
ELECTRICAL POWER SYSTEM FUNDAMENTALS FOR NON-ELECTRICAL ENGINEERS



WHAT YOU WILL LEARN:

- The basics of electrical power engineering
- Basic electrical design rules
- Practical steps in selection, installation and commissioning of electrical systems
- How to work more effectively with electrical engineering professionals
- How to apply the local electrical codes effectively
- The role that electrical power plays within your organisation

WHO SHOULD ATTEND:

- Administration staff
- Civil, mechanical, chemical, mining engineers, technologists and technicians
- Electrical contractors
- Finance, IT and accounting managers
- Human resources managers
- Managers who are involved with or work with staff and projects in electrical engineering
- Non-electrical engineers and technicians
- Non-electrical personnel who want to understand the broader picture
- Plant and facility engineers
- Project managers
- Procurement and buying staff
- Sales engineers



The Workshop

The focus is on the building blocks of electrical engineering, the fundamentals of electrical design and integrating electrical engineering know-how into the other disciplines within an organisation. Unnecessary theory will be minimised and you will focus on best practice over the two days of the course.

The course will commence by reviewing basic electrical circuits and electrical laws. You will then be exposed to the basic principles of electrical generation, transmission and distribution. Electrical distribution will then be covered in considerably more detail. The interesting area of electrical measurements as applied to single phase and three phase systems will then be reviewed. You will be exposed to earthing with a strong focus on safety issues. Transformers will then be examined with an emphasis on power transformers as used in the electrical distribution industry. The first day will be concluded with coverage of power system components in terms of isolators, fuses and circuit breakers.

The second day will commence with an examination of AC and DC motors, followed by a review of electrical lighting and illumination concepts. The power hungry topic of electrical heating in industry is then examined. The impact especially in the modern world of power electronics is discussed with a demonstration of the possible unpleasant harmonics arising from using this powerful technology. This then smoothly leads into the topic of dealing with power quality. The last three major topics are electrical power system protection, electrical safety and customer installations. The penultimate topic of great interest to executive management in a company (and indeed municipalities and governments) is load forecasting.

The workshop is concluded with modern developments such as substation automation, the smart grid, industrial data communications and the still controversial topic of carbon trading.

A workshop such as this is certainly not going to make you a professional electrical engineer - although many experienced electrical engineers have commented on how useful this course has been in broadening their perspective in other areas of the electrical world. But in two action packed and enjoyable days, you will leave with a valuable toolbox of skills in electrical engineering, thus becoming far more productive and safer in your career and in working with electrical engineers, technicians and managers.

Pre-requisites

No formal electrical education is required as everything is examined from a fundamentals and practical point of view. This is thus certainly not an advanced course but one focussing on the fundamentals using basic maths to ensure you quickly understand the key concepts.

Practical Sessions and Activities

We firmly believe that no one learns by simply listening to an instructor. So we have added in numerous activities to "liven the show up" and to make it a truly memorable and enjoyable course. You will thus engage in: eight hands-on practical electrical labs with real equipment to demonstrate the basics, twelve simple electrical design exercises using software and calculators, five case studies undertaken in groups of your colleagues in assessing real situations, a case study in a group of your colleagues where you go through an entire project for design, specification, procurement, installation and commissioning to "sign off and handover".

We will also make extensive use of video clips, visual effects and simulation software to help you with the understanding of these concepts.

To gain full value from this workshop, please bring your laptop/notebook computer.

The Program

DAY ONE

OVERVIEW OF THE ELECTRIC POWER SYSTEMS

- A brief historical perspective, overview of course

BASIC CONCEPTS

- Units and electrical quantities, voltage, current, resistance, power, energy, frequency, inductance and capacitance, Ohm's law, rms and average values, single and three phase systems, power factor

Practical session

ELECTRICAL GENERATION, TRANSMISSION AND DISTRIBUTION

- Various forms of energy, energy conversion, modern power station, coal-fired power plant, hydro and nuclear, impact on environment, solar, wind, geothermal, transmission of electricity, distribution, power demand and tariffs, power factor, HVDC

Practical session

ELECTRICAL DISTRIBUTION

- Power source, typical electrical power system, electrical distribution systems, substations, step down transmission, distribution substation, distribution feeder circuits, switches and circuit breakers, industrial and residential customers, types - radial, loop, network, network reliability (outages/power interruptions), power transformers and distribution boards

Practical session

ELECTRICAL MEASUREMENTS AND APPLICATIONS

- Electrical parameters - W/V/VA/r, measuring, power and energy measurement, smart metering, measuring voltages, currents and resistance

Practical session

EARTHING

- Need for earthing, direct and indirect shocks, touch and step potential, types of earthing, system and protective earthing, isolation, earth conductors and electrodes, measurement of earth resistance, lightning protection, bonding connection

Practical session

TRANSFORMERS

- Magnetic fields, electromagnetic fields, transformer operation, step down and step up, construction, single and polyphase transformers, cooling, oils and coolants, efficiency, tap changers, voltage regulation, earthing of transformers

Practical session

ISOLATORS, FUSES AND CIRCUIT BREAKERS

- Isolation, electrical faults, fuses, isolation, switching, tripping, circuit breakers, components of circuit breakers, medium voltage circuit breakers

Practical session

DAY TWO

ELECTRICAL ROTATING MACHINES - AC AND DC

- Basic principles, machines, DC motor operation, speed, flux and armature voltage, speed control, single phase AC motors, 3-phase induction motor, synchronous machines, torque versus speed, efficiency and power factor

Practical session

ELECTRICAL LIGHTING AND ILLUMINATION

- Incandescent lamps, high intensity discharge lamps, mercury vapour, metal halide lamps, fluorescent lamps, compact fluorescent lamps, LEDs, luminaire concepts, energy efficiency

Practical session

ELECTRICAL HEATING IN INDUSTRY

- Principles of heating, electrical heating, resistance heating, welding, electric arc furnaces, induction heating

Practical session

POWER ELECTRONICS AND APPLICATIONS

- Semi conductor devices, motor controllers, rectifiers, AC motors and soft starting, variable speed drives

Practical session

POWER QUALITY

- Power Quality problems, voltage variations, overvoltage and undervoltages, voltage imbalances, voltage and frequency variations, interruptions and surges, lightning and harmonics, harmonic compensation

Practical session

POWER SYSTEMS PROTECTION

- Incipient and solid faults, need for protection, overloads, overvoltage and overcurrent, fuses, circuit breakers, relays, protection of equipment

Practical session

ELECTRICAL SAFETY AND NATIONAL ELECTRICAL CODES

- Key elements of National Electrical Codes (AS3000/NEC/CEC/SANS), electrical hazards, electrical shock, arc flash and burns, personal protective equipment, safety through better design and installation, work permits, authorisation personnel, training and first aid, legislation

Practical session

CUSTOMER INSTALLATIONS

- Metering and billing, tariff structures, connections

THE ENTIRE ELECTRICAL PROJECT

- Design rules, specification, procurement, installation, commissioning, punchlist of defects, contractual disputes, certificate of compliance

Case study

THE ELECTRICAL ENGINEER/ TECHNOLOGIST/TECHNICIAN

- The engineering team, roles of the team, management of the engineering team, leading the team

LOAD FORECASTING, PLANNING AND PROJECT EVALUATION

- Load forecasting principles, forward planning, supply and demand side management, evaluation of electrical projects

MODERN DEVELOPMENTS

- The smart grid, substation automation and industrial IT, data communications (including wireless), cost of carbon/emissions trading

SUMMARY, OPEN FORUM AND CLOSING