Electrical Installation Theory and Practice Part 2

Scheme pamphlet

City & Guilds

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Electrical Installation Theory and Practice Part 2

Scheme pamphlet

2360
For examinations commencing June 1996

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City & Guilds vocational schemes

1.1 City & Guilds provides vocational certification for all occupational areas at seven levels within its Progressive Structure of Awards.

The Certificates described in this scheme pamphlet relate to Electrical Installation Theory Part Two and Electrical Installation Theory and Practice Part Two. This version will be incorporated into the Part One scheme pamphlet in due course. Details of the certificate are given on page 5.

1.2 City & Guilds does not itself provide courses of instruction, specify entry requirements or length of study. However, for the purpose of making provision for resources, centres may wish to note that on average 350 guided learning hours would be required. Its approved centres use the syllabuses on page 8 onwards to design and implement courses to meet the needs of their own students or trainees. They also arrange assessments and may recommend accreditation on the basis of prior achievements.

Introduction

2.1 This scheme for assessment and certification is intended for those undergoing training for, or those employed in, the electrical contracting industry.

2.2 The scheme has been redeveloped to match the requirements of the Level 3 NVQ standards, *Installing and Commissioning Electrical Systems and Equipment.* Candidates successfully completing assessments towards either or both of the two Certificates may be able to apply these successes through a process of Accreditation of Prior Achievement, towards the achievement of a Level 3 NVQ, see 2.4 below.

Centre approval

2.3 Before proceeding with the assessments related to this scheme, centres will need to
a) ensure that the appropriate assessment facilities can be made available to candidates
b) seek approval, through City & Guilds Regional Quality Services, to offer assessments.

2.4 Those centres wishing their candidates to use the Part Two Certificates as a means of assessment towards the Level 3 NVQ must seek approval to do so via the NVQ Awarding Body. Details may be obtained from the Joint Industry Board for the Electrical Contracting Industry.

2.5 Entries for assessment in this scheme are confined to centres in the United Kingdom and the Republic of Ireland.

Certificates

3.1 The certificates described in this scheme pamphlet are

a) The Part Two Certificate in Electrical Installation Theory

b) The Part Two Certificate in Electrical Installation Theory and Practice.

Assessments, entries and results

Assessments

4.1 The assessments related to these certificates are listed below

a) **Electrical Installation Theory Part Two Certificate**

(2360-101) Assignments
(2360-201) Assignments Part Two
This component will consist of three Assignments for sections 01, 02 and 03.

2360-202 Installation, Commissioning and Fault Diagnosis
- Written Paper 3 Hours
This component will cover syllabus sections 02 and 03.

2360-203 Electrical Science and Principles
- Written Paper 2 Hours
This component will cover syllabus section 04.

b) **Electrical Installation Theory and Practice part Two Certificate**

(2360-101) Assignments
(2360-201) Assignments Part Two
This component will consist of three Assignments for sections 01, 02 and 03.

2360-202 Installation , Commissioning and Fault Diagnosis
- Written Paper 3 Hours
This component will cover syllabus sections 02 and 03.

2360-203 Electrical Science and Principles
- Written Paper 2 Hours
This component will cover syllabus section 04.

(2360-204) Practical Tasks
This component will cover syllabus section 05.

Entry for certification and assessments

4.2 Candidates who enter through centres which have directed their preparation (whether by attendance at the centre, co-operation with another institution, accreditation of prior learning or by open learning methods) are internal candidates. Others may enter as external candidates provided they have sufficient industrial experience and are able to meet the assessment requirements.

4.3 Every centre will have a Centre Co-ordinator or Local Examinations Secretary or scheme contact who makes entries, collects fees, arranges for assessments to take place, and corresponds with City & Guilds (or its examiners). The Local Examinations Secretary also receives all certificates and correspondence from City & Guilds on behalf of the centre's candidates.

