City & Guilds Level 2 Diploma in Electrical Power Engineering - Distribution and Transmission (Technical Knowledge) (2304-17)

Version 1.3 (April 2025)

Qualification Handbook

Qualification at a glance

Subject area	04.1 Engineering
City & Guilds number	2304
Age group approved	16-18, 18+
Entry requirements	None
Assessment	Multiple choice and short answer test
Grading	Pass/Fail
Approvals	Automatic approval
Support materials	Centre handbook Assessment pack
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	City & Guilds qualification number	Regulatory reference number	GLH	TQT
City & Guilds Level 2 Diploma in Electrical Power Engineering - Distribution and Transmission (Technical Knowledge)	2304-17	603/7179/1	210	370

Version and date	Change detail	Section
1.0 February 2021	First published	All
1.1 February 2021	Amended qualification titles and removed reference to SCQF credit	Throughout
1.2 June	Added City & Guilds to titles, add reasonable adjustments section and added pass/fail grading statement to section 4	Throughout
1.3 April 2025	Handbook transferred to latest version of the template. The section on Quality Assurance has been updated and sections on Inclusion and diversity, and Sustainability have been added	All

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1 Introduction

This document tells you what you need to do to deliver the qualification(s):

Area	Description
Who is the qualification for?	This qualification is for those individuals who are wishing to enter or are already working within the power industry. They could be undertaking an Apprenticeship such as The Power Network Craftsperson, wishing to gain knowledge or progress to a more advanced role.
What does the qualification cover?	This qualification covers This qualification allows candidates to learn, develop and practise the knowledge and understanding required for employment and career progression in the power industry.
What opportunities for progression are there?	They allow candidates to progress into employment or into a management opportunity.
Who did we develop the qualification with?	Power sector employers and the Sector Skills Council Energy & Utility Skills (EU Skills).
Is it part of an apprenticeship framework or initiative?	This qualification supports the Power Network Craftsperson Standard.

Structure

To achieve the City & Guilds Level 2 Diploma in Electrical Power Engineering - Distribution and Transmission (Technical Knowledge), learners must achieve:

City & Guilds unit number	Unit title	GLH
Mandatory units:		
Learners must achieve all 4 mandatory units.		
261	Understand legislation in the power industry	42
262	Mathematics, mechanical and electrical theory in power engineering	60
263	Power engineering electrical networks, plant and apparatus	54
264	Power engineering: cables, sub stations and overhead lines	54

Total Qualification Time (TQT)

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to demonstrate the achievement of the level of attainment necessary for the award of a qualification.

TQT consists of the following two elements:

1) the number of hours that an awarding organisation has assigned to a qualification for guided learning
2) an estimate of the number of hours a learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by – but, unlike guided learning, not under the immediate guidance or supervision of – a lecturer, supervisor, tutor or other appropriate provider of education or training.

Title and level	GLH	TQT
City & Guilds Level 2 Diploma in Electrical Power Engineering - Distribution and Transmission (Technical Knowledge)	210	370

2 Centre requirements

Approval

Full approval

To offer this qualification, new centres will need to gain both centre and qualification approval. Please refer to the document **Centre Approval Process: Quality Assurance Standards** for further information.

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualification before designing a course programme.

Resource requirements

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area(s) for which they are delivering training and/or have experience of providing training (this knowledge must be to the same level as the training being delivered)
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Continuing professional development (CPD)

Centres are expected to support their staff in ensuring that their knowledge remains current of the occupational area and of best practice in delivery, mentoring, training, assessment and quality assurance, and that it takes account of any national or legislative developments.

Quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications. Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance. All external quality assurance processes reflect the minimum requirements for verified and moderated assessments, as detailed in the Centre Assessment Standards Scrutiny (CASS), section H2 of Ofqual's General Conditions. For more information on both CASS and City & Guilds Quality Assurance processes visit: the **What is CASS?** and **Quality Assurance Standards** documents on the City & Guilds website.

Standards and rigorous quality assurance are maintained by the use of:

- Internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must

- have appropriate teaching and vocational knowledge and expertise
- have experience in quality management/internal quality assurance
- hold or be working towards an appropriate teaching/training/assessing qualification
- be familiar with the occupation and technical content covered within the qualification.

External quality assurance for the qualification will be provided by City & Guilds EQA process. EQAs are appointed by City & Guilds to approve centres, and to monitor the assessment and internal quality assurance carried out by centres. External quality assurance is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

The role of the EQA is to:

- provide advice and support to centre staff
- ensure the quality and consistency of assessments and marking/grading within and between centres by the use of systematic sampling
- provide feedback to centres and to City & Guilds.

