Fundamentals of Electrical Maintenance
Hands-On Training Course

I. Overview
This four-day training course provides maintenance technicians and non-electrical personnel working in industrial plants and commercial buildings with a thorough foundation in electrical maintenance. Through a combination of illustrated lectures, discussion, and hands-on exercises, students will learn how electrical systems work, how to maintain electrical safety, and how to install and troubleshoot common electrical equipment.

Students completing the course will emerge with the ability to reduce equipment downtime, improve facility safety, and fix problems on their own.

II. Curriculum

Day One – Understanding Industrial Electricity

Students will gain a basic understanding of how electricity works in commercial and industrial settings. Starting with easily understood analogies to explain the fundamentals of electricity, students are then quickly immersed in practical, real world examples that illustrate how electricity is distributed and used in their plants and facilities. They’ll learn how to use electrical test equipment in their everyday jobs before moving on to an in-depth discussion about major electrical components, where & how these components work, and their purposes within electrical systems.

Electrical Fundamentals
• Production & Distribution of Electricity
• DC and AC in Plants and Facilities – Hands-on Exercise
• Voltage, Current and Resistance; Ohm’s Law
• Basic Electrical Circuits: Series/Parallel - Hands-on Exercise
• Power: Types & Control
• Single-phase and Three-phase Systems
• Workplace Electrical Safety

Electrical Test Equipment
• Multimeters – Hands-on Exercise
• Voltage Testers

Verifying a Circuit De-energized – Hands-on Exercises
• 3 Modes of Failure: Opens, Shorts & Ground Faults
• Clamp-on Ammeter, Megohmmeters & Others

Understanding Your Building Electrical System
• Reading Electrical Single-Line Diagrams
• Major Components
• The Electrical Service
• Main Distribution Centers
Day Two – Working with Industrial Electricity

Students will receive a short introduction to common electrical standards as the starting point for all electrical work. Next they will learn how to choose the right materials for the job and how to perform basic electrical repairs and installations. A discussion on proper wiring will be followed by practical tips for electrical troubleshooting. The day will end with an overview of other common electrical work activities such as preventive maintenance.

Electrical Safety Standards
- Hazards & Dangers of Electricity
- Personal Protective Equipment (PPE)
- Lockout/Tagout (LOTO)
- Developing Safe Work Practices

Wire Selection
- Conductor Types & Materials
- Wire Size and Wire Insulation

Installing Wire (Conductors)
- Raceways & Cable Trays
- Conduits
- Fittings and Boxes

Wiring Equipment – Hands-on Exercises
- Wire Nuts, Terminals and Crimpers
- Switches and Receptacles
- Fluorescent Ballasts
- Motors
- Temporary Wiring

Basic Troubleshooting Techniques
- Branch Circuit Problems
- Control Circuit Troubleshooting
- Checking and Replacing Fuses

Electrical Maintenance Activities
- Performing Checks as part of an Assured Equipment Grounding Program
- Use and Operation of GFCI’s
- Types of Electrical Maintenance
- Special Precautions
Day Three – Basic Electrical Troubleshooting

The day begins with a review of safety standards before moving on to a discussion on electrical symbols, where students will learn to create their own electrical drawings to be used for troubleshooting. From there, lessons focus on troubleshooting components, circuits and motors using hands-on equipment. We will also demonstrate Personal Protective Equipment (PPE) and why a proper fit is critical to working efficiently.

Basic Skills for Electrical Troubleshooting

- Safety First
- Using Electrical Drawings – Hands-on Exercise
- Using Meters (multimeters) and Circuit Measurements
- Developing a Logical, Systematic Approach to Troubleshooting

Troubleshooting Control Circuits - Hands-on Exercise

- Relays, Motor Starters and Control Devices
- Reading and Interpreting Ladder Diagrams
- Power Loss
- Control Circuit Industrial Applications
- Electric Motor Drives
- Solenoid-Operated Valves
- Heating Elements

Troubleshooting Motors

- Most Common Motor Problems
- Electrical Problems
- Testing Windings for Shorts, Opens and Ground Faults
- Phase Unbalance
- Mechanical Problems
- Phase Rotation Testing – Hands-on Exercise

Day Four – Troubleshooting Complex Systems

Power distribution problems will be discussed as well as testing for power quality issues and troubleshooting the different types of lighting circuits. A brief introduction to variable frequency drives and how to troubleshoot their most common problems will wrap up the course along with a final review of basic electrical preventive maintenance practices to keep equipment from failing in the first place.

Troubleshooting Power Distribution – Hands-on Exercise

- Wye and Delta Systems
- Overcurrent Protection
- Branch Circuits

Troubleshooting Power Quality Problems

- Sources of Power Quality Problems
- Test Equipment for Troubleshooting Power Quality Problems – Hands-on Exercise
- Harmonics

Troubleshooting Lighting Circuits
• Lighting Terminology
• Types of Lighting Circuits
• Incandescent Lighting
• Fluorescent Lighting
• HID Lighting

Troubleshooting Programmable Logic Controllers (PLCs)
• Overview of PLCs
• Reading PLC Ladder Diagrams
• Status Indicators and Error Codes
• Force and Disable
• Startup Procedures

Troubleshooting Variable Frequency Drives (VFDs)
• VFD Terminology
• VFD Basic Operation
• Components
• Pulse Width Modulation
• Types of VFDs
• Common Problems and Corrective Action

Electrical Preventative Maintenance
• Why Perform Electrical Maintenance
• Overview of an Electrical Maintenance Program
• Building Your Own Walk-Through Inspection Checklist