Basic Electrical Training

Electricians' Tools

Objectives:

- Explain how various hand tools are used by an electrician
- Discuss the safe use of hand tools and power tools
- Perform basic calculations and measurement conversions using the metric system
- Use Ohm's law to explain the relationship among current, voltage, and resistance in a circuit
- Explain how electrical measuring instruments are used to measure current, voltage, and resistance
- Define many of the basic electrical terms that electricians use every day
- Identify the basic symbols used in electrical schematic drawings

Tool Grinding and Sharpening

Objectives:

- Use a grinding machine, following all safety procedures
- Hone, or whet, tools with an oilstone
- Explain the procedures for grinding metal stock
- Compare the methods used in grinding screwdrivers, snips, chisels, plane irons, and twist drills

Woodworking Hand Tools

Objectives:

- Distinguish between the types of hand saws, and -use them correctly
- Bore and drill holes wood
- Explain the differences between planes, and use planes effectively
- Use abrasive tools correctly

Routers, Power Planes, and Sanders

Objectives:

- Operate (with practice) the portable router
- Outline the procedures for using a portable power planer
- Recognize by sight the common stationary power sanders, and compare their operation
- Choose the right portable power sander for a given job, and operate (with practice) the portable belt sander

Jacks, Hoists, and Pullers

Objectives:

- Identify the many forms of jacks and hoists
- Safely operate jacks and hoists
- Understand the construction details of fiber ropes, wire ropes, and chains
- Properly use and maintain fiber-rope, wire-rope, and chain slings
- Properly use jaw and push pullers

Plumbing and Pipe-Fitting Tools

Objectives:

- Explain the importance of safety on the job
- Identify the rules of job safety and tool safety
- Apply the rules of job safety and tool safety to workplace situations
- Identify the various tools available to perform layout, cutting, and boring tasks
- Determine when and how to use layout, cutting, and boring tools
- Identify the tools available to join and assemble pipes of various materials
- Determine when and how to use pipe-joint assembly tools
- Identify the tools needed for testing and maintaining piping systems
- Determine hen and how to use finishing, testing, and maintenance tools for piping systems

Nature of Electricity

Objectives:

- Explain the operation of a simple circuit
- Define the terms conductor, insulator, and resistor
- Demonstrate that unlike charges attract and like charges repel
- List some of the dangers and benefits of static electricity
- Define he terms volt, ampere, and ohm
- Describe some common notations and prefixes used to identify electrical and electronic values
- Identify carbon resistors, potentiometers, and rheostats, and explain how they work
- Identify some of the electrical symbols used in schematic diagrams
- Explain the difference between a series and a parallel circuit

Circuit Analysis and Ohm's Law

Objectives:

- Find the total resistance in series, parallel, and series-parallel circuits
- Use Ohm's law to calculate the amount of current, voltage, or resistance in circuits
- Calculate the amount of power supplied and dissipated in a DC circuit
- List the steps for reading current, voltage, and resistance with a meter

Capacitors and Inductors

Objectives:

- Explain how a capacitor holds a charge
- Describe common types of capacitors
- Identify capacitor ratings
- Calculate the total capacitance of a circuit containing capacitors connected in series or in parallel
- Calculate the time constant of a resistance-capacitance (RC) circuit
- Explain how inductors are constructed and describe their rating system
- Describe how an inductor can regulate the flow of current in a DC circuit
- Calculate the total inductance of a circuit containing inductors connected in series or parallel
- Calculate the time constant of a resistance-inductance (RL) circuit

Magnetism and Electromagnetism

Objectives:

- Identify the north and south poles of permanent magnets and electromagnets
- List several magnetic and nonmagnetic materials
- Describe how to magnetize a piece of steel by induction
- Explain the difference between simple, compound, and closed magnetic circuits
- Determine the direction of magnetic lines of force around a conductor (if the direction of the current is known)
- Use the right-hand rule to locate the poles of a solenoid
- Describe the operation of simple electromagnetic relays, buzzers, and stepping switches
- Explain how a DC motor operates
- Explain the generator action and motor action of electromagnetic induction in simple terms

Conductors, Insulators, and Batteries

Objectives:

- Describe the various types of conductors and discuss their conductivity
- Explain the American Wire Gage system of sizing copper conductors
- Determine the size of conductor needed for an application
- Identify the various types of insulating materials and list their temperature ratings
- Explain the difference between a dry cell and a storage battery
- Connect cells together to obtain more voltage, more current, or more of both voltage and current
- Describe the proper safety precautions used when working with storage batteries
- Describe how to properly clean and care for storage batteries
- Discuss the instruments used for testing storage batteries
- Explain how NiCad, lithium, and other types of special batteries operate, and describe their ratings

DC Motor and Generator Theory

Objectives:

- Describe the function of a commutator and brush assembly in a DC motor
- Explain how permanent magnet DC motors and stepper motors operate
- Identify series-wound, shunt-wound, and compound-wound motors and discuss their applications
- List the steps used to reverse a DC motor's direction
- Describe how the speed of a DC motor is controlled
- Explain the basic principle used to generate direct current
- List the factors that affect the strength of an induced voltage
- Explain how the field connections of series-wound, shunt-wound, and compound-wound generators differ
- Explain why it's necessary to shift brushes in a DC generator
- Discuss how interpoles and compensating windings can produce better generator operation
- List the various types of machine losses and calculate machine efficiency

Alternating Current

Objectives:

