

### **Lesson 1 - Resistors and Resistance**

Objectives:

- Describe the differences among various types of resistors.
- Describe the basic structure of resistors.
- Explain how electrons move through a resistor.
- Explain how resistive materials function.
- Find the resistance value of resistors.
- Calculate the wattage requirement of a resistor.
- Calculate the value of resistors in series.
- Calculate the value of resistors in parallel.
- Explain the difference between single-phase ac resistance the three-phase ac resistance.
- Calculate the total current in a resistance network of a three-phase circuit.

### **Lesson 2 - Capacitors and Capacitance**

Objectives:

- Explain the basic structure of capacitors.
- Describe the movement of the electrons in a capacitor.
- Define dielectric.
- Calculate the value of capacitors in series.
- Calculate the value of capacitors in parallel.
- State the basic rules of capacitance.
- Test capacitors for shorts, opens, and values.
- Calculate the capacitive reactance of a capacitor.

### **Lesson 3 - Inductors and Inductance**

Objectives:

- Define inductance and describe how an inductor works.
- Explain the difference between self-inductance and mutual induction.
- Define electromotive force and counter electromotive force.
- State Lenz's Law.
- Define inductive reactance.
- Calculate inductive reactance.
- Explain how to solve for inductance when inductors are connected in series.
- Explain how to solve for inductance when inductors are connected in parallel.

### **Lesson 4 - Transformers**

Objectives:

- List the main components of a transformer.
- Describe the basic operation of a transformer.
- Explain the relationship between turns and voltage.
- Calculate primary and secondary voltages.
- Describe how and when transformers are connected in series and in parallel.
- Explain the common applications of control transformers and autotransformers.

### **Lesson 5 - Relays and Contactors**

Objectives:

- Describe the basic construction of a relay.
- Explain how a contactor works.

- Describe the operation of a potential relay.
- Describe the operation of an impedance relay.
- Calculate the impedance of relay coil.
- Explain the term "delay on make."
- Explain the term "delay on break."
- Identify the different types of time-delay relays.

### **Lesson 6 - Motors**

Objectives:

- Calculate the synchronous speed of a motor.
- Explain what slip is, and demonstrate how to calculate it.
- Identify the start and run windings in a motor.
- Describe the operation of a shaded-pole motor.
- Describe the operation of a permanent split-capacitor motor.
- Describe the operation of a three-phase motor.
- Explain how a stepper motor works.
- Define service factor.

### **Lesson 7 - Circuit Protection Devices**

Objectives:

- Discuss the conditions under which circuit protection is needed.
- Describe the different types of fuses.
- List the main components and explain the basic function of circuit a breaker.
- Describe the operation of overload protectors used on compressors and motors.
- Explain the difference between "inherent" overload protection and "external" overload protection.
- Describe the various types of electronic motor protectors.

### **Lesson 8 - Conductors**

Objectives:

- Explain how conductor sizes are measured.
- Calculate the cross-sectional area of a conductor in square mills and circular mills.
- Define the term ampacity.
- Explain the difference between solid wire and stranded wire.
- Explain the purpose of insulation and describe different types of insulation.
- Discuss the difference between low-voltage control wiring and high-voltage control wiring.

### **Lesson 9 - Power Supplies**

Objectives:

- Describe basic power distribution systems for residential and light commercial applications.
- Explain the difference between three-phase power and single-phase power.
- Explain what a "stinger" leg is, and why it is used.
- Describe how single-phase power can be derived from a three-phase power supply.
- Explain the difference between wye and delta transformers.

### **Lesson 10 - Basic Controls**

Objectives:

- Explain the need for automatic control systems.
- Identify the four major classifications of automatic control systems.
- Explain the difference between two-position (on/off) controls and proportional controls.
- Describe the operation of a three-wire oil failure control.
- Describe the operation of four-wire oil failure control.
- Describe the operation of electric defrost controls.
- Describe the operation of pump-down controls.
- Describe the operation of Carrier's Time Guard and Cycle-Loc controls.
- Describe the operation of a "winter start relay."

### **Lesson 11 - Miscellaneous Components**

Objective:

- Describe the operation and application of the following miscellaneous components:
  1. Ignition devices:
    - glow coils
    - hot-surface ignitors
    - spark ignition systems
  2. Safety devices:
    - heat-sensitive fuse links
    - lame roll-out switches
    - cadmium sulfide cells
    - mercury flame sensors
    - thermocouples
    - powerpiles
  3. Control devices:
    - multistage sequencers
    - head pressure controllers
    - pressure sensors
    - dc motors
    - thermistors
    - resistance temperature detectors