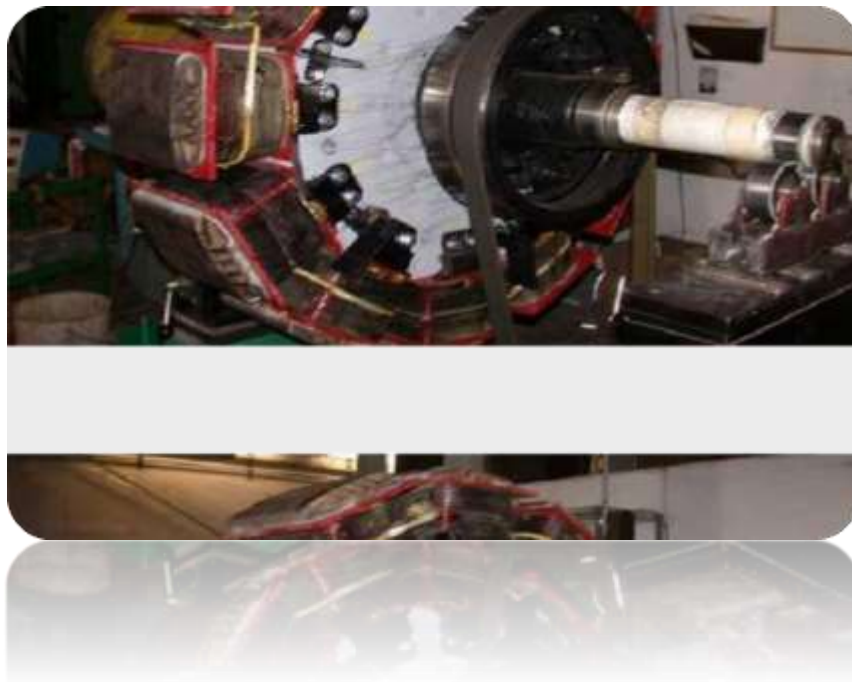




EE173

Electric Motor Maintenance & Troubleshooting

Course Introduction:

It is estimated that electrical drives and other rotating equipment consume about 50% of the total electrical energy consumed in the world today (and this figure increases to 70% if you only consider industry.) The cost of maintaining electrical motors can be a significant amount in the budget item of manufacturing and mining industries. This course gives you a thorough understanding of electrical motor's protection, control and maintenance and gives you the tools to maintain and troubleshoot electrical motors.

You will gain a fundamental understanding of the protection, control and maintenance of electric motors and drives. Typical applications of electric motors in manufacturing, materials handling, process control are covered in detail. The concluding section of the course gives you the fundamental tools in troubleshooting motors confidently and effectively.

Course Objectives:

Upon successful completion of this course, the delegates will be able to:

- Apply and gain an in-depth knowledge on electric motor maintenance and troubleshooting
- Specify protection requirements for motors and maintain electrical motors
- Identify the speed control requirements for motors and discuss the essentials of motors and drives
- Enumerate the main issues with testing of motors to prevent motor bearing failure
- Troubleshoot and fix faults on motors and drives
- Discuss interface control circuits of motors with PLC's/DCS's
- Reduce downtime on electrical motors and improve plant safety
- Develop plant throughput and reduce spares usage and requirements

Who Should Attend?

This course is valuable for those associated with the use of electrical motors in the industrial or automation environment. This course will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting.