- Draw a graph of an AC voltage and describe how AC voltage is created
- Explain what an AC cycle is using the terms alternation, peak, positive, and negative
- Express the time period of an AC cycle in degrees
- List the characteristic values of an AC cycle and describe the relationship between the values
- Define phase angle and describe how it relates to reactive circuits
- Calculate power for single-phase and three-phase circuits
- Describe how a 220 VAC, single-phase circuit operates
- Calculate the phase and line voltages of multiphase wave forms
- Determine real power by reading a power factor meter
- Describe delta-connected and wye-connected three-phase circuit connections

Alternating Current Circuits

Objectives:

- Identify electric circuits in terms of their characteristics
- List several circuit characteristics used to describe a circuit for a particular load application
- Identify electrical components wired as series and parallel circuits
- Descriube how to control loads from one or two switch locations
- Describe how current flows in a three-wire circuit
- Describe how current flows in delta-and wye-connected circuits
- Calculate the line-to-line and line-to-neutral voltage in a Y-connected circuit

Inductors in AC Circuits

Objectives:

- Explain how an inductor is made and how it operates in a DC and AC circuit
- Define inductive reactance and impedance
- Describe how AC frequency affects impedance
- Apply Ohm's law when calculating the current in an AC circuit that includes an inductor
- Calculate the impedance of a series RL circuit
- Calculate the impedance of a parallel RL circuit

Capacitors in AC Circuits

Objectives:

- Describe how a capacitor stores a charge and how series-connected and parallel-connected capacitance values are calculated
- Define capacitive reactance
- Apply Ohm's law in AC circuits that contain a capacitor
- Calculate the impedance of a series RC circuit
- Calculate the impedance of a parallel RC circuit
- Explain how changing the frequency of an AC signal changes capacitive reactance
- Calculate the resonant frequency of an RCL circuit

Transformers

Objectives:

- Explain what the main parts of a transformer are
- Explain how mutual inductance makes it possible to change an AC (alternating current) voltage or current from one value to another
- Determine the turns ratio when the primary and secondary voltages or currents are known
- Calculate primary or secondary voltage or current when either one of these and the turns ratio are known
- Explain why transformer cores are laminated (layered)
- Connect three single-phase transformers for three-phase operation
- Calculate line current (if phase current is known) in delta-connected transformers
- Explain the principle of operation of an autotransformer

Alternators

Objectives:

- Explain how single-and three-phase alternators operate
- List and describe the major parts of an alternator
- Discuss alternator ratings in terms of power, voltage, speed, and temperature
- State the steps required for starting, stopping, and operating alternators
- Describe the similarities of and differences between the three main types of alternators

Electrical Energy Distribution

Objectives:

- Explain the difference between feeder and branch circuits
- Describe the different types of systems for distributing power within a plant
- Identify utilization equipment by name and recognize the equipment when you see it
- Discuss the use of transformers
- Identify by name, and give the uses of, various types of raceways
- Distinguish between panel boards and switchboards
- Discuss the electrical system of a power utility
- Describe how electricity is generated

Rectification and Basic Electronic Devices

Objectives:

- Explain how diodes are used as rectifiers
- Connect a PN junction for forward bias and reverse bias
- Explain how a transistor operates as an amplifier
- Recognize transistor input and output circuits
- Compare rectifier outputs (with and without filters)
- Reverse the polarity of a DC output voltage on the schematic of a rectifier
- Calculate the ripple frequency of half-wave and full-wave single-phase and three-phase rectifier circuits
- Discuss the basic operation of the triode tube as an amplifier

Basic Test Equipment

Objectives:

- Identify the schematic symbols used to represent various reactive devices
- Define the terms voltage, current, and resistance, and explain their relationship in a circuit
- Discuss how voltage, current, and resistance is measured with a multimeter
- Describe the major features of analog and digital VOMs
- Explain how to use both analog and digital VOMs to measure voltage, resistance, and current in a circuit
- Discuss some of the important safety precautions you must take when using a multimeter

Troubleshooting with Volt-Ohm-Milliamp Meters

Objectives:

- List the safe practices you should use when troubleshooting with a VOM
- Describe the purpose of a continuity test
- Perform tests for short circuits
- Perform resistance tests on resistors, fuses, solenoids, relays, switches, transformers, motors, and semiconductors
- Measure current by using a direct series connection or by using a clamp-type ammeter
- Measure the output voltage of a DC power supply and the voltage of an AC feeder line
- Measure voltage at disconnect switches, circuit breakers, contactors, and transformers
- Perform voltage tests on circuit boards, PLC systems, and motor circuits

Using Basic Oscilloscopes

Objectives:

- Explain how an oscilloscope operates and describe its component parts
- Describe how to perform low-voltage measurements on circuit boards
- Explain how to measure the voltage output of a power supply and measure AC ripple
- Describe how to perform measurements in SCR and TRIAC circuits
- Test both DC and AC servo motor controller circuits, as well as heater controller circuits
- Perform basic scope measurements on digital circuits

Electrical Safety

Objectives:

- Explain how electricity can harm you and your property
- Discuss the importance of properly using quality electrical components
- Follow the basic methods of protection when wiring electrical installations
- Tell why it's important to ground electrical equipment and systems
- Select the type of electrical equipment to use in a hazardous location
- List the safety practices required in an electrical work area
- Talk about the importance of a clear working space around electrical equipment
- Educate your own level of safety training to be sure it matches the electrical work you're performing