Learner entry requirements

City & Guilds does not set entry requirements for this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully.

Age restrictions

This qualification is approved for learners aged 16 or above.

Access arrangements and reasonable adjustments

City & Guilds has considered the design of this qualification and its assessments in order to best support accessibility and inclusion for all learners. We understand however that individuals have diverse learning needs and may require reasonable adjustments to fully participate. Reasonable adjustments, such as additional time or alternative formats, may be provided to accommodate learners with disabilities and support fair access to assessment.

Access arrangements are adjustments that allow candidates with disabilities, special educational needs, and temporary injuries to access the assessment and demonstrate their skills and knowledge without changing the demands of the assessment. These arrangements must be made before assessment takes place.

The Equality Act 2010 requires City & Guilds to make reasonable adjustments where a disabled person would be at a substantial disadvantage in undertaking an assessment.

It is the responsibility of the centre to ensure at the start of a programme of learning that candidates will be able to access the requirements of the qualification.

Please refer to the JCQ access arrangements and reasonable adjustments and Access arrangements - when and how applications need to be made to City & Guilds for more information. Both are available on the **City & Guilds website**

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each learner should be made before the start of their programme to identify:

- if the learner has any specific training needs
- support and guidance they may need when working towards their qualification
- any units they have already completed or credit they have accumulated which is relevant to the qualification
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the learner fully understands the requirements of the qualification, their responsibilities as a learner and the responsibilities of the centre. This information can be recorded on a learning contract.

Inclusion and diversity

City & Guilds is committed to improving inclusion and diversity within the way we work and how we deliver our purpose which is to help people and organisations develop the skills they need for growth.

More information and guidance to support centres in supporting inclusion and diversity through the delivery of City & Guilds qualifications can be found here:

Inclusion and diversity | City & Guilds (cityandguilds.com)

Sustainability

City & Guilds are committed to net zero. Our ambition is to reduce our carbon emissions by at least 50% before 2030 and develop environmentally responsible operations to achieve net zero by 2040 or sooner if we can. City & Guilds is committed to supporting qualifications that support our customers to consider sustainability and their environmental footprint.

More information and guidance to support centres in developing sustainable practices through the delivery of City & Guilds qualifications can be found here:

Our Pathway to Net Zero | City & Guilds (cityandguilds.com)

Centres should consider their own carbon footprint when delivering this qualification and consider reasonable and practical ways of delivering this qualification with sustainability in mind. This could include:

- reviewing purchasing and procurement processes (such as buying in bulk to reduce the amount of travel time and energy, considering and investing in the use of components that can be reused, instead of the use of disposable or single use consumables)
- reusing components wherever possible
- waste procedures (ensuring that waste is minimised, recycling of components is in place wherever possible)

- minimising water use and considering options for reuse/salvage as part of plumbing activities wherever possible.

Support materials

The following resources are available for this qualification:

Description	How to access
Assessment pack	www.cityandguilds.com
Qualification handbook	www.cityandguilds.com

4 Assessment

Assessment strategy

This qualification is graded pass / fail.

City & Guilds has written the following assessments to use with this qualification:

- live assignments that can be downloaded from the City & Guilds website
- sample assignments that can be downloaded from the City & Guilds website.

Assessment Types			
Unit	**Title**	**Assessment method**	**Where to obtain assessment materials**
261	Understand legislation in the power industry	Multiple choice paper 261 This is a paper-based multiple-choice paper that is internally marked and externally verified.	Assessment pack downloadable from www.cityandguilds.com
262	Mathematics, mechanical and electrical theory in power engineering	Multiple choice and short answer questions paper 262 This is a paper-based multiple-choice and short answer question paper that is internally marked and externally verified.	Assessment pack downloadable from www.cityandguilds.com
263	Power engineering electrical networks, plant and apparatus	Multiple choice paper 263 This is a paper-based multiple-choice paper that is internally marked and externally verified.	Assessment pack downloadable from www.cityandguilds.com
264	Power engineering: cables, sub stations and overhead lines	Multiple choice paper 264 This is a paper-based multiple-choice paper that is internally marked and externally verified.	Assessment pack downloadable from www.cityandguilds.com

Time constraints

Qualification registration is valid for five years.

Test specifications

The test specifications for the units within this qualification are provided in the assessment pack which is freely downloadable from the City & Guilds website www.cityandguilds.com

5 Units

Structure of the units

These units each have the following:

- City & Guilds reference number
- title
- level
- unit aim
- learning outcomes, which are comprised of a number of ssessment criteria
- supporting information

Guidance for delivery of the units

This qualification comprises a number of **units**. A unit describes what is expected of a competent person in particular aspects of their job.