The provision and conduct of assessments

4.4 City & Guilds processes entries for certification 12 times a year. Details of the availability of assessments and of the general regulations for their conduct are given in the City & Guilds *Directory of Assessments and Awards*. If there is any inconsistency between the scheme regulations set out in this pamphlet and the City & Guilds *Directory of Assessments and Awards*, the latter prevails.

Issue of certificates of unit credit

4.5
a) All candidates for City & Guilds certificates and assessments receive a Notification of Candidate Results giving details of their performance.
b) Candidates who successfully complete any component receive a Certificate of Unit Credit. Certificates of Unit Credit make no mention of assessments for which candidates did not enter, which they failed or from which they were absent.
c) For components 2360-101 Assignments, 2360-201 Assignments Part Two and 2360-204 Composite Practical Exercises, no higher grade than PASS shall be awarded.
d) For components 2360-202 and 2360-203, there will be three grades of success, DISTINCTION, CREDIT and PASS.

4.6
a) Centres will receive all the Notification of Candidates Results, Certificates of Unit Credit and Certificates for their own candidates. Any correspondence is also conducted through the centre.
b) Centres will receive consolidated results lists detailing the performance of all the candidates they enter, whether they are completely successful or not.

Designing courses of study

4.7 Candidates for the Part Two in Electrical Installation Competences will have come from very varied backgrounds and will have different employment and training experiences, ambitions and opportunities. Centres will therefore wish to
a) conduct an initial assessment of candidates' achievements for the purposes of accrediting prior learning and determining level of entry to studies
b) consider what learning modes and locations will best suit their candidates.

4.8 In their initial assessment of candidate needs, centres will wish to consider
a) what, if any, previous educational qualifications or training the candidate has; particular attention is drawn to performance in the various general vocational education certificates provided by the Institute, including GNVQs
b) what, if any, previous practical experience the candidate has which is relevant and from which relevant skill and knowledge may have been informally acquired.

4.9 In their selection of learning modes and locations, centres will wish to consider the results of their initial assessments and the availability or provision of
a) open or distance learning material
b) workplace learning and assessment to be carried out co-operatively by the centre and the workplace
c) co-operative working with other registered centres.

2360 Electrical Installation Theory and Practice

Part Two

Syllabus

It should be understood that adherence to all current statutory and non-statutory regulations applicable to the electrical installation industry will be applied to all areas of the scheme where relevant.

SECTION 01 QUALITY ASSURANCE FOR ELECTRICAL INSTALLATION

The candidate will be required to

1.1 Identify the parties concerned with design and preparation as
- a) clients
- b) contractors
- c) sub-contractors
- d) suppliers
- e) advisers.

1.2 Identify regulatory requirements and state the responsibility of the parties concerned with reference to
- a) building control, eg Building Regulations
- b) environmental
- c) Health and Safety, eg HASAWA 1974
- d) fire
- e) electrical, eg
  - i) IEE Wiring Regulations (BS7671)
  - ii) Electricity at Work Regulations 1989
  - iii) Electricity Supply Regulations.

1.3 State the importance and means of effectively
- a) establishing client's requirements
- b) researching and collating relevant information
- c) advising clients and translating agreed requirements into an installation design.

1.4 With reference to proposed installations, outline the importance of information-gathering with respect to
- a) determining the financial, legal, technical and resource implications
- b) its sufficiency and accuracy.

1.5
- a) State the need to relate statutory and non-statutory regulations to design objectives for a proposed electrical installation.
- b) Outline the possible effects of failure to accurately assess and determine regulatory and regional requirements.
- c) State methods of confirming regulatory and regional planning requirements and the importance of maintaining accurate results.

1.6 State how regulatory and planning requirements may have implications for the electrical contractor with reference to
   a) finance
   b) legislation
   c) resources
   d) technical requirements.

