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.
- Describe the relationship between amperes, volts, and ohms.
- Explain how electricity flows.
- Use Ohm’s law and the power wattage formula.
- Understand choosing automation over manual control.
- Explain how Inputs send information to logic devices.
- Identify logic devices and how they collect data.
- Describe how output devices become the action to the decision made from the logic device.
- Interpret ladder diagrams.
- Identify symbols used on ladder diagrams for input switches, logic devices, output devices and connections.

Chapter Outline

Chapter 1: Electricity Introduction
   A. Types of Current
   B. Amps and Volts
   C. Conductors and Insulation
   D. Circuits and Circuit Protection
   E. Ohm’s Law

Chapter 2: Automation Introduction
   A. Input Devices
   B. Logic Devices
   C. Timing Relays
   D. PLCs
   E. Output Devices

Chapter 3: Language of Automation
   A. Momentary and Maintained Contacts
   B. Ladder Diagrams
   C. Normally Open and Normally Closed
   D. Control Panels
   E. Types of Switches
   F. Logic and Output Devices

Chapter Four: EPEC Assignment
   A. EPEC Electrical System: Ladder Diagram of Packaging Conveyor
   B. EPEC Assignment
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.
• Identify the solenoid principle.
• Explain the principal function of an overload relay.
• Explain the principal function of fuses and circuit breakers.
• Identify the four basic types of overload relays.
• Describe how magnetic control starts.
• Explain the purpose of a shading coil.
• Identify a holding contact on a diagram and know its function.
• Explain what circuit protective devices are designed to do and where they can be found.
• Describe the functions of a transformer.
• Explain the sequence of three phase power.
• Give an example of a two-wire and three-wire controls.
• Explain what the digital input signal does.
• Describe discrete inputs.
• Identify the function and design of an analog input signal.
• Understand how logic works in PLCs.
• Explain why notes are written on the side of a diagram.
• Understand how different kinds of signals can be used as outputs.
• Identify analog output signals.
• Identify the standards for enclosures.
• Identify devices that are self-contained within enclosures.

Chapter Outline

Chapter 1: System Functions
   A. System Functions
   B. Wiring Diagrams and Ladder Diagrams
   C. Coils and the Solenoid Principle

Chapter 2: System Operations
   A. System Operations
   B. Fuses and Circuit Breakers
   C. Overload Relays

Chapter 3: Automatic Control
   A. Magnetic Control
   B. Shading Coils
   C. Holding Contacts
Chapter 4: More Complex Systems
   A. Circuit Protective Devices
   B. Transformers
   C. Complex Systems using Three-phase Power

Chapter 5: Control Method Choices
   A. Two-wire Controls
   B. Three-wire Controls

Chapter 6: Input Signals
   A. Digital Input Signals
   B. Discrete Inputs
   C. Analog Input Signals

Chapter 7: Decision Makers
   A. Programmable Logic Controller (PLC) Logic
   B. Notes on the Ladder Diagram

Chapter 8: Discrete Outputs
   A. Types of Outputs
   B. Electromechanical Relay Logic

Chapter 9: Enclosures
   A. Standards for Enclosure
   B. Self-contained Devices

Chapter 10: EPEC Assignment
   A. EPEC Electrical System: Ladder Diagram of Packaging Conveyor
   B. EPEC Assignment
EPEC Automation Module 3: Intermediate Automation

Objectives

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

- Describe how automation reduces repetitive motion injuries.
- Describe the difference between constant torque and constant horsepower.
- Understand the need for several different stop devices in an industrial setting.
- State what a transducer is designed to do.
- Explain the roles of an input and a relay.
- Explain what a closed loop system function is.
- Define the role of the no touch sensor.
- Explain the meaning behind the term Supervisory Control and Data Acquisition (SCADA).
- Understand the process of the system designer regarding the logic for a system.
- Explain what semiconductors do.
- Identify the differences between the electromechanical relay and solid state.
- Identify the different terms used for timers.
- Explain what PLCs are designed to do.
- Describe the need for a soft starter.
- List the different types of soft starters.
- Explain the reason for the need of a cooled cabinet.
- Describe how a terminal block fits within the system.
- Describe what the communication system does in a business.
- Decipher why it is important to gather data from the plant floor networks.
- Explain what the NEC defines when it comes to working on equipment.
- List the steps to create safe work environments.

Chapter Outline

Chapter 1: Reducing Risk of Harm
   A. Design Considerations
   B. Reducing Risk with Automation

Chapter 2: Motors, Controls, Risks, and Safety
   A. Motors and Constant Torque
   B. Emergency Stop Devices
   C. Transducers
   D. Types of Inputs
   E. Closed Loop Systems
   F. No Touch Sensors
   G. Operator Interface Panels and Human Machine Interfaces (HMI)
   H. Supervisory Control and Data Acquisition (SCADA)
Chapter 3: Logic Options
   A. Solid State Controls
   B. Semiconductors
   C. TDOE and TDOD Timers
   D. PLCs

Chapter 4: Work/Load Automation Options
   A. Soft Starter Design Considerations
   B. Types of Soft Starters

Chapter 5: Distribution and Protection
   A. Cooled Cabinets
   B. Terminal Blocks
   C. Communication Systems
   D. NEC Safety Requirements and Procedures

Chapter 6: EPEC Assignment
   A. EPEC Electrical System: Ladder Diagram of a Bottling Conveyor
   B. EPEC Assignment
EPEC Automation Module 4: Advanced Automation

Objectives

Upon completion of this module, you will be able to:
- Recognize the different types of advanced inputs.
- Explain what a bar code reader’s functions are.
- Define the three most common optical sensors and how they operate.
- Describe the function of a laser distance sensor.
- Explain the need for different types of specialty sensors.
- Describe the differences between PNP and NPN solid state transistors.
- Understand what each component does in a PLC.
- Describe the principle of magnetism and how it applies to the design of AC motors.
- Explain the ladder diagram and how power flows to the motor.
- Explain how a PID controller interacts with a machine.
- Explain how an analog sensor can provide advanced outputs.
- Describe a bus network, ring network, star network, tree topology, and mesh network.
- Explain the difference between unmanaged and managed switches.
- Describe the IIOT (Internet of Things).

Chapter Outline

Chapter 1: Advanced Inputs
A. Types of Advanced Inputs
B. Bar Code Readers
C. Optical Sensors
D. Specialty Sensors

Chapter 2: Advanced Logic
A. PNP and NPN Transistors
B. Components of the PLC System
C. AC Motor Design and Operation
D. PID Controllers

Chapter 3: Advanced Outputs
A. Advanced Outputs
B. PID Controller Corrections

Chapter 4: Convergence of IT and OT Networking
A. Types of Networks
B. Unmanaged and Managed Switches
C. The IIOT (Internet of Things)

Chapter 5: EPEC Assignment
A. EPEC Electrical System: Ladder Diagram of a Batching System
B. EPEC Assignment
EPEC Automation: Final Exam

This exam presents 100 random 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. EPEC Electrical System: Ladder Diagram of a Sorter Conveyor System
B. EPEC Capstone Project