Each **unit** is divided into **learning outcomes** which describe in further detail the skills and knowledge that a candidate should possess.

Each **learning outcome** has a set of **assessment criteria** (performance and knowledge and understanding) which specify the desired criteria that must be satisfied before an individual can be said to have performed to the agreed standard.

Range statements define the breadth or scope of a learning outcome and its assessment criteria by setting out the various circumstances in which they are to be applied.

Supporting information provides guidance of the evidence requirement for the unit and specific guidance on delivery and range statements. Centres are advised to review this information carefully before delivering the unit.

Unit 261 Understand legislation in the power industry

Level:	2
Endorsement by a sector or regulatory body:	This unit is endorsed by Energy & Utility Skills
Aim:	The learner will be able to demonstrate an understanding of the following when working in a power engineering environment: • relative health, safety and environmental legislation, the use of method statements, codes of practice and risk assessments • effective working management techniques to improve productivity of self and others • methods of using and communicating technical information.

Learning outcome

The learner will:

LO1 demonstrate an understanding of relevant health and safety legislation

Assessment criteria

The learner can:

AC1.1 describe employers and employees responsibilities relating to the following health and safety regulations:

a) Health and Safety at Work Act 1974

b) Electricity at Work Regulations 1989

c) Management of Health & Safety at Work Regulations and Fire Precautions (workplace) 2003.

AC1.2 outline statutory requirements relating to the following health and safety regulations:

a) Electricity Supply, Quality and Continuity Regulations 2002

b) Manual Handling Operations Regulations 1992

c) Provision and Use of Work Equipment Regulations 1998

d) Control of Noise at work Regulations 2005

e) Construction (Design and Management) Regulations 2015.

Learning outcome

The learner will:

LO2 demonstrate an understanding of relevant health and safety procedures

Assessment criteria

The learner can:

AC2.1 describe where to access sources of health and safety information and advice

AC2.2 state the roles and responsibilities safety officers/ representatives

AC2.3 state the roles, responsibilities and powers of Health and Safety Executive Inspectors

AC2.4 describe where information relating to safety policies, codes of practice and procedures can be found

AC2.5 outline the requirements of the Control of Substances Hazardous to Health Regulations 2002

AC2.6 identify relevant health and safety warning signs used in the power industry in relation to:

a) warning

b) prohibition

c) safe condition

d) mandatory safety signs.

Learning outcome

The learner will:

LO3 understand the risk assessment process

Assessment criteria

The learner can:

AC3.1 describe the reasons for reporting health and safety hazards

AC3.2 describe the reasons for carrying out risk assessments

AC3.3 define the terms ‘hazard’ and ‘risk

AC3.4 describe the principles of a risk assessment process to control hazards

Learning outcome

The learner will:

LO4 understand the importance of Personal Protective Equipment (PPE)

Assessment criteria

The learner can:

AC4.1 describe why personal protective equipment (PPE) should be stored, inspected and maintained correctly

AC4.2 outline the requirements relating to the Personal Protective Equipment at Work Regulations 1992

Learning outcome

The learner will:

LO5 understand the causes of accidents

Assessment criteria

The learner can:

AC5.1 list the basic causes of accidents

AC5.2 outline the requirements relating to Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013

AC5.3 state appropriate actions to be taken in the event of an injury / accident

AC5.4 describe the effects of electric shock

AC5.5 describe precautions that can be taken to prevent electric shock

AC5.6 state the difference between direct and indirect electrical contact

Learning outcome

The learner will:

LO6 understand the storage and inspection of lifting equipment

Assessment criteria

The learner can:

AC6.1 describe why lifting equipment should be stored, inspected and maintained correctly

AC6.2 describe the meaning of these terms when using lifting equipment terms:

a) safe working load

b) maximum working load.

AC6.3 outline the requirements of the Lifting Operations and Lifting Equipment Regulations 1998

Learning outcome

The learner will:

LO7 understand about working at height

Assessment criteria

The learner can:

AC7.1 describe hazards associated with working at height

AC7.2 describe preventative measures used to reduce the hazards of working at height

AC7.3 outline the requirements of the Construction Regulations with regard to work at height

Learning outcome

The learner will:

LO8 understand about working in confined spaces

Assessment criteria

The learner can:

AC8.1 describe hazards associated with working in confined spaces

AC8.2 outline the requirements of the Confined Spaces Regulations 1997

Learning outcome

The learner will:

LO9 understand fire prevention

Assessment criteria

The learner can:

AC9.1 describe the conditions required for the combustion and extinction of fire with respect to:

a) heat

b) oxygen

c) fuel.