1.7 List methods of receiving, recording and retrieving information.

1.8 Explain the use of reports, charts, drawings, plans and schedules in the presentation of design proposals.

1.9 Read and interpret
   a) circuit diagrams
   b) location drawings
   c) block diagrams
   d) site plans.

1.10 Prepare requisitions from given drawings.

1.11 Identify survey methods and equipment and state the factors which affect their selection with reference to
   a) methods
      i) visual
      ii) detailed measurement
      iii) structural
   b) equipment
      i) measuring (tapes, levels)
      ii) access equipment
   c) factors
      i) access to site
      ii) site structure
      iii) fabric
      iv) affected parties.

1.12 State the responsibilities of the following in respect of undertaking a survey and the need for co-operation
   a) installer
   b) site owner/occupier
   c) affected parties.

1.13 Identify the assurance requirements necessary prior to survey with respect to
   a) authorisation
   b) appropriate insurance.

1.14 State the importance of the condition of site structures, their characteristics and interaction with installations
   a) structure
      i) floors
      ii) walls
      iii) access way
      iv) roofs
      v) trenches
      vi) open ducts
      vii) ceilings

b) fabric
   i) wood
   ii) plaster
   iii) brick
   iv) steelwork
   v) concrete
   vi) stud partitioning
c) external influences
   i) temperature
   ii) moisture
   iii) load bearing strength
   iv) porosity
   v) corrosion.

1.15 State the safety procedures to be adopted when undertaking a survey with respect to
   a) site safety regulations
   b) use of access equipment
   c) personal protective equipment
   d) existing installations
   e) building structure and fabric.

1.16 Describe assessment methods to survey existing installations for
   a) visual
   b) electrical testing.

1.17 With reference to existing installations, state the importance and means of effectively
   a) establishing appropriate technical information
   b) recognising legal and regulatory requirements.

1.18 State procedures involved in producing a formal contract and the possible consequences of non-compliance with such a contract.

1.19 State the relationship between the following parties associated with an electrical installation contract
   a) client
   b) main contractor
   c) sub-contractors
   d) suppliers
   e) consultants.

1.20 Explain how to co-ordinate electrical installation contracts with other trade contracts.

1.21 Describe means of developing planned schedules from contract requirements and specifications.

1.22 State the use of the following to control contract progress
   a) bar charts
   b) critical path networks
   c) site records
   d) site diaries
   e) variation orders.

1.23 State the sources of contract cost data as
   a) material costs
   b) plant costs
   c) labour costs.

1.24 Identify opportunities to provide cost savings as
- a) material control
- b) improved use of resources
- c) application of new technology.

1.25 State means of maintaining quality standards by verifying quality against
- a) design and contract requirements
- b) standard documentation
- c) manufacturers' documentation.

1.26 Explain the actions to be taken and the possible implications of variances from the specified standards.

1.27 List possible causes of delays to progress and their implications in terms of
- a) shortage of resources
- b) contract anomalies
- c) physical site constraints
- d) third party activities
- e) environmental conditions.

1.28 Identify means of improving contract progress by reference to
- a) costs
- b) resourcing
- c) new technology
- d) planning.

1.29 Explain the importance of effective communication in quality control.

1.30 Describe the types of information which can be provided to customers through
- a) installation specifications
- b) manufacturer data
- c) user instructions.

1.31 Recognise the means of checking the awareness of customers for installation services.

1.32 Explain the importance for the organisation of good relationships with customers.

1.33 Explain the importance of effective relationships with colleagues and other parties.

SECTION 02 INSTALLATION AND COMMISSIONING

The candidate will be required to

2.1 State the suppliers' standard voltages for transmission and distribution.

2.2 Describe the single phase and three phase four wire systems of distribution.

2.3 Describe the need for balancing single phase loads on three phase four wire systems.

2.4 Describe the arrangements for industrial, commercial, agricultural and domestic distribution systems relevant to
- a) isolation and switching
- b) overcurrent protection
- c) earth fault protection.

2.5 Describe system earthing arrangements to include TT, TN-S, TNC-S and TN-C.

2.6 Identify and prepare circuit diagrams for connections of the following instruments to both single and three phase circuits
- a) energy meters
- b) wattmeters
- c) voltmeters and voltage transformers
- d) ammeters and current transformers.

