

## C-202 Electrical Motor Control Systems 1 Course Credential

### About this course

This SACA certified C-202 Electrical Motor Control Systems 1 course prepares students for a career in an industrial automated 4.0 industry environment. Participants are taught to connect, adjust, and operate electrical motor control circuits using these electrical components: 3-phase AC motors, reversing magnetic motor starters with overloads, drum switches, control relays, timer relays, pushbutton switches, selector switches, limit switches, pressure switches, and float switches.

### Modules to be covered

1. Standard 202.1 Apply approved safety practices for electric motor control systems
  - Performance Indicators:
    - Perform a lockout/tagout
    - Identify and correct electrical hazards
  - Knowledge Indicators:
    - Describe electrical and electric motor hazards
    - Describe PPE/ safe dress for operating or troubleshooting motor control systems
    - Describe the purpose of the lockout/tagout system used in industry
    - Describe how to determine if equipment is properly grounded
    - Describe the basic rules of electrical safety
2. Standard 202.2 Interpret Ladder logic Schematics
  - Performance Indicators:
    - Identify the symbols for transformers, lamps, motors, solenoids, meters, fuses, coils, contacts, limit switches, float switches,



pressure switches, magnetic motor starters, manual motor starters, and pushbutton switches, and selector switches

- Knowledge Indicators:
  - Interpret ladder diagram of a control circuit
  - Draw a ladder diagram of a control circuit
  - Describe the function of an electrical ladder diagram
  - Describe six rules of drawing a ladder diagram
  - Describe the function of electrical control systems
  - Describe the operation of a separate control and power circuits
  - Describe the operation of AND, OR, NOT, NOR, and NAND circuits

### 3. Standard 202.3 Make proper electrical ground connections

- Performance Indicators:
  - Use a multimeter to measure the voltage at a point referenced to ground
  - Install a grounding circuit for an electrical control system
  - Inspect and verify an installed grounding circuit
  - Identify and interpret NEC code for an electrical system
- Knowledge Indicators:
  - Define a ground
  - Describe the parts of an electrical control system grounding circuit
  - Explain the importance of the equipment ground connection
  - Describe the operation of grounded and ungrounded systems
  - Explain the function of a neutral line
  - Describe the National Electrical Code (NEC) grounding requirements for electrical systems

### 4. Standard 202.4 Connect and operate a 3-phase motor

- Performance Indicators:
  - Connect and operate a dual-voltage three-phase motor for low voltage operation
  - Connect and operate a dual-voltage three-phase motor for high voltage operation



- Knowledge Indicators:
  - Interpret a motor nameplate
  - Describe the functions of common standards associated with electrical control
  - Describe the basic operation of three-phase power
  - Describe the three-phase voltage systems: Wye and Delta
  - Explain why time-delay fuses are used with motor starting circuits
  - Describe the operation of overcurrent protection devices
  - Define service factor and explain its importance
  - Explain why dual-voltage motors should be run on the highest available voltage
  - Select heaters for a NEMA overload
- 5. Standard 202.5 Connect and operate a manual motor control circuit
  - Performance Indicators:
    - Connect and operate a motor control circuit with a manual motor starter
    - Test the operation of a manual motor starter using a multimeter
    - Test the low-voltage protection of a manual starter
    - Adjust and test the trip level of a bimetallic overload
    - Connect and operate a drum switch to reverse a motor
  - Knowledge Indicators:
    - Describe functions of motor control
    - Describe the basic requirements for motor installation
    - Describe types of motor starters
    - Describe the operation and importance of low-voltage protection
    - Describe the function and operation of magnetic and thermal overloads
- 6. Standard 202.6 Select and install a control transformer
  - Performance Indicators:
    - Calculate the turns ratio of a transformer
    - Calculate the secondary voltage of a transformer
    - Connect and operate a control transformer



- Test a control transformer
  - Size a control transformer
  - Knowledge Indicators:
    - Describe the operation of a control transformer and give its schematic symbol
7. Standard 202.7 Connect and operate a basic ladder logic control circuit
- Performance Indicators:
    - Connect and operate a basic electrical control circuit with pushbutton switch
    - Connect and operate a basic electrical control circuit with selector switch
    - Connect and operate a control circuit given a ladder diagram
    - Connect and operate a control relay in a memory logic circuit
    - Connect and operate a forward/reverse jog control circuit
  - Knowledge Indicators:
    - Describe the three steps of a control process
    - Describe the functions of the components of a ladder diagram
8. Standard 202.8 Connect and operate a 2/3 wire magnetic motor starter circuit
- Performance Indicators:
    - Connect and operate a two-wire motor control circuit
    - Connect and operate a three-wire motor control circuit
    - Design a multiple operator station three-wire control circuit
  - Knowledge Indicators:
    - Describe the operation of a control relay and give an application
    - Describe the operation/construction of 2 types of control relays
    - Describe the operation of a magnetic motor starter
9. Standard 202.9 Connect and operate a reversing motor control circuit
- Performance Indicators:
    - Connect and operate a reversing magnetic motor starter to reverse a motor
    - Connect and operate a reversing motor circuit with mechanical and auxiliary contact interlocking
  - Knowledge Indicators:



- Describe two methods used to reverse a three-phase motor
- Describe the function of interlocking control
- Describe three interlocking methods used in reversing motor control
- Describe the function of manual and automatic modes
- Describe the operation of two types of motor jogging circuits
- Describe the operation of a hand-off-automatic motor control circuit
- State the NEMA and IEC standards for reversing the rotation of a three-phase motor

10. Standard 202.10 Connect and operate a hands-off-auto motor control circuit

- Performance Indicators:
  - Connect and operate a hand-off-automatic motor control circuit
  - Design a hands-off-automatic motor control circuit
  - Design a pump control circuit that includes hand-off operation
- Knowledge Indicators:
  - Describe the function of a hand-off-automatic motor control circuit
  - Describe the function of a hand-off automatic circuit

11. Standard 202.11 Connect and operate automatic input device

- Performance Indicators:
  - Connect and operate a limit switch, pressure switch and a float switch
  - Connect and operate a pump control circuit
  - Connect and operate a motor control sequence control circuit
  - Design a sequence control circuit
- Knowledge Indicators:
  - Describe the function of a motor control sequence control circuit
  - Describe the operation of a limit switch, pressure switch, and float switch

12. Standard 202.12 Connect and operate basic timer control circuits

- Performance Indicators:
  - Connect and operate an On-Delay timer circuit



- Design a control circuit to perform an unloaded start of a motor
- Connect and operate an Off-Delay timer circuit
- Design a motor control circuit to perform time-driven sequencing
- Knowledge Indicators:
  - Describe the function and application of a time-delay relay
  - Describe the function of 2 types of timer relays: on-delay and off-delay
  - Describe the operation of an On-Delay timer relay and give its schematic symbol
  - Describe the operation of an unloaded motor start circuit
  - Describe the operation of an Off-Delay timer relay and give its schematic symbol
  - Describe the operation of a time-delay relay in a time-driven sequencing