AC9.2 describe methods of fire prevention

AC9.3 outline methods for controlling and extinguishing fires using suitable firefighting equipment for different types of fires

AC9.4 describe the purpose and potential hazards of automatic firefighting equipment

AC9.5 outline the requirements of the Fire Safety Regulations 2005

Learning outcome

The learner will:

LO10 understand the dangers of asbestos

Assessment criteria

The learner can:

AC10.1 outline the different uses and properties of asbestos in the power industry

AC10.2 describe potential risks to the health of workers exposed to asbestos

AC10.3 describe situations/work environments where asbestos might be found

AC10.4 describe methods for controlling and minimising the risk of exposure to asbestos

AC10.5 describe emergency and decontamination procedures for dealing with asbestos

AC10.6 outline the requirements of the Control of Asbestos Regulations 2012

Learning outcome

The learner will:

LO11 understand the importance of handling and disposing of waste

Assessment criteria

The learner can:

AC11.1 describe the importance of safely storing, handling and disposing of waste products

Learning outcome

The learner will:

LO12 understand the importance of working effectively and efficiently

Assessment criteria

The learner can:

AC12.1 identify methods to assess own levels of competence and learning needs

AC12.2 describe how to plan and implement a timetable for developing competence and improve their personal performance

AC12.3 describe the principles and importance of team working

AC12.4 state the importance of effective communication in a working environment

AC12.5 describe how to plan work activities effectively and efficiently

AC12.6 list types of information needed to plan tasks effectively

AC12.7 outline basic principles for dealing with problems in planned activities

AC12.8 describe basic methods to evaluate the success of a completed planned activity

AC12.9 outline the benefits of improving working practices and procedures

AC12.10 describe the importance of meeting customer expectations

AC12.11 describe the impact of interruptions and loss of supply to customers

Learning outcome

The learner will:

LO13 demonstrate an understanding of using and communicating technical information

Assessment criteria

The learner can:

AC13.1 describe types of written technical information used in a power engineering environment

AC13.2 describe types of diagrammatic / pictorial technical information used in a power engineering environment

AC13.3 identify types of technical information that can be gained from geographic diagrams/site plans

AC13.4 describe the purpose of safety documentation used in the power sector including:

a) Permit to Work

b) Limitation of Access

c) Sanction for Test.

AC13.5 describe typical information contained in a Permit to Work

AC13.6 identify the range of customers encountered whilst working in the Power Sector

AC13.7 state methods by which technical information can be communicated

AC13.8 describe the purpose of maintaining accurate system records

AC13.9 state how technical information can be recorded and stored

AC13.10 describe the importance of reporting technical information inconsistencies or inaccuracies to relevant parties

AC13.11 explain the importance of effective communication to maintain good relationships with customers

Unit 262 Mathematics, mechanical and electrical theory in power engineering

Level:	3
Endorsement by a sector or regulatory body:	This unit is endorsed by Energy & Utility Skills
Aim:	The learner will be able to demonstrate: • an understanding of the practical engineering application of addition, subtraction, division, multiplication, basic transposition and trigonometry • an understanding of mathematical calculations in a power engineering environment • an understanding of mechanical engineering principles, materials, equipment and techniques including, movement of loads, SI units, pulleys, transposition and application of basic formulae • an understanding of the use of mechanical engineering principles and techniques in a power engineering environment • an understanding of basic electrical principles including AC/DC theory, electrical dangers, simple circuits, magnetism, SI units, transformers and transposition and application of basic formulae • an understanding of basic electrical principles and their application in a power engineering environment.

Learning outcome

The learner will:

LO1 demonstrate an understanding of round numbers, use scientific notation, percentages and ratios

Assessment criteria

The learner can:

AC1.1 round a number to a given number of significant figures and/or decimal places
AC1.2 convert a number from standard notation to scientific notation or vice versa
AC1.3 use a calculator to add, subtract, multiply and divide numbers in scientific notation
AC1.4 calculate percentages of quantities
AC1.5 calculate quantities linked by ratios and split quantities correctly by ratios

Learning outcome

The learner will:

LO2 demonstrate an understanding of areas, perimeters, volumes and surface areas of simple shapes

Assessment criteria

The learner can:

AC2.1 calculate areas and perimeters of squares, rectangles, triangles and circles

AC2.2 calculate volumes and surface areas of cubes, cuboids, cylinders and (other) prisms of spheres

Learning outcome

The learner will:

LO3 demonstrate an understanding of scales, tables, graphs and charts

Assessment criteria

The learner can:

AC3.1 extract information from scales

AC3.2 extract information from tables

AC3.3 extract information from graphs

AC3.4 extract information from charts

Learning outcome

The learner will:

LO4 demonstrate an understanding of Pythagoras' Theorem and sin/cos/tan in right-angled triangles