2.7 Describe the installation and connection of
- a) energy meters
- b) wattmeters
- c) voltmeters
- d) voltage transformers
- e) ammeters
- f) current transformers.

2.8 Describe the precautions to be taken when using current transformers.

2.9 Interpret schematic wiring and layout diagrams in order to connect single and three phase circuits.

2.10 Describe the installation and connection of
- a) air and oil cooled transformers
- b) air break, oil and vacuum switchgear
- c) single and three phase motors.

2.11 State the requirements within BS 7671 specific to
- a) circuits and connections
- b) identification and labelling of circuits.

2.12 State the dangers associated with the use of electricity and describe methods of controlling the risk for industrial, commercial, agricultural and domestic installations, with reference to
- a) isolation and switchgear
- b) direct and indirect contact
- c) installation terminals
- d) location of equipment and components.

2.13 Establish appropriate support and fixing methods for cabling, equipment and components with reference to
- a) types of installation site
- b) building fabric and structure
- c) contract specification and work instructions.

2.14 Identify appropriate wiring systems for industrial, commercial, agricultural and domestic installations with reference to
- a) use of the building
- b) environmental conditions
- c) current demand
- d) overcurrent protection.

2.15 Describe methods of terminating cables and conductors into equipment and components.

2.16 Calculate design currents for the following circuits
- a) single phase
- b) balanced three phase
- c) unbalanced 4 wire three phase.

2.17 Select appropriate type and rating of overcurrent protection devices for given conditions.

2.18 Determine and apply correction factors for
- a) type of overcurrent protection
- b) cables installed in groups
- c) effects of ambient temperature
- d) effects of thermal insulation on cables.

2.19 Undertake calculations to select live and protective conductors to meet the requirements of BS 7671 for
- a) main cables
- b) sub-main cables
- c) final circuits.

2.20 State the requirements of the appropriate regulations with reference to
- a) calculation of earth loop impedance of circuit from given data
- b) verification of compliance with shock protection constraints
- c) verification of compliance for thermal constraints.

2.21 Interpret wiring , schematic and layout diagrams for the identification, location and connection of equipment and components.

2.22 Interpret the requirements of
- a) contract specifications
- b) work instructions
- c) statutory and non-statutory legislation

with reference to the installation process.

2.23 State the purpose of the following devices with reference to the installation of single and three phase motors
- a) thermal and magnetic overload devices
- b) under voltage devices
- c) the use of thermistors to prevent damage to motor windings
- d) emergency stops
- e) remote start/stop control.

2.24 State the purpose of commissioning of electrical systems.

2.25 Establish the purpose and usage of identified systems to be commissioned with reference to
- a) power
- b) lighting
- c) alarms
- d) heating
- e) controls
- f) earthing.

2.26 State the safety precautions to be taken when carrying out commissioning.

2.27 State appropriate sources of information to facilitate commissioning with reference to
- a) contract specifications
- b) manufacturers' instructions
- c) relevant statutory legislation, eg HASAWA, EWR
- d) BS 7671.

2.28 List and describe the procedures to undertake commissioning of systems with reference to
- a) appropriate isolation
- b) contact with relevant parties
  - i) customer
  - ii) suppliers
  - iii) work colleagues
  - iv) other trades.

2.29 State the purpose of inspection and the factors to be taken into account prior to testing electrical systems.

2.30 Describe methods of verifying test equipment.

2.31 With reference to pre-commissioning testing, explain the importance of
- a) instrument accuracy
- b) need for regular calibration of instruments
- c) keeping documentary evidence.

2.32 Describe the types of tests to be carried out in order to meet regulatory requirements.

2.33
- a) Select test equipment for appropriate commissioning.
- b) Explain how to verify the integrity of test equipment.

