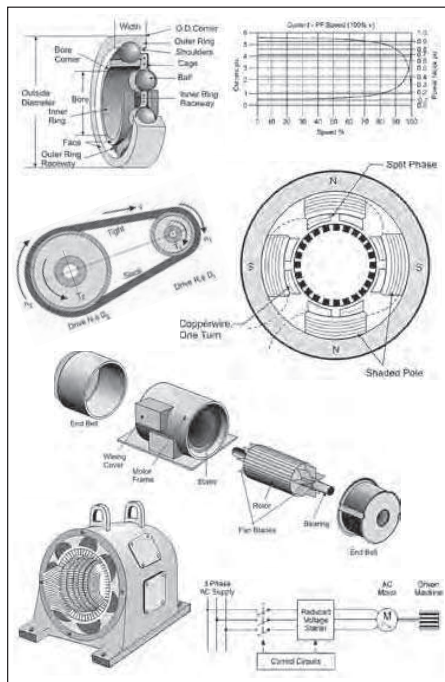


MOTOR PROTECTION, CONTROL AND MAINTENANCE TECHNOLOGIES



YOU WILL LEARN HOW TO:

- Specify protection requirements for motors
- Maintain electrical motors
- Specify speed control requirements for motors
- Understand essentials of motors and drives
- Detail the main issues with testing of motors
- Prevent or at least minimise motor bearing failure
- Troubleshoot and fix faults on motors and drives
- Interface control circuits of motors with PLCs/DCSs
- Reduce downtime on electrical motors
- Improve plant safety
- Improve plant throughput
- Reduce your spares usage and requirements

WHO SHOULD ATTEND:

Anyone associated with the use of electrical motors in the industrial or automation environment. The workshop will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting. Typical personnel who would benefit are:

- | | |
|--------------------------------------|--------------------------------------|
| • Plant Engineers | • Electrical Contractors |
| • Instrument Technicians | • Electrical Consulting Engineers |
| • Engineering and Design Personnel | • Process Control Engineers |
| • Operations Personnel | • Mechanical Engineers |
| • Electrical Maintenance Technicians | • Service Technicians |
| • Instrument and Control Engineers | • Maintenance Personnel |
| | • Electrical Maintenance Supervisors |

The Workshop

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 mining, 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.

Pre-requisites

A fundamental knowledge of basic electrical concepts would be useful.

The Program

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

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

TESTING

- Insulation life and resistance
- Polarisation 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
- Under frequency
- Pole slip/Out of step
- Loss of excitation
- Inadvertent energisation
- 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 stabilising 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

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

SUMMARY, OPEN FORUM AND CLOSING