Assessment criteria

The learner can:

AC4.1 use Pythagoras' Theorem to calculate an unknown side in a right-angled triangle

AC4.2 use sine or cosine or tangent to calculate an unknown side and angle in a right-angled triangle

Learning outcome

The learner will:

LO5 demonstrate an understanding of substitute numerical values into simple engineering formulae

Assessment criteria

The learner can:

AC5.1 substitute numerical values into engineering formulae involving addition, subtraction, multiplication, division of terms, and combinations of these operations

AC5.2 substitute numerical values into engineering formulae involving simple powers: squares, square roots, cubes and cube roots

Learning outcome

The learner will:

LO6 demonstrate an understanding of the sequence of arithmetic operations

Assessment criteria

The learner can:

AC6.1 perform arithmetic operations following the form BODMAS
AC6.2 use a range of functions found on a calculator (non VPAM)
AC6.3 demonstrate the use of minus sign preceding numbers and number scale

Learning outcome

The learner will:

LO7 define mass, force and weight

Assessment criteria

The learner can:

AC7.1 describe the differences and relationship between mass, force and weight
AC7.2 perform calculations using equations and SI units
AC7.3 represent force as a vector quantity

Learning outcome

The learner will:

LO8 define the parameters of mechanical systems

Assessment criteria

The learner can:

AC8.1 identify the function of gears, levers, toggles, cams, cranks and pawl and ratchet
AC8.2 identify types of springs and their characteristics

Learning outcome

The learner will:

LO9 define the components of hydraulic and pneumatic systems

Assessment criteria

The learner can:

AC9.1 identify hydraulic and pneumatic components
AC9.2 describe the function of hydraulic and pneumatic components

Learning outcome

The learner will:

LO10 define statics and forces

Assessment criteria

AC10.1 explain the importance of identify conditions for static equilibrium, parallelogram of forces, triangle of forces, polygon of forces, following:

a) principles of moments

b) frictional resistance to motion

c) data to determine resultants

d) equilibrants and reactions.

AC10.2 describe the states of equilibrium of a body and the effect of its center of gravity in relation to overhead line structures

AC10.3 describe the effect the width of base, weight and center of gravity have on a body's stability

Learning outcome

The learner will:

LO11 define energy, work and power

Assessment criteria

AC11.1 describe the terms energy, work and power

AC 11.2 define work as force multiplied by distance moved in the direction of the force

AC 11.3 perform calculations for energy work and power using equations and SI units

Learning outcome

The learner will:

LO12 define the parameters of material tensile strengths

Assessment criteria

AC12.1 explain the importance of identify the tensile strength of material types given relevant data

AC12.2 identify the sag of a conductor using:

$$T = \frac{WL^2}{8S}$$

Learning outcome

The learner will:

LO13 define the parameters of mechanical advantage

Assessment criteria

AC13.1 describe mechanical advantage provided by the use of winches and pulley systems

Learning outcome

The learner will:

LO14 understand the lever principle and theorem of movement

Assessment criteria

AC14.1 explain the importance of describe the lever principle and theorem of movement
AC14.2 explain practical applications of the lever principle
AC14.3 calculate – mechanical advantage, velocity ratio and torque turning force
AC14.4 calculate efficiency as a percentage using input and output power or energy

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Learning outcome

The learner will:
LO15 demonstrate an understanding of circuit technology

Assessment criteria

AC15.1 describe the basic principles of electron theory and current flow
AC15.2 define electrical resistance and impedance
AC15.3 use graphs to evaluate resistive circuits
AC15.4 interpret data from graphs and evaluate their statistical relevance
AC15.5 define the meaning of gradients on straight-line graphs
AC15.6 plot graphs showing:
- a) inverse relationships
- b) graphs of resistance
- c) cross-sectional area.

AC15.7 determine resistance from material dimensions and resistivity
AC15.8 state the effect of temperature on the resistance of common conducting and insulating materials
AC15.9 use graphs to show positive and negative temperature coefficients indicating their uses
AC15.10 state the principles of Ohm's Law in respect of AC/DC sources
AC15.11 outline the difference between:
- a) series
- b) parallel
- c) series/parallel resistive circuits.

AC15.12 explain the meaning of voltage drop relative to conductors / cables
AC15.13 determine voltage drop created by simple connection of combinations of resistors
AC15.14 determine current, voltage and power in circuits (and parts of circuits) formed by simple combinations of resistors
AC15.15 state the importance of voltage rating in respect to conductors, cables and transformers
AC15.16 identify the constructional features of the following:
- a) parallel plate capacitor
- b) variable and semi-variable air-spaced
- c) solid dielectric types of capacitor.