2.34 State the procedures for accurate interpretation of results from commissioning and recording methods.

2.35 Describe the action to be taken in the event of a system failing to meet requirements.

SECTION 03 FAULT DIAGNOSIS AND RECTIFICATION

The candidate will be required to

3.1 Identify final circuits and their application and utilisation relevant to a.c. (single and three phase) and d.c. supplies within the following types of installation
- a) industrial
- b) commercial
- c) agricultural
- d) domestic

with reference to
- i) power distribution
- ii) lighting
- iii) intruder and fire alarms
- iv) microprocessor control circuits
- v) space heating, water heating, cooking.

3.2 Describe the symptoms of inherent or developed faults as
- a) complete loss of supply at the origin of installation
- b) localised loss of supply
- c) overload or fault current devices operating
- d) transient voltages
- e) insulation failure
- f) plant, equipment or component failure.

3.3 State how negligence, misuse or abuse by the installer or user may result in faults.

3.4 State the basic principles of undertaking fault diagnosis as
- a) knowledge and understanding of relevant electrical systems and equipment
- b) optimum use of personal and other's experience and expertise of systems and equipment
- c) use of a logical approach.

3.5 List and describe the stages of logical fault diagnosis and rectification as
- a) collection and collation of data
  - i) information on events leading up to the fault
  - ii) information from verbal and/or written reports
- b) analysis of evidence and use of standard tests to diagnose cause of faults
- c) interpretation of test results
- d) functional checks and tests to verify rectification and restoration of system and equipment.

3.6 Identify appropriate sources of information relevant to fault diagnosis from
- a) relevant drawings, charts and schedules
- b) manufacturer's data
- c) Regulations eg BS 7671
- d) other British Standards eg ISO Euro Norm, Harmonised documentation relevant to diagnostic processes.

3.7 State the safe working procedure to be applied on electrical systems and equipment prior to undertaking fault diagnosis as
- a) on load, off load isolating devices are identified and operated
- b) voltage indication equipment (complying with GS38) is 'proved' prior to verifying that isolation has been effected
- c) isolation device is secured in the off position
- d) warning notices are posted

e) all relevant safety and function checks are completed prior to restoration of supply.

3.8 a) List the sequence of tests as identified within BS 7671.
b) Identify those tests required prior to the circuit or installation being energised.
c) Select appropriate test equipment.
d) Describe the procedure for conducting the relevant tests.

3.9 Describe the range and limitations of test equipment with reference to
a) fault identification and rectification
b) requirements of BS 7671
c) requirements of GS38
d) requirements of safe working practices.

3.10 Recognise where faults may occur in an installation other than plant and equipment as
a) cable interconnections
b) cable terminations, seals and glands
c) accessories such as switches, switchgear control equipment, contactors, electronics, solid state devices
d) instrumentation/metering
e) protective devices
f) luminaires
g) flexible cables/chords
h) portable appliances and equipment connected to a fixed installation.

3.11 a) Identify the appropriate forms for
i) reporting fault conditions
ii) recording test results.
b) Describe the documentation used for periodic inspection and testing reports by
i) IEE within BS7671
ii) IEE with GN3
iii) NICEIC.
c) Identify the responsibilities of personnel in respect of completion of documentation.

3.12 Describe the factors which influence whether faulty equipment should be repaired or replaced as
a) cost of replacement
b) availability of replacement
c) downtime under fault condition
d) availability of resources/staff
e) limits of responsibility of tester.

3.13 State factors which may affect the rectification process as
a) access to system during normal working hours
b) whether system can be isolated by section
c) provision of emergency or standby supply
d) client demand for 'live working'.

3.14 Identify situations where special precautions should be applied when undertaking fault diagnosis as
a) fibre optic cabling
b) antistatic precautions
c) damage to electronic devices by 'over-voltage'
d) avoidance of shut down for IT equipment
e) risk of high frequency or large capacitive circuits
f) danger of storage batteries.

