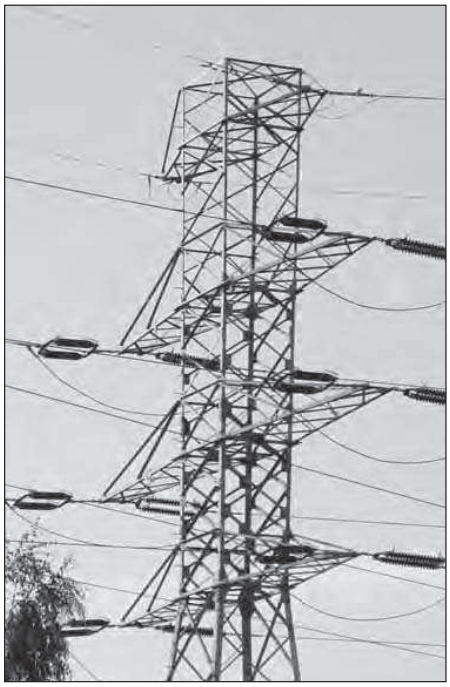
THE FUNDAMENTALS OF POWER DISTRIBUTION AND POWER SYSTEMS
HANDS-ON PRACTICAL ANALYSIS AND DESIGN



WHAT YOU WILL LEARN:

- You will have a deeper understanding of the fundamentals of power distribution systems
- Carry out advanced calculations in power distribution systems with greater confidence
- Master difficult concepts like three-phase power system network analysis, active, reactive and apparent power calculations, power factor correction and much more
- Extend your learning experience by problem solving; use specific solution formulations on your own applications

WHO SHOULD ATTEND:

This course is designed for practical engineers and technicians interested in maintaining power quality and minimising outages in power distribution networks:

- Electrical engineers
- Project engineers
- Design engineers
- Instrumentation and design engineers
- Electrical technicians
- Field technicians
- Electricians
- Plant operators

The Workshop

Practical engineers and technicians are always under pressure to meet the day-to-day challenges of maintaining power quality and minimising outages in power distribution networks. As a result of this challenge they tend to sharpen their skills only with regard to the most obvious practical and theoretical tools and to allow other insights that are as necessary to power systems as vitamins are to biological systems, to be relegated to the archives or to the "experts". It is often possible to apply quick-remedies or to use trial and error to obtain "cures" to correct difficult to diagnose faults in Power Distribution Systems. By gaining a deeper and more fundamental understanding of the basics, the traditional trial-and-error approach makes way for deterministic solutions with surer cures.

Pre-requisites

A fundamental knowledge of electrical engineering is very useful.

Workshop Objectives

At the end of this workshop delegates will understand:

- Fundamentals of power distribution systems
- Master difficult concepts that relate to power distribution

Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

The Program

REVIEW OF AC CIRCUIT FUNDAMENTALS

- Definitions of AC voltages, currents and power based on concepts of time dependent voltage, current and power
- Review of DC circuit principles and extending those to AC circuits with sinusoidal waveforms
- Review of complex algebra, important trigonometric relations, polar and rectangular coordinate systems
- RMS and average values of periodic waveforms

Practical Exercises

INTRODUCTION TO VECTORS AND PHASORS

- Introduction to voltage and current rotating vectors and phasors and their use in AC circuit calculations
- Multiplication and division of complex quantities
- Fundamental physical meanings of resistance, inductance and capacitance and their influence on power distribution systems
- Impedance of resistance, inductance and capacitance in AC circuits
- Impedance networks and their use in AC circuit calculations

Practical Exercises

INTRODUCTION TO ELECTRICAL SYSTEM STUDIES

- Time domain simulations of different types of single phase AC circuits
- Transient and steady state behaviour of AC circuits
- Admittance, conductance and susceptance and their usage in power distribution system calculations
- Principles of AC network reductions and its use in power distribution circuits
- Definitions of power in AC circuits, time dependent power, active, reactive and apparent power
- Power dissipation and storage in AC circuits involving resistance, inductance and capacitance

Practical Exercises

INTRODUCTION TO ELECTRICAL SYSTEM CALCULATIONS

- Usage of software for calculating RMS and average values of periodic non-sinusoidal waveforms
- Use of real, imaginary and complex power to streamline power calculations in AC circuits
- Phasor diagrams and their use in AC circuit analysis
- Meaning, consequences and correction of displacement power factors in AC circuits

Practical Exercises

INTRODUCTION TO STUDY OF THREE PHASE SYSTEMS

- Introduction to balanced three phase power systems: voltage, current and power relationships between phases
- Comparison of single and three phase power systems and the advantages of three phase systems over single phase systems
- Per phase calculation method and single line diagram representation of balanced three phase power distribution systems
- Analysis and definitions of voltages, current and impedance in three phase networks with star and delta configured sources and loads
- Calculation of power in three phase power distribution systems
- Time domain simulations of examples to complement analytical calculations of three phase power systems

Practical Exercises

INTRODUCTION TO ANALYSIS OF TRANSFORMERS

- Transformers and their use in AC power transmission and distribution systems
- Transformer design principles; flux density, number of turns, voltage transformation, current ratio, core size, core material implications
- Development of the equivalent circuit of a power transformer through addition of winding resistance, leakage inductance, magnetizing inductance, core losses
- Three phase power transformers and their use in power distribution systems
- Extending single phase concepts for transformers to balanced three phases
- The per unit system for multi-voltage level power distribution system calculations
- Calculations and simulations showing phase shift and the effects of different vector groupings

Practical Exercises

FUNDAMENTALS OF HARMONICS

- Introduction to steady state harmonics
- Fundamental definitions under sinusoidal conditions
- The concept of orthogonality
- What is meant by power system harmonics
- Harmonic problems in practice
- Limits of harmonic presence in power system
- Quality factor
- Bandwidth
- Series and parallel resonance in power systems
- Neutral overloading
- Other harmonic problems in brief

Practical Exercises

INTRODUCTION TO HARMONIC STUDIES

- The one sided exponential Fourier series
- Power system definitions based on a time domain model
- Modeling of power systems with harmonics

Practical Exercises

SUMMARY & OPEN FORUM

COMPLETE FEEDBACK SHEETS

CLOSING