Basic Electrical and Instrumentation Design Training

Description

Course Description

This five days course covers the electrical principles and components used in Electrical systems and industrial instrumentation, emphasizing safety. You'll cover schematic symbols and the use of basic test equipment

This course will cover:

- **Direct and Alternating Current Circuits:** DC Potential Sources | Conductors | Resistances | Switches | Energy Transfer (Current) | Values and Currents | Peak and Amplitude | Peak-to-Peak Amplitude | Frequency | Conversion Units | Phase
- **Overcurrent Devices:** Fuses | Circuit Breakers | Overloads
- **Inductance and Capacitance:** Electromagnetism | Transition Effects | Inductive Reactance | Inductive Kick | Relays | Solenoids | Contractors | Values and Units | Capacitive Reactance | Capacitors (Type Values)
- **Applied Circuits:** Impedance | Resonance | Power Factor
- **Measuring Equipment:** Voltmeter | Ammeter | Ohmmeter | Wattmeter
- **Safety:** Measurement | Work Environment
- **Bridges:** Description | Operation | Use
- **Schematic Analysis:** Symbols | Circuit Identification | References
- **Poly-phase Sources:** 3 Phase | Y | Delta | Blind Delta Connection

Course Objectives

At the end of this course the participant will be able to:

- Evaluate the direct current (DC) relationships between voltage, current, and resistance
- Determine alternating current (AC) characteristics including amplitude, frequency, and phase
- Identify the properties of an inductor and of a capacitor
- Using basic test equipment to evaluate and to determine basic electrical characteristics
- Apply safety considerations when measuring electrical values or working around electrical

equipment
- Compare bridge operation in balanced and unbalanced condition
- Identify schematic symbols used for electrical devices
- Understand poly-phase voltages and currents found in the industrial environment
- Understand how to install, testing, commissioning and maintain of electrical equipment.

Course Outline

Electrical Properties

- Basic Electricity
- The Atom
- Electrons of Different Materials
- Electrical Terms
- Electrical Potential Moves Electrons
- Why Electrons Move
- Voltage Defined
- Current Defined
- Resistance Defined
- Electrical Circuit

Sources of Electricity

- Magnetism
- Magnetic Field
- Introduction to Generating a Voltage
- Generating DC Electricity
- Controlling Voltage Generated
- Generating DC vs. AC power
- The Sine Wave
- Frequency
- Peak – Peak to Peak — RMS Voltages
- Multi Phase Power Generation
- Three Phase Power Voltage Advantage
- Why it is Hard to Push Electrons?
- Power Distribution

Law’s of Electricity

- Ohm’s Law
- Variations of Ohm’s Law
- Ohm’s Law
- Simple Ohm’s Law Operations
- Sample Problems
- Kirchoff’s Law for Voltage
- Kirchoff’s Law for Current
- Watt’s Law
- Computing Watts

- Electro Magnetic Fields
- Electrical Work Terms
- Large and Small Numbers

Electrical Measurements

- Safety, Safety, Safety!
- Caution Note
- Measuring Voltage Precautions
- Current Measuring Precautions
- Resistance Measuring Precautions
- A Complete Path
- Measurement – Voltage
- Measurement – Current
- Measurement – Resistance

Series & Parallel Resistances

- Series or Parallel???
- Series Resistances
- Series Circuit
- Parallel Resistances
- Computing Parallel Resistance
- Combination Circuit (DC Bridge)
- Typical Bridge Circuit Depiction

Electrical Schematic Symbols

- Resistors Pictorial
- Resistor Schematic Symbols
- Signal Schematic Depiction
- Switches
- Push Button Switch Symbology of Connection
- Overload Symbology
- Limit & Other Switches
- An Electrical Circuit

Capacitance

- Electrostatic Field
- Factors Affecting Capacitance
- Dielectric Materials
- Capacitors in Parallel
- Capacitors in Series
- RC Time Constant
- Discharge Path
- Optional RC Assignment
- Capacitors & AC

- Capacitors & Switched DC
- Capacitive Reactance

Chapter 8: Inductance

- Magnetic Field
- Ferrous Core
- Solenoids
- LR Time Constant
- Inductive Kick Inductors & Switched DC
- Inductive Reactance

Impedance and Resonance

- Impedance Defined
- Impedance Determined by Vector
- Resonance – Defined
- Series Resonant Circuit
- Parallel Resonant Circuit
- Resonance Formula

Transformers

- Increasing Voltage for Distribution
- Step-Down vs. Step-Up
- Turns Ratio
- Power Distribution Power In/Power out
- Transformer Load Currents
- Transformer Efficiency
- Transformer Applications
- User End of Distribution
- Electrical Distribution with Transformers Transformer Isolation

Electromechanical Devices

- The Relay
- A Solenoid
- AC and DC Solenoids
- Contactors
- Uses of Contactors (Sealing Circuits)

Industrial Power

- Definition of “Ground”
- Solidly Grounded System
- Grounding Elements
- Single Rod
- Grid

- Radials
- Ground Maintenance
- Three-Phase Power
- WYE Transformers (Star)
- Delta Transformers
- Common Industrial
- Voltages Voltage Applications
- Typical Industrial Distribution System

Overcurrent Protection

- Overcurrent Contributors
- GF Protection Devices
- Fuses
- Plug Type Fuses
- Cartridge Fuses
- Cartridge Fuse Lengths
- Fuses – Rejection Feature
- Circuit Breakers

Industrial Wiring

- Equipment Grounding
- Power Wiring
- Signal Wiring
- Conductor Identification
- Wiring Insulation Color Codes
- Conductor Selection
- Documentation

Industrial Electrical Safety

- Hazardous Locations