1. Module details

Module name

Electrical Installations -Protection Methods and Devices

Suggested structured learning time

A learner possessing the prerequisite skills and knowledge should achieve the module purpose in 36 to 40 hours.

Module code

NUE 400

Discipline code

0703110

2. Module purpose

This module provides Learners with knowledge of the methods and devices to protect persons, livestock and property against dangers and damage that may arise in the reasonable use of electrical installations and under fault conditions.

Learners will gain an understanding of earthing systems and develop skills in applying acceptable earthing arrangements. The operating principles and applications of circuit breakers, fuses and residual current devices and protection against overvoltage and undervoltage are also covered.

3. Learning pathway

Intended use in the structured learning program

This module is intended to supplement workplace exposure to electrical installation work. In particular it applies to the installation of MEN earthing systems, equipotential bonding and protective devices.

Therefore before undertaking this module a student should have a clear understanding and extensive experience of installing electrical wiring systems and how the fundamental principles for safety apply.

Recommended prerequisite

For the most effective learning this module should be undertaken only after modules in single-phase theory and electrical wiring and equipment have been completed.

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills in the 'Evidence Guide' of specific units of competency in the National Electrotechnology Training Package and provides similar support, where mapped, to equivalent units in the National Metals and Engineering Competency Standards. For details refer to the module to unit maps, available from EEQSBA.

This module supports the development of essential capabilities required for electrical licensing.

5. Content

1. Electrical installation safety
    - Effects of current on the human body
    - Risk from thermal effects of current
    - Risk of injury from mechanical movement
2. Protection against indirect contact
    - Terms
    - Methods
        - automatic disconnection of supply
        - Class II equipment
        - Electrical separation
    - Touch voltage & touch current
    - Current path
    - Wiring Rules' requirements
3. Earthing
    - Earthing terms
    - Minimum earthing conductor size
    - Men system
    - Protective earthing arrangements
    - Wiring Rules' requirements
    - Equipotential bonding
4. Protection against overload and short circuit current
    - Causes of overcurrent and fault currents
    - Fault loop impedance
    - Determining prospective fault current
    - Wiring Rules' requirements

5. Devices for automatic disconnection of supply
    - Operating principles
        - circuit breakers
        - fuses
        - RCD's
    - Characteristics, types and Wiring Rules' requirements
        - circuit breakers
        - fuses
        - RCD's
    - Factors that effect fault loop impedance
    - Maximum permissible fault loop impedance
6. Protection against overvoltage and undervoltage
    - Causes:
        - overvoltage
        - undervoltage
    - Methods of protection.

6. Assessment strategy

Assessment methods

Assessment should be progressive reflecting a holistic approach to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical exercises, assignments and written tests consisting of a number of item types, such as multiple choice, short answer and problem solving.

Conditions of assessment

Normally learning and assessment will take place in a formal learning environment.

7. Learning outcome details

Learning outcome 1

Demonstrate an understanding of the need to ensure electrical installations are safe.

Assessment criteria

1.1 Explain the effects on the human body of various levels of a.c. and d.c. current and duration of current flow for various current paths.

1.2 Outline the risk of ignition of flammable materials due the thermal effects of current or electric arcs in normal service of an electrical installation.

	1.3 Outline the risk of injury from mechanical movement of electrically actuated equipment.
Learning outcome 2	Demonstrate knowledge of methods for protecting persons and livestock against dangers that may arise from contact with exposed conductive parts, which may become live under fault conditions.
Assessment criteria	2.1 Explain how an indirect contact with live parts of an electrical installation may occur. 2.2 Outline the methods and devices that comply with the Wiring Rules for providing protection against indirect contact. 2.3 Describe the components of the 'automatic disconnection of supply' method of protection against indirect contact. 2.4 Explain the terms ‘touch voltage’ and ‘touch current’. 2.5 Show, by diagram, the current path when a short circuit fault to exposed conductive parts of an appliance occurs. 2.6 Explain how protection against indirect contact is achieved by the use of Class II equipment and by electrical separation.
Learning outcome 3	Demonstrate knowledge of the purpose of earthing systems, their function under fault conditions and the Wiring Rules’ requirements for earthing and equipotential bonding.
Assessment criteria	3.1 Define the terms: • ‘Earthed’; • ‘Earthed situation’; • Equipotential bonding’; • ‘Multiple earthed neutral (MEN) system’; • ‘Main earthing conductor’; • ‘Protective earthing conductor’; • ‘Functional earthing’. 3.2 Determine the minimum size-earthing conductor for a range of active conductor sizes and materials. 3.3 Identify the parts of an earthing system and explain the purpose of each. 3.4 Draw a diagram of a typical arrangement for a MEN earthing system. 3.5 Show by diagram, arrangements of protective earthing conductors that comply with the Wiring Rules.

	3.6 Determine requirements for earthing in a range of installation situations.
	3.7 Determine requirements for equipotential bonding in a range of installation situations.
Learning outcome 4	Demonstrate knowledge of methods and devices for protecting persons and livestock from injury and property from damage due to overload and short circuit current.
Assessment criteria	4.1 Explain how overload current or fault currents may occur in an electrical installation.
	4.2 Draw an equivalent circuit of a fault loop identifying