Course Outline:

DAY 1:

- **Introduction, Overview & Discussion of Objectives**
- **Fundamentals of Motor Technology and Construction**

- Basic Principles of Rotating Electric Machines
- Fundamental Principles of Speed Control
- Efficiency, Torque, Inertia, Horsepower/Power Factor
- Torque-Speed Curves
- Induction/Synchronous/Wound Rotor Types
- Basic Construction and Physical Configuration, Windings
- Principles of Operation and Performance
- **Three Phase Ac Induction Motors**
 - Components
 - Theory of Operation
 - Induction Motor Design
 - Duty Cycles
 - Insulation and Cooling Requirements
 - Starting Methods Selecting motors
 - Types of Faults, Fault Finding and Testing of AC Machines
 - Testing Instrumentation

DAY 2:

- **Energy Losses and Efficiency of Three Phase AC Induction Motors**
 - Standards
 - Types of Losses Tests for Measurement and Computation of Losses and Efficiency
 - Dynamometers
 - Principles of Load Application By Braking
 - Torque Measurement Basics
 - Types of Practical Dynamometers
- **Motor Failure Analysis**
 - Frequent Starts
 - High Inertia
 - Inadequate Cooling
 - Congestion on Fan Cover
 - Improper Spacing at End of Motor
 - Incorrect Belt Alignment
 - Solid Belt Guards
 - Excessive Loading Causing Bearing Clearance Problems
 - Insulation Failures
 - Bearing Current Problems

DAY 3:

- **Testing**
 - Insulation Life and Resistance
 - Polarization Index
 - DC Hipot
 - DC Ramp Test
 - AC Hipot
 - Capacitance Test
 - Dissipation Factor
 - Partial Discharge
 - Surge Test
 - Mechanical Testing
 - Online Testing
- **Bearing Failure Analysis**
 - Bearing Failures
 - Grease and Greasing
 - Belt Drive Aspects
 - Balance
 - Storage Issues
 - Service Factor Loading
- **Protection of Motors**
 - Thermal Overload
 - Time Constraints
 - Early Relays and New Digital Relays
 - Starting and Stalling Conditions
 - Over Current / Overload
 - Under-Voltage / Over-Voltage

DAY 4:

- **Protection of Motors (cont'd)**
 - Under Frequency
 - Pole Slip / Out of Step
 - Loss of Excitation
 - Inadvertent Energization
 - Over Fluxing
 - Stall Protection / Acceleration Time / Start Up Supervision / Time Between Starts
 - Unbalanced Supply Voltages

- Negative Sequence Currents
- De-Rating Factors
- Earth Faults – Core Balance, Residual Stabilizing Resistors
- Calculation of Protective Relay Settings
- **Motor Control**
 - Power Circuit
 - Control Circuit
 - Full Online Voltage Starting
 - Reduced Voltage Starting: Delta-Star, Resistance, Reactor, Autotransformer, Soft Start
 - Braking
 - Speed Control
 - Reversing

DAY 5:

- **Control System for AC Variable Speed Drives**
 - Overall Control System
 - Power Supply for the Control System
 - Dc Bus Charging System
 - VSD Control Loops (Open Loop/Closed Loop)
 - Vector Control
 - Current Feedback in Ac Variable Speed Drives
 - Speed Feedback from Motor
- **Installation And Fault Finding**
 - General Installation and Environmental Requirements
 - Power Supply Connections and Earthing
 - Where to Install Contactors in Power Circuit
 - Installation of Ac Converters into Metal Enclosures
- **New Technologies and Developments**

Course Certificate:

International Center for Training & Development (ICTD) will award an internationally recognized certificate(s) for each delegate on completion of training.

Course Methodology:

A variety of methodologies will be used during the course that includes:

- (30%) Based on Case Studies
- (30%) Techniques
- (30%) Role Play
- (10%) Concepts
- Pre-test and Post-test
- Variety of Learning Methods
- Lectures
- Case Studies and Self Questionnaires
- Group Work
- Discussion
- Presentation

Course Fees:

To be advised as per the course location. This rate includes participant's manual, and-Outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Timings:

Daily Course Timings:

08:00 - 08:20	Morning Coffee / Tea
08:20 - 10:00	First Session
10:00 - 10:20	Coffee / Tea /Snacks
10:20 - 12:20	Second Session
12:20 - 13:30	Lunch Break & Prayer
Break 13:30 - 15:00	Last Session