



Western Technical College

## 10620135 Basic Industrial Controls

### Course Outcome Summary

#### Course Information

<b>Description</b>	A variety of industrial control components and systems are explored. Emphasis is placed on relay control components and ladder logic applications along with three phase motors and motor starting. Photo electric and proximity sensors are introduced. Electronic overload protection and "soft" motor starting are explored. Adjustable Frequency AC motor drives are covered. Actual industrial equipment and manuals are used by students in the development and testing of practical circuits and systems. Students will interpret and create wiring diagrams.
<b>Career Cluster</b>	Manufacturing
<b>Instructional Level</b>	Associate Degree Courses
<b>Total Credits</b>	2
<b>Total Hours</b>	54

#### Textbooks

*Electric Motors and Control Systems*. 3rd Edition. Copyright 2020. Petruzella, Frank. Publisher: McGraw-Hill Publishing Company. **ISBN-13:** 978-1-260-25805-9. Required.

#### Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. Required.

#### Success Abilities

1. Cultivate Passion: Enhance Personal Connections
2. Live Responsibly: Embrace Sustainability

## Program Outcomes

1. Troubleshoot electrical and mechanical systems and devices

## Course Competencies

### 1. Explore the design and operation of electrical pilot devices.

#### Assessment Strategies

- 1.1. Skill Demonstration
- 1.2. Written Product

#### Criteria

*You will know you are successful when*

- 1.1. you categorize pilot devices in terms of their function.
- 1.2. you identify the electrical symbol for various pilot devices.
- 1.3. you develop latching and jogging control circuits.
- 1.4. you build and verify the operation of latching and jogging control circuits.
- 1.5. you develop non-timed sequence control circuits.
- 1.6. you build and verify the operation of non-timed sequence control circuits.

#### Learning Objectives

- 1.a. Identify the electrical symbol for various pilot devices.
- 1.b. Construct practical control circuits using various pilot devices.
- 1.c. Construct jogging control circuits.
- 1.d. Produce non-timed sequence control circuits.
- 1.e. Construct non-timed sequence control circuits.
- 1.f. Utilize appropriate instrumentation for pilot device testing.
- 1.g. Implement switches, relays, and multiple methods of motor starting.

### 2. Explore the design and operation of timing and non-timing electrical relays and contactors.

#### Assessment Strategies

- 2.1. Skill Demonstration
- 2.2. Written Product

#### Criteria

*You will know you are successful when*

- 2.1. you classify control relays according to type and function.
- 2.2. you describe the electrical properties of control relays.
- 2.3. you build practical control circuits using selected control relays.
- 2.4. you verify the operation of control circuits with control relays.

#### Learning Objectives

- 2.a. Classify control relays according to type and function.
- 2.b. Explore the electrical properties of control relays.
- 2.c. Construct practical control circuits using selected control relays.
- 2.d. Confirm the operation of control circuits with control relays.

### 3. Analyze photoelectric and proximity switches.

#### Assessment Strategies

- 3.1. Skill Demonstration
- 3.2. Written Product

#### Criteria

*You will know you are successful when*

- 3.1. you demonstrate the operation of through-beam photoelectric devices.
- 3.2. you demonstrate the operation of retro reflective photoelectric devices.
- 3.3. you design circuits using photoelectric devices.
- 3.4. you verify the operation of circuits containing photoelectric devices.

#### **Learning Objectives**

- 3.a. Investigate the operation of through-beam photoelectric devices.
- 3.b. Investigate the operation of retro reflective photoelectric devices.
- 3.c. Investigate the operation of diffuse scan photoelectric devices.
- 3.d. Discuss the term "modulated light source."
- 3.e. Compare "2-wire" and "3-wire" control configurations.
- 3.f. Examine "Sinking" and "Sourcing" outputs for proximity switches.

### **4. Explore the design and operation of an AC induction motor.**

#### **Assessment Strategies**

- 4.1. Skill Demonstration
- 4.2. Written Product

#### **Criteria**

*You will know you are successful when:*

- 4.1. you describe the function of the parts of an AC induction motor.
- 4.2. you describe the function and operation of a rotating magnetic field.
- 4.3. you explain how SLIP affects the torque, speed, and current of an AC induction motor.
- 4.4. you measure voltage and current applied to an AC induction motor.
- 4.5. you build a control and power circuit for an AC induction motor.
- 4.6. you verify operation of the control and power circuit for an AC induction motor.

#### **Learning Objectives**

- 4.a. Identify the parts of an AC induction motor.
- 4.b. Examine the function and operation of a rotating magnetic field.
- 4.c. Explore how SLIP affects the torque and speed of an AC induction motor.
- 4.d. Explore how SLIP affects current of an AC induction motor.
- 4.e. Calculate voltage and current applied to an AC induction motor.
- 4.f. Confirm operation of the control and power circuit for an AC induction motor.

### **5. Explore the design and operation of a Variable Frequency Drive.**

#### **Assessment Strategies**

- 5.1. Skill Demonstration
- 5.2. Written Product

#### **Criteria**

*You will know you are successful when*

- 5.1. you analyze the simulated sinusoidal wave form reconstruction of a Variable Frequency Drive.
- 5.2. you explain the circuitry of a Variable Frequency Drive.
- 5.3. you identify the relationship between frequency and speed in a 3Ø motor.
- 5.4. you demonstrate methods of operational control for a Variable Frequency Drive.
- 5.5. you describe the affect of parameter settings on operation of a Variable Frequency Drive.

#### **Learning Objectives**

- 5.a. Explore the circuitry of a Variable Frequency Drive.
- 5.b. Investigate the simulated sinusoidal wave form reconstruction of a Variable Frequency Drive.
- 5.c. Explore the relationship between frequency and speed in a 3Ø motor.
- 5.d. Investigate methods of operational control for a Variable Frequency Drive.
- 5.e. Identify the effect of parameter settings on operation of a Variable Frequency Drive.

### **6. Demonstrate multiple methods using devices for circuit and 3 Phase motor protection.**

#### **Assessment Strategies**

- 6.1. Skill Demonstration
- 6.2. Written Product

## Criteria

*You will know you are successful when*

- 6.1. you describe motor breakers, fuses, bimetal overloads, electronic overloads, thermal overloads, and circuit breakers.
- 6.2. you explain operation of fuses and circuit breakers.
- 6.3. you build protective circuits using appropriate circuitry.
- 6.4. you verify operation of protective circuit.

## Learning Objectives

- 6.a. Identify motor breakers, fuses, bimetal overloads, electronic overloads, thermal overloads, and circuit breakers.
- 6.b. Investigate operation of fuses and circuit breakers.
- 6.c. Construct protective circuits using appropriate circuitry.
- 6.d. Ascertain operation of protective circuit.

## 7. Create ladder diagrams.

### Assessment Strategies

- 7.1. Skill Demonstration
- 7.2. Written Product

## Criteria

*You will know you are successful when*

- 7.1. you define standard symbols in ladder diagrams.
- 7.2. you draw ladder diagrams utilizing standard symbols.
- 7.3. you fix any problems with circuit design.

## Learning Objectives

- 7.a. Convey standard symbols in ladder diagrams.
- 7.b. Draw ladder diagrams utilizing standard symbols.
- 7.c. Fix any problems with circuit design.
- 7.d. Apply industry standards methods and terminology in ladder diagrams.

## 8. Construct control circuits.

### Assessment Strategies

- 8.1. Skill Demonstration
- 8.2. Written Product

## Criteria

*You will know you are successful when*

- 8.1. you build circuits as outlined by ladder diagrams.
- 8.2. you verify operation of circuits built.
- 8.3. you fix any problems with constructed circuits.
- 8.4. you follow safety procedures.

## Learning Objectives

- 8.a. Build circuits as outlined by ladder diagrams.
- 8.b. Inspect operation of circuits built.
- 8.c. Fix any problems with constructed circuits

## 9. Operate a 3 phase motor.

### Assessment Strategies

- 9.1. Skill Demonstration
- 9.2. Written Product

## Criteria

*You will know you are successful when*

- 9.1. you identify methods for starting and controlling the speed of a 3Ø motor.

- 9.2. you wire motor starters to a motor.
- 9.3. you wire variable frequency drives to a motor.
- 9.4. you identify options for Variable Frequency Drive starting and control programming.
- 9.5. you identify options for motor starting and control circuitry.

**Learning Objectives**

- 9.a. Find method options for starting and controlling the speed of a 3Ø motor.
- 9.b. Wire motor starters to a motor.
- 9.c. Wire Variable Frequency Drives to a motor.
- 9.d. Inspect options for VFD starting and control programming.
- 9.e. Inspect options for motor starting and control circuitry.