AC15.17 describe the principles and effect of capacitance relative to conductors/cables
AC15.18 describe safety, charge and discharge characteristics of capacitors relative to conductors/cables
AC15.19 describe the principles and effect of inductance relative to conductors / cables/steelwork

Learning outcome

The learner will:

LO16 demonstrate an understanding of magnetism and electromagnetism

Assessment criteria

AC16.1 explain the importance of describe the theory relating to magnetic fields and their effects on overhead and underground cables

AC16.2 describe the characteristics of magnets

AC16.3 describe the laws relating to magnetic fields

AC16.4 state the relationship between magnetic field strength and relative areas of magnetic poles

AC16.5 explain electromagnetism

AC16.6 identify what happens to a magnetic field when a conductor carries current in relation to transformers

AC16.7 describe the forces exerted on a current carrying conductor

AC16.8 describe how magnetic forces can be reduced on underground and overhead cables

AC16.9 describe the dangers of switching inductive circuits

AC16.10 describe the movement caused to an armature when applying a DC current to a coil

AC16.11 identify using sketches how magnetic shielding is provided in power engineering plant and apparatus

Learning outcome

The learner will:

LO17 demonstrate an understanding of transformers

Assessment criteria

AC17.1 describe the operation and construction of power transformers

AC17.2 identify transformer types from sketches

AC17.3 identify the function of transformer features; laminations, core, limb and yoke

AC17.4 compare hysteresis and eddy current losses

AC17.5 compare the construction of auto-transformers and double-wound transformers

AC17.6 describe the operation and construction of instrument transformers

AC17.7 differentiate between iron and copper losses

AC17.8 state the relationship between input, output and losses

AC17.9 describe how losses may be reduced with respect to laminating the iron core

AC17.10 carry out basic mathematical analysis on transformers and perform simple calculations on input, output and losses

AC17.11 use percentages to define efficiency and losses within a transformer

AC17.12 perform calculations involving current, voltage and turns based on an ideal transformer using the equation below in relation to transformer tap changers

Unit 263 Power engineering electrical networks, plant and apparatus

Level:	2
Endorsement by a sector or regulatory body:	This unit is endorsed by Energy & Utility Skills
Aim:	The learner will be able to demonstrate: • an understanding of power engineering electrical networks including; generation, transmission, distribution and transformation of system voltages • an understanding of power engineering electrical plant and apparatus including the properties and purpose of transformers, switchgear, earthing devices, voltage and load control and automated equipment • an understanding of the types, properties and use of power engineering electrical transmission and distribution plant and apparatus • an understanding of power engineering common network configurations, terms and characteristics, switching operations, safety documentation and protection.

Learning outcome

The learner will:

LO1 demonstrate an understanding of power generation including distributed generation

Assessment criteria

The learner can:

AC1.1 list energy sources that can be used when generating electricity

AC1.2 describe how energy is converted into electrical power in the generation process using a range of energy sources

AC1.3 state why LV/HV power stations systems are interconnected and the advantages of interconnection

AC1.4 identify the relationship between generation, transmission and distribution arrangements within the UK

AC1.5 describe the function of the Electricity Regulator in the UK

AC1.6 describe reasons for high voltage transmission and lower voltage distribution

AC1.7 describe the transmission to distribution process from high voltage to low voltage and identify the common voltage levels at each transitional stage

AC1.8 describe the function of a step-down transformer in the transmission and distribution of electricity

AC1.9 describe the function of a step-up transformer in the transmission and distribution of electricity

Learning outcome

The learner will:

LO2 demonstrate an understanding of power transmission and distribution

Assessment criteria

The learner can:

AC2.1 describe the advantages and disadvantages of using overhead line conductors to transmit/distribute electricity

AC2.2 describe the advantages and disadvantages of using underground cables to transmit / distribute electricity

AC2.3 describe the term Protective Multiple Earthing (PME)

AC2.4 2 describe the term Separate Neutral Earthing (SNE/TNS)

AC2.5 describe the construction and application of high voltage fuses used to protect networks

AC2.6 describe the construction and application of low voltage fuses used to protect networks

AC2.7 explain the usage of protection schemes on electrical networks

Learning outcome

The learner will:

LO3 demonstrate an understanding of electrical plant and apparatus

Assessment criteria

The learner can:

AC3.1 3 state the constructional features and cooling arrangements of distribution and transmission transformers

AC3.2 describe the relationship between a transformer's ratio of primary and secondary windings and how they affect the output voltage

AC3.3 state the function of a transformer tap changer

AC3.4 describe the function of the following types of apparatus:

a) voltage transformer
b) current transformer
c) liquid earthing resistor
d) fault thrower.