SECTION 04 ELECTRICAL SCIENCE AND PRINCIPLES

The candidate will be required to

Magnetism

4.1 Describe with simple sketches the pattern and direction of magnetic flux paths for
- a) various arrangements of permanent magnets
- b) adjacent parallel current carrying conductors
- c) an electromagnet (solenoid, relay).

4.2 State and apply the units, symbols and quantities for the following
- a) magnetic flux
- b) magnetic flux density
- c) magneto-motive force.

4.3 Determine the force on a current carrying conductor when at right angles to a magnetic field, applying the formula $F = B\ell I$.

4.4 Determine
- a) the emf induced in a conductor moving at right angles to a magnetic field and apply the formula $E = Bv\ell$
- b) the direction of the induced emf by application of
  - i) Lenz's Law
  - ii) Flemings right-hand rule
- c) the magnitude of an induced emf due to the rate of change of magnetic flux

4.5 Explain how an emf may be produced by
- a) self induction
- b) mutual induction.

4.6
- a) State that energy that may be stored within a magnetic field.
- b) State that energy may be lost within magnetic materials due to flux reversals and/or rotation of magnetic components in magnetic fields
- c) State that such losses may be attributed to either
  - i) hysteresis loss
  - ii) eddy current loss.
- d) Identify B/H characteristics for both ferro-magnetic and non-ferro-magnetic materials.
- e) State methods of reducing hysteresis and eddy current losses in electrical equipment or plant.

4.7 Describe the basic principle of operation of
- a) d.c. machines
- b) transformers
- c) relays.

4.8 State the principle of operation of the following overload protective devices
- a) thermal
- b) magnetic
- c) thermistors.

Electrostatics

4.9 a) Identify the construction and component parts/materials for capacitors in common use.
b) State the units and identify symbols relevant to capacitance and capacitors
i) charges on a capacitor
ii) electric field strength
iii) electric flux density
iv) energy stored in a capacitor.
c) Describe how the plates of a capacitor may be charged.
d) Explain the importance of the working voltage of a capacitor.

4.10 Perform calculations relevant to capacitors connected in series and in parallel .

4.11 State industrial uses of capacitors and explain the reason for connecting discharge resistors to some capacitors.

4.12 a) Identify the conditions which give rise to static electricity and describe potential hazards.
b) Identify ways of reducing the risks associated with static electrical charge.

D.C. Machines

4.13 a) State that most d.c. machines will operate as a motor or as a generator.
b) Explain the operation of simple d.c. machines.

4.14 Recognise circuit diagrams and describe operating characteristics for the following d.c. motors
a) series-wound
b) shunt-wound
c) compound wound
d) separately excited.

Alternating Current Theory (Single Phase)

4.15 a) Describe how a.c. quantities (current, voltage) may be represented by a rotating phasor.
b) Draw circuit waveform and construct phasor diagrams for a.c. circuits containing
i) pure resistance
ii) pure inductive
iii) pure capacitive
iv) resistance and inductance in series
v) resistance and capacitance in series
vi) resistance, inductance and capacitance in series.

4.16 Construct power and impedance triangles for a.c. circuits.

4.17 a) Define the term power factor.
b) Determine the power factor for an a.c. series circuit.

4.18 Construct phasor diagrams or perform calculations for an a.c. circuit containing R and L in series with C in parallel.

4.19 Explain why power factor correction is necessary and explain with the aid of diagrams how this may be achieved.

Alternating Current Theory (Polyphase)

4.20 Describe the production/operation, transmission and distribution of energy by a polyphase system.

4.21 Identify and calculate voltages and currents in both star and delta three phase circuits.

4.22 Draw circuit waveforms and construct phasor diagrams for star connected three phase circuits under balanced conditions.

4.23 Perform simple calculations for polyphase a.c. circuits/loads to include
- a) kW
- b) kVA
- c) kVAr
- d) power factor
- e) neutral current.

