation of an electronic sensor.
7.b. Describe the characteristics and operation of digital electronic sensor (inductive, capacitive, Hall-Effect, photo-sensor, and fiber optic).
7.c. Describe the characteristics and operation of analog electronic sensor (inductive, capacitive, Hall-Effect, photo-sensor, and fiber optic).
7.d. Practice connecting and operating electronic sensors.
7.e. Observe performance characteristics of the various electronic sensors.
7.f. Practice connecting a variety of electronic sensors to PLCs.

8. Apply industrial manufacturing controls to a basic automated system.

Assessment Strategies

8.1. Skill demonstration
8.2. In the lab

8.3. Written product

Criteria

You will know you are successful when

8.1. you verify that PLC power and control indicators are correct.
8.2. you verify that actuator sensors are operating correctly.
8.3. you verify that a PLC output operates correct machine function.
8.4. you measure DC voltage using a multimeter for inputs and outputs.
8.5. you interpret sensor applications (limit switch, photoelectric sensor, inductive proximity sensor, magnetic reed sensor) applied as inputs to automated manufacturing system control.
8.6. you adjust sensor application (limit switch, photoelectric sensor, inductive proximity sensor, magnetic reed sensor) applied as inputs to automated manufacturing system control.
8.7. you connect AC Variable Frequency Drive to an automated manufacturing system according to a schematic.
8.8. you connect a pneumatic circuit to an automated manufacturing system according to a schematic.

Learning Objectives

8.a. Construct an automated manufacturing system to control a machine function.
8.b. Integrate pneumatics into the automated manufacturing system.
8.c. Integrate sensors into the automated manufacturing system.