AC3.5 describe the function of the following types of electrical plant and apparatus:

a) circuit-breakers
b) switches
c) isolators
d) busbars
e) switch fuse.

AC3.6 describe the constructional features and the principles of switchgear operation

AC3.7 identify electrical plant and apparatus symbols on a given network diagram

AC3.8 state the function of high voltage surge arrestors

AC3.9 describe the purpose of earthing plant and apparatus

AC3.10 identify methods for measuring the earth resistance value of plant and apparatus

AC3.11 state the importance of achieving the correct resistance value when testing earth resistance values

AC3.12 describe how fuses are used to protect electrical plant and apparatus

AC3.13 describe what is meant by the term 'fuse rating'

AC3.14 interpret a fuses rating and characteristics from specification data

Learning outcome

The learner will:

LO4 demonstrate an understanding of electrical network operations

Assessment criteria

The learner can:

AC4.1 explain the importance of identify electrical plant and apparatus symbols on network diagrams

AC4.2 describe the characteristics and function of electrical power networks in relation to:

a) radial circuits

b) ring circuits

c) feeder circuits.

AC4.3 describe methods of sectionalising a network

AC4.4 describe common causes and types of network faults

AC4.5 describe basic procedures for carrying out the isolation of:

a) a low voltage overhead line operating under 1000V

b) a high voltage overhead line operating over 1000V

c) a low voltage underground cable operating under 1000V

d) a high voltage underground cable operating over 1000V.

AC4.6 describe the purpose of safety documentation in a power engineering environment

AC4.7 describe when each of the following safety documents would be used

a) Permit to Work

b) Limitation of Access / Limited Work Certificate

c) Sanction for Test.

AC4.8 describe the basic roles and responsibilities of persons carrying out operations on an electrical network

AC4.9 describe the basic roles and responsibilities of persons carrying out operations on an electrical network

AC4.10 list the types of protective systems used to protect electrical networks

AC4.11 state the advantages of carrying out network operations using remotely operated equipment

AC4.12 describe the methods by which network equipment can be remotely operated

Unit 264 Power engineering: cables, sub stations and overhead lines

Level:	2
Endorsement by a sector or regulatory body:	This unit is endorsed by Energy & Utility Skills
Aim:	The learner will be able to demonstrate an understanding of the types and characteristics of: • common cables and joints, including causes and consequences of common faults • the types and characteristics of common substation plant and apparatus including causes and consequences of common faults • common overhead line plant and apparatus including causes and consequences of common faults

Learning outcome

The learner will:

LO1 demonstrate an understanding of underground cables

Assessment criteria

The learner can:

AC1.1 state the common types of underground cables used in electrical power networks including distributed power networks

AC1.2 describe the construction of commonly used underground cable types including their core, insulation, sheathing and armouring arrangements

AC1.3 describe the common types and usage of joints used in underground cable installations

AC1.4 describe the advantages and disadvantages of different insulation materials

AC1.5 identify the electrical ratings of cables from specifications / charts

AC1.6 describe factors that effect the rating of a cable

AC1.7 describe the effects of electric stress on underground cables

AC1.8 explain how electrical stress can be reduced and controlled in underground cables

Learning outcome

The learner will:

LO2 demonstrate an understanding of underground cable installations

Assessment criteria

The learner can:

AC2.1 the requirements of the health and safety guidance note HSG 47 in relation to the safe working methods of cable identification, location and excavation

AC2.2 state the codes of practice and legal requirements that must be followed when carrying out cable laying activities

AC2.3 explain the advantages and disadvantages of direct lay and draw-in systems

AC2.4 state the factors to be recorded when a cable is laid

AC2.5 describe the benefits of keeping cable records and data

AC2.6 interpret information from cable plans / records

AC2.7 describe types of underground plant apparatus used in underground power networks

Learning outcome

The learner will:

LO3 demonstrate an understanding of underground cable testing and common faults

Assessment criteria

The learner can:

AC3.1 describe the types and purpose of electrical testing when carrying out jointing activities

AC3.2 describe the purpose of bonding underground cables when jointing cables

AC3.3 state causes of common cable faults

AC3.4 describe the meaning of the terms:

a) open circuit
b) short circuit
c) earth faults
d) high resistance.

AC3.5 describe reasons for ‘cable spiking’ an underground cable

Learning outcome

The learner will:

LO4 demonstrate an understanding of substation installations

Assessment criteria

The learner can:

AC4.1 describe the purpose of plant and apparatus in primary and secondary substation installations, including:

a) circuit breakers
b) tap changers
c) isolators
d) neutral earthing resistors
e) fault thrower switches
f) earthing transformer
g) reactors.

