

## **EPEC Automation Module 1: Introduction to Automation**

### **Objectives**

Upon completion of this module, you will be able to:

- Understand how electricity is generated
- Explain the differences between alternating current and direct current
- Identify how current and resistance is measured
- Describe the relationship between amperes, volts, and ohms
- Identify the properties of resistance
- Explain how electricity flows
- Use Ohm's law and the power wattage formula
- Understand choosing automation over manual control
- Explain how inputs send signals to logic devices
- Identify logic devices and how they collect and interpret signals
- Describe how output devices respond to signals from logic devices
- Interpret ladder diagrams
- Understand input switches and how to recognize them on a diagram
- Describe logic devices and their functions and symbols
- Identify output devices and symbols
- Interpret ladder diagram connections

### **Chapter Outline**

#### Chapter 1: Basics of Electricity

- How electricity is generated
- Types of electrical current
- Amperes, volts, and ohms
- Conductors and insulation
- Circuit protection
- Ohm's Law and the Power Formula

#### Chapter 2: Basics of Automation

- Automation versus manual control
- Input devices
- Logic devices
- Output devices

#### Chapter 3: Language of Automation

- Ladder diagrams
- Input switch symbols
- Logic device symbols
- Output device symbols

### **EPEC Workbook Activities**

- Chapter questions and exercises
- Project Assignment

### **Module Quiz**

## EPEC Automation Module 2: Basic Automation

### Objectives

Upon completion of this module, you will be able to:

- Explain the differences between a wiring diagram and a ladder diagram
- Describe the function of a coil
- Explain the solenoid principle
- Explain why coils are enclosed
- Explain the principal function of an overload relay
- Explain the principal function of fuses and circuit breakers
- Identify the four basic types of overload relay
- Describe the difference between contactors and motor starters
- Explain the function of a holding contact
- Describe the purpose of a shading coil in a circuit
- Explain the functional differences between two-wire and three-wire motor controls
- Explain the functional differences between fuses and circuit breakers
- Explain the purposes of fuses and circuit breakers in a motor control circuit
- Describe the purpose of a transformer in a motor control circuit
- Explain how transformers change the incoming voltage for a motor control circuit
- Explain the difference between discrete (digital) and analog inputs
- Explain how inputs function in a motor control circuit
- Identify how smart relays function in a control circuit
- Describe the types of timers that are available for automation controls
- Explain the value of programmable logic controllers (PLCs)
- Explain why notes are provided on ladder diagrams
- Explain the difference between discrete (digital) and analog outputs
- Recognize examples of discrete and analog output signals
- Describe the advantages of PLCs
- Describe the purposes of enclosures in control circuits
- Distinguish between open and enclosed control devices
- Recall the different safety standards that regulate the proper use of enclosures

- Recognize the different NEMA ratings for enclosures

### Chapter Outline

#### Chapter 1: Coils

- Wiring and ladder diagrams
- Coil types

#### Chapter 2: Overload Relays

- Types of overload relays
- Melting alloy overload relays
- Bimetal overload relays
- Electronic overload relays

#### Chapter 3: Motor Controls

- Two-wire and three-wire control
- Contactors and motor starters
- Shading coils

#### Chapter 4: Protective Devices and Transformers

- Fuses and circuit breakers
- Transformers

#### Chapter 5: Input Signals

- Discrete (digital) input signals
- Analog input signals

#### Chapter 6: Logic Devices

- Smart relays and timers
- PLCs
- Ladder diagram logic

#### Chapter 7: Output Signals

- Types of outputs  
Common logic applications

#### Chapter 8: Enclosure

- Enclosures
- Open or enclosed devices
- Enclosure standards and NEMA ratings

### EPEC Workbook Activities

- Chapter questions and exercises
- Project Assignment

### Module Quiz

## **EPEC Automation Module 3: Intermediate Automation**

### **Objectives**

Upon completion of this module, you will be able to:

- Explain how automation can improve process and system efficiency
- Identify how automation can minimize equipment damage and system downtime
- Describe how automation promotes worker and workplace safety
- Identify the goals of automation technology
- Describe the function and purpose of a closed loop system
- Explain the function and application of pressure switches and transducers
- Identify the types and function of limit switches
- Identify the different types of no touch devices
- Explain the function of thumbwheel switches and HMI devices
- Describe the function and purpose of soft starters and drives
- Explain the value of using terminal blocks in a system
- Identify the organizations and publications that regulate safety in the industrial workplace
- Identify control devices that protect machines and employees during operation
- Recognize control panel features that are industry standard and safety compliant
- Distinguish the different devices that are designed to stop machines for emergencies or for maintenance
- Explain how pressure, limit, and interlock switches all protect equipment and workers from damage and injury
- Describe how PPE and lockout/tagout requirements promote safe working environments
- Recognize the factors to consider when determining the logic needs of a system
- Explain the function of semiconductors
- Identify the differences between the electromechanical and solid-state relays
- Identify the different types of timers
- Explain the function of PLCs in an automated system

### **Chapter Outline**

#### **Chapter 1: Automation Design Goals**

- Design goals and questions
- Automation data
- Promoting safe workplaces

- Pull cords and disconnects
- Pressure and limit switches
- Interlocks
- PPE and LOTO

#### **Chapter 2: Efficient Operations**

- Closed loop systems
- Pressure switches and transducers
- Limit switches
- Touch and no-touch sensors
- Encoders
- Light curtains
- Thumbwheel switches and HMIs
- Soft starters and drives
- Terminal blocks

#### **Chapter 4: Effective Logic Design**

- Logic considerations
- Types of semiconductors
- Pros and cons of solid-state devices
- Types of relays and timers
- PLCs
- Communications

#### **Chapter 3: Safe Operations**

- Motor risks and safety controls
- Control panels

### **EPEC Workbook Activities**

- Chapter questions and exercises
- Project Assignment

### **Module Quiz**

## **EPEC Automation Module 4: Advanced Automation**

### **Objectives**

Upon completion of this module, you will be able to:

- Distinguish between discrete and analog inputs
- Explain the functionality of a barcode reader
- Identify appropriate applications for optical sensors
- Describe how a laser distance sensor operates
- Identify the different types of specialty sensors
- Understand how each component functions in a PLC
- Explain how PLC logic is depicted on ladder diagrams
- Explain the steps involved in a PLC scan
- Describe the difference between sinking and sourcing
- Explain how a PLC can function as a PID controller
- Distinguish between discrete and analog outputs
- Describe the function and purpose of reversing motor starters
- Explain how reduced voltage starters control motors
- Distinguish between the function of servo motors and stepper motors
- Describe how CNC technology is used in industrial applications
- Describe the characteristics of a bus network, ring network, star network, tree topology, and mesh network
- Explain the difference between unmanaged and managed switches
- Describe the Internet of Things (IoT)

### **Chapter Outline**

#### Chapter 1: Advanced Inputs

- Readers and scanners
- Optical sensors
- Laser distance sensors
- Specialty sensors

#### Chapter 2: Advanced Logic

- PLC functionality and ladder logic
- PLC scans
- Sinking and sourcing
- PID controllers

#### Chapter 3: Advanced Output Controls

- Reversing motor starters
- Reduced voltage controllers
- Servo and stepper motors
- CNC machinery

#### Chapter 4: IT and OT Networking

- Types of networks
- Managed and unmanaged switches
- The Internet of Things (IoT)
- Industrial Internet of Things (IIoT)

### **EPEC Workbook Activities**

- Chapter questions and exercises
- Project Assignment

### **Module Quiz**

## **EPEC Automation: Final Exam**

This exam presents 100 questions based on the content presented in Automation Modules 1 through 4. There is no time limit for this exam, and you need to score 75% or higher to pass.

## **EPEC Automation: Capstone Project**

### **Objectives**

Upon completion of this module, you will be able to:

- Review plans and specifications
- Create a bill of materials for the products selected
- Determine the best product for each application
- Develop a cut package of all selected products including related items from the EPEC Triangle
- Consider product selection variables and trade-offs

### **Chapter Outline**

- A. Review ladder diagram of a sorter conveyor system
- B. Complete EPEC Capstone activities and assignments