4.24 Explain with the aid of diagrams the production of a rotating magnetic field from a three phase supply.

4.25 Explain the reasons for balancing single phase loads on polyphase systems.

4.26 Calculate percentage voltage drops throughout an installation.

4.27 Describe methods used to produce d.c. supplies derived from a.c. sources.

A.C. Machines

4.28 Describe the construction and basic operational principles of the following a.c. machines
- a) three phase induction motor (cage and wound rotors)
- b) single phase split-phase start
- c) single phase capacitor-start
- d) single phase shaded-pole.

4.29 Describe with the aid of diagrams the following methods for starting polyphase a.c. machines to include
- a) direct-on-line
- b) star-delta
- c) auto-transformer
- d) rotor resistance.

4.30 Determine synchronous speed and rotor speed for a.c. machines.

Transformers

4.31 Describe with the aid of diagrams the construction and operational principles of the following types of transformers
- a) single phase
- b) polyphase.

4.32 Perform simple calculations for single phase transformers under full load conditions relevant to
- a) volts per turn
- b) turns ratios
- c) primary voltages and currents
- d) secondary voltages and currents
- e) losses in terms of input power/output power
- f) efficiency. in terms of input power/output power.

4.33 State precautions to be observed when using current transformers.

Illumination

4.34 State units and perform simple calculations, supported by diagrams, related to illumination, to include
- a) luminous intensity
- b) luminous flux
- c) lux
- d) source/lamp efficacy
- e) inverse square law
- f) cosine law
- g) coefficient of utilisation factor
- h) light loss factor.

4.35 State the principle of operation of the following types of lighting systems
- a) incandescent
- b) tungsten halogen
- c) low pressure mercury vapour
- d) high pressure mercury vapour
- e) low pressure sodium
- f) high pressure sodium.

Work energy and power

4.36
- a) Define the terms work, energy, power and efficiency.
- b) State the units for work, energy, power and the ratios applied for efficiency.
- c) Explain energy in terms of input and output energy.

4.37 Perform simple calculations relevant to 4.36 above for machines.

Instruments

4.38 Describe the connection of the following instruments to single phase and three phase circuits
- a) ammeters
- b) voltmeters
- c) wattmeters
- d) energy meters.

4.39 State methods of extending the range of voltmeters and ammeters by using
- a) shunts and multipliers
- b) current and voltage transformers.

4.40 Compare the advantages and disadvantages of digital and analogue instruments.

SECTION 5 PRACTICAL TASKS

The purpose of this section is to provide the objectives and performance criteria which a candidate must meet to satisfy practical outcomes associated with Installation, Commissioning and Fault Diagnosis. Systems for heating, lighting, power and associated systems may be used as appropriate.

The practical exercises are intended to simulate work-based tasks and centres will be required to facilitate suitable facilities for

a) installation systems and building fabric and structure
b) test equipment.

The practical tasks should be designed to meet the following outcomes.

5.1 Demonstrate the application to electrical installation work for
- a) building regulations
- b) Health and Safety regulations
- c) electrical regulations, eg
  - i) IEE Wiring Regulations
  - ii) Electricity at Work Regulations 1989
  - iii) Electricity Supply Regulations
- d) British Standards and Codes of Practice.

5.2 Prepare a site survey and carry out preliminary assessments for
- a) structure
- b) fabric
- c) installation factors.

5.3 Prepare requisition lists from given site diagrams and specifications for
- a) installation materials
- b) tools and equipment
- c) labour.

5.4 Prepare planned schedule from contract requirements and specifications.

5.5 Prepare reports on 'mock' accidents.

5.6 Demonstrate how to safely isolate and carry out relevant confirmatory test(s) on the whole and parts of an electrical installation.

5.7 Use appropriate instruments to measure current on
- a) single phase
- b) three phase four wire systems.

5.8 Use appropriate instruments to measure voltages on
- a) single phase
- b) three phase four wire systems.

5.9 Use appropriate instruments to measure current and voltage drop in a radial circuit with several load positions.

5.10 Compare readings obtained from wattmeters with the calculated value of circuit wattage based upon the readings of voltmeters and ammeters.

5.11 Test earth leakage devices.

5.12 Select an appropriate wiring system for a set of information including
- a) use of building
- b) environmental conditions
- c) possible load currents
- d) methods of overcurrent protection available.

5.13 Instal and connect an a.c. motor with direct on-line starter to a 240V system.

5.14 Dismantle and reassemble the following types of motor
- a) single phase capacitor start
- b) universal (series)
- c) three phase (cage or wound).

5.15 Connect up a number of open and closed contacts to a relay or contactor to switch a load when any contact is operated.

5.16 Carry out commissioning in accordance with IEE Wiring Regulations for
- a) an a.c. motor
- b) a radial circuit
- c) a lighting circuit.

5.17 Carry out tests and take readings using appropriate instruments as identified with BS 7671.

5.18 Carry out fault diagnosis to locate faults in equipment and systems.

5.19 Undertake necessary action to rectify faults by
- a) repair
- b) replacement.

Assessment specification

2360-201 Assignments

A set of three assignments based on the objectives in units 01, 02 and 03. These will be produced by City & Guilds and issued to centres as a set. An evidence specification will be provided for centre marking. Each assessment will assess objectives from Quality Assurance, Installation and Commissioning and Fault Diagnosis and Rectification. All sections must be completed satisfactorilyy for a candidate to be credited with success and the result must be based on one set, assignments cannot be mixed. Where candidates do not reach the required outcome, centres may require candidates to repeat assignments or undertake a new set.

The suggested time allocation is 30 hours, 10 hours for each assignment. The duration is non-specific in order that candidates may be allowed to consult source material.

Assignments may be attempted in stages. Centres are required to ensure that candidates assignment work is retained to enable inspection by the verifier if required.

Success will be recorded as PASS only.

2360-202 Installation, Commissioning and Fault Diagnosis

A three hour written paper set by City & Guilds at fixed dates and externally marked.

The examination paper will be in two parts

Part A - consisting of 25 short answer questions of three marks each
Part B - consisting of 4 structured questions of ten marks each.

Candidates must answer all questions in both sections.

Candidates should have a copy of BS 7671 and a copy of the IEE On Site Guide and/or a copy of the ÂEEU (EETPU Section) Electrical Guide to Good Electrical Practice.

Syllabus topics are covered by these questions in approximately the percentages and numbers shown below

Specification

PART A		
Syllabus topic	**Percentage of questions**	**Number of questions**
02 Installation	48	12
02 Commissioning	24	6
03 Fault Diagnosis	20	5
03 Rectification	8	2
	100	25

PART B		
Syllabus topic	**Percentage of questions**	**Number of questions**
02 Installation	25	1
02 Commissioning	25	1
03 Fault Diagnosis	25	1
03 Rectification	25	1
	100	4

2360-203 Electrical Science and Principles

A two hour written paper, set by City & Guilds at fixed dates and externally marked. The examination paper will consist of thirty short answer type questions of three marks each. Candidates must answer all thirty questions.

Syllabus topics are covered by these questions in approximately the percentages and numbers shown below

Specification

Syllabus topic	Percentage of questions	Number of questions
04 Magnetism	13	4
04 Electrostatics	7	2
04 DC Machines	7	2
04 AC Single-phase theory	16	5
04 AC Polyphase theory	13	4
04 AC Machines	13	4
04 Transformers	7	2
04 Illumination	7	2
04 Work, Energy, Power	10	3
04 Instruments	7	2
	100	30

2360-204 Practical Tasks

This component is a centre assessment of the practical objectives in unit 05.

Candidates are expected to demonstrate competence with regard to safety and the specified procedures and working practices.

Assessment may take place in the centre or at the workplace.

Differing grades of success will not be given.

The criteria for success in this component will be that candidates can achieve the required outcomes consistently. Centres should develop assessment programmes that suit their requirements; an appropriate method would be integrated tasks which encompass a range of objectives.

Candidate Log Books will be available for the recording of evidence and verification purposes.

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