AC4.2 describe the function of plant and apparatus used in primary and secondary sub-station installations

AC4.3 describe the primary reason for the earthing of the neutral point in high voltage and low voltage systems

AC4.4 explain the reason for bonding and earthing of metalwork

AC4.5 describe the reason for measuring the earth resistance value of earth electrodes in substation installations

AC4.6 describe the meaning of the terms:

a) earth resistance

b) earth resistivity

c) earth fault loop impedance.

AC4.7 interpret basic substation installation connections using single line diagrams

AC4.8 describe the reasons for interlock systems and mechanisms used in substation installations

AC4.9 differentiate between the use of a bus section and bus coupler switches

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Learning outcome

The learner will:

LO5 demonstrate an understanding of substation insulating mediums

Assessment criteria

The learner can:

AC5.1 state types of insulating mediums used in substation plant and apparatus

AC5.2 describe the function of insulating mediums used in substation plant and apparatus

AC5.3 describe the purpose of testing insulating mediums in electrical plant and apparatus

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Learning outcome

The learner will:

LO6 demonstrate an understanding of substation transformer protection

Assessment criteria

The learner can:

AC6.1 describe the construction and operation of a Buchholz relay

AC6.2 describe the construction and principles of transformer winding temperature

AC6.3 state the reasons for earthing the core and secondary windings in voltage and current transformers

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Learning outcome

The learner will:

LO7 demonstrate an understanding of substation maintenance

Assessment criteria

The learner can:

AC7.1 describe advantages and disadvantages of substation inspection and preventative maintenance procedures

Learning outcome

The learner will:

LO8 demonstrate an understanding of overhead lines

Assessment criteria

The learner can:

AC8.1 explain statutory consents and notices and the procedures to be followed in the planning of overhead lines

AC8.2 describe common types of overhead line plant and apparatus and their purpose

AC8.3 outline topographical features that effect the routing of overhead lines

AC8.4 describe way-leave procedures in relation to overhead planning, including:

a) right grantors

b) notices

c) access

d) tree preservation orders

e) damage and compensation.

AC8.5 compare advantages and disadvantages of different types of overhead line support and identify the differing voltage ranges they may support

AC8.6 describe the purpose of different support configurations and associated items in relation to overhead line design

AC8.7 describe the construction and characteristics of a range of overhead line conductors

AC8.8 state the regulatory conductor ground clearances and conductor spacing for common overhead line voltages

AC8.9 state the effects on conductors of span length, tension, temperature, wind and ice loading

AC8.10 state the constructional features and purpose for types of insulator

AC8.11 describe the purpose and effect of applying earthing devices to an overhead line when it has been isolated

Learning outcome

The learner will:

LO9 demonstrate an understanding of common faults on overhead lines

Assessment criteria

The learner can:

AC9.1 state typical causes and symptoms of common faults on overhead lines

Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the **Centre document library** on **www.cityandguilds.com** or click on the links below:

Centre Handbook: Quality Assurance Standards

This document is for all approved centres and provides guidance to support their delivery of our qualifications. It includes information on:

- centre quality assurance criteria and monitoring activities
- administration and assessment systems
- centre-facing support teams at City & Guilds/ILM
- centre quality assurance roles and responsibilities.

The Centre Handbook should be used to ensure compliance with the terms and conditions of the centre contract.

Centre Assessment: Quality Assurance Standards

This document sets out the minimum common quality assurance requirements for our regulated and non-regulated qualifications that feature centre-assessed components. Specific guidance will also be included in relevant qualification handbooks and/or assessment documentation.

It incorporates our expectations for centre internal quality assurance and the external quality assurance methods we use to ensure that assessment standards are met and upheld. It also details the range of sanctions that may be put in place when centres do not comply with our requirements or actions that will be taken to align centre marking/assessment to required standards. Additionally, it provides detailed guidance on the secure and valid administration of centre assessments.

Access arrangements: When and how applications need to be made to City & Guilds provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **Centre document library** also contains useful information on such things as:

- conducting examinations
- registering learners
- appeals and malpractice.

Useful contacts

Please visit the **Contact us** section of the City & Guilds website.

City & Guilds

For over 140 years, we have worked with people, organisations and economies to help them identify and develop the skills they need to thrive. We understand the life-changing link between skills development, social mobility, prosperity and success. Everything we do is focused on developing and delivering high-quality training, qualifications, assessments and credentials that lead to jobs and meet the changing needs of industry.

We partner with our customers to deliver work-based learning programmes that build competency to support better prospects for people, organisations and wider society. We create flexible learning pathways that support lifelong employability because we believe that people deserve the opportunity to (re)train and (re)learn again and again – gaining new skills at every stage of life, regardless of where they start.

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