
Overview

This is the electrotechnical knowledge required of those at level 4 in the electrotechnical industry. This unit contains the essential knowledge requirements all of which underpin the occupational standards developed for those working at this level in the electrotechnical industry.

At this level it is expected that you will have autonomous or, at least, semi-autonomous responsibility for complex electrotechnical projects, and that you will be operating within a technical and/or supervisory role in one or more of the key electrotechnical occupational areas which include buildings installation, maintenance, panel building, electrical machine repair and rewind, installation of public lighting systems and equipment and installation of instrumentation and associated equipment.

This unit covers the knowledge base for all electrotechnical units at level 4 which requires you to know the principles and applications of the subject areas listed overleaf, the main headings of which are:

- 1 electrotechnical regulations
- 2 hazardous environments
- 3 electrical supply and distribution
- 4 electromagnetic theory
- 5 electrostatic theory
- 6 electrical circuit theory
- 7 electrical machines
- 8 double wound & auto-transformers
- 9 measuring instruments
- 10 utilisation of electrical power
- 11 illumination
- 12 power electronics

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Performance criteria

There are no Performance Criteria for this standard

You must be able to:

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Knowledge and understanding

You need to know and understand:

Electrotechnical regulations

- K1 the Health & Safety at Work Act 1974 and other related legislation embraced by the HASAW and its implications for people at work on Electrotechnical projects
- K2 the latest Electricity at Work Regulations 1989.
- K3 the Electricity Supply Regulations 1988 and how they impact on consumer installations
- K4 about the existence of and where to source relevant British, European and International Standards and codes of practice.

Hazardous environments

You need to know and understand:

- K5 the risks and implications for electrotechnical working in environmental conditions which are;
 - K5.1 explosive
 - K5.2 damp or humid
 - K5.3 chemically erosive
 - K5.4 of high and low temperature
- K6 the type of conditions where an electrotechnical project could be vulnerable to damage by;
 - K6.1 rodents or vermin
 - K6.2 vehicular
- K7 the different electro-mechanical damage limitation methods, protective equipment and protective systems relevant to electrotechnical projects, particularly;
 - K7.1 intrinsically safe systems
 - K7.2 cathodic protection

Electrical supply & distribution

You need to know and understand:

- K8 the fundamental characteristics of a supply system to a consumer's premises in terms of;
 - K8.1 load centres
 - K8.2 single and multi-substation systems
- K9 about 11kV supply distribution systems used in consumer premises and relevant to;
 - K9.1 load centres
 - K9.2 single and multi-substation systems on site and in buildings (single and multi-storey)
 - K9.3 ring and radial feeders
 - K9.4 bus-bar systems
 - K9.5 protective devices – fuses; circuit-breakers (oil, air and

vacuum); arc control

- K10 the principles and their application to the supply system on the consumer's premises of;
 - K10.1 load balancing
 - K10.2 diversity
 - K10.3 discrimination between protective devices
 - K10.4 load sharing
- K11 the main aspects of the principles and practices associated with;
 - K11.1 supply authority and consumer metering – domestic and commercial
 - K11.2 load demand curves
 - K11.3 types of consumer tariffs
 - K11.4 D.C. supplies and protection

Electromagnetic theory

You need to know and understand:

- K12 the characteristics of electromagnetism and in particular with reference to;
 - K12.1 the properties of an electromagnetic circuit
 - K12.2 electromagnetic force
 - K12.3 iron losses
 - K12.4 growth and decay of current in an inductive circuit
- K13 how to interpret B/H curves
- K14 how to determine the effects of self and mutual inductance

Electrostatic theory

You need to know and understand:

- K15 and understand;
 - K15.1 capacitors and the effects of series and parallel connections
 - K15.2 charge and discharge and energy stored
 - K15.3 application as a timing device
 - K15.4 how to interpret growth and decay curves in capacitive circuits
- K16 the effects of capacitance in terms of;
 - K16.1 voltage and current changes
 - K16.2 cables
 - K16.3 dielectric strength
 - K16.4 static electricity
- K17 industrial applications of capacitors

Electrical circuit theory

You need to know and understand:

- K18 the values of voltage, current and power in A.C. and D.C. circuits with reference to;
 - K18.1 Kirchoffs Law
 - K18.2 bridge circuits
 - K18.3 resistive-inductive-capacitive circuits

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- K18.4 resonance
- K18.5 power factor
- K18.6 power factor improvement
- K19 about Three-Phase Systems in terms of;
 - K19.1 star & delta connections
 - K19.2 line/neutral currents and voltages
 - K19.3 balanced and unbalanced loads
 - K19.4 apparent, actual and re-active power
 - K19.5 phasor diagrams

D.C. machines

You need to know and understand:

- K20 the operating principles of;
 - K20.1 motors and generators
 - K20.2 the effects of armature reaction and commutation
 - K20.3 the construction and component parts of D.C. machines
- K21 the characteristics, application and efficiency of;
 - K21.1 series wound machines
 - K21.2 shunt wound machines
 - K21.3 compound wound machines
- K22 the characteristics, application and efficiency of different starting and speed control systems and overload protection including;
 - K22.1 direct-on-line
 - K22.2 resistance – start
 - K22.3 solid-state

A.C. motors

You need to know and understand:

- K23 their operating principles in terms of;
 - K23.1 single-phase rotating magnetic fields
 - K23.2 three-phase rotating magnetic fields
 - K23.3 the relationship between the supply frequency and speed
- K24 the construction, characteristics, application and efficiency of three-phase motors of these types;
 - K24.1 cage induction
 - K24.2 double cage and pole changing
 - K24.3 wound rotor
 - K24.4 synchronous
- K25 the construction, characteristics, application and efficiency of single-phase motors of the type;
 - K25.1 capacitor start
 - K25.2 split-phase
 - K25.3 shaded-pole
 - K25.4 universal
- K26 the characteristics, application and efficiency of starting and speed

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control systems and overload protection including;

K26.1 direct-on-line

K26.2 star-delta

K26.3 soft-start

Double-wound & auto-transformers

You need to know and understand:

K27 the construction, characteristics, application and efficiency of transformers particularly;

K27.1 cooling systems

K27.2 copper and iron losses

K27.3 regulation

K27.4 percentage impedance

K27.5 voltage loss

K28 how to determine fault-currents from given data

K29 how to interpret standard terminal markings

Measuring instruments

You need to know and understand:

K30 the operating principles, types and applications of analogue and digital instruments that measure;

K30.1 voltage

K30.2 current

K30.3 power

K30.4 resistance

K30.5 speed

K30.6 temperature

K30.7 frequency

K30.8 power factor

K30.9 levels, flow and pressure

K30.10 illuminance

Utilisation of electrical power

You need to know and understand:

K31 the purpose and benefits of Energy Management Systems

K32 the electro-mechanical requirements of;

K32.1 hoists

K32.2 lifts

K32.3 pumps

K32.4 drives

Illumination

You need to know and understand:

K33 the advantages and limitations of luminaires of these types;

K33.1 incandescent

- K33.2 fluorescent
- K33.3 halogen
- K33.4 mercury vapour
- K33.5 sodium vapour
- K33.6 extra low – voltage lighting
- K34 the effects of harmonics and haloids on lighting installations and their control equipment
- K35 the cause and rectification of stroboscopic effects as a result of a lighting installation
- K36 the installation requirements of high voltage discharge signs and relevant regulations and codes of practice in relation to installation
- K37 the applications of the principles of illumination and lighting design in terms of;
 - K37.1 inverse square law
 - K37.2 cosine law
 - K37.3 illumination levels
 - K37.4 luminous flux
 - K37.5 interpretation of polar curves

Power electronics

You need to know and understand:

- K38 the characteristics and applications of;
 - K38.1 Passive and active filters
 - K38.2 Stabilised power supplies
 - K38.3 Signal processing
 - K38.4 Transducers
 - K38.5 Digital techniques
 - K38.6 Infrared and sonic beams
 - K38.7 Oscilloscopes
- K39 the characteristics and applications of;
 - K39.1 Gating (Three-phase control)
 - K39.2 Pulse and burst triggering
 - K39.3 Programmable Logic Controllers
 - K39.4 Converters and Inverters
 - K39.5 Solid state controllers
- K40 the techniques, industry procedures and test instruments commonly used for conducting tests on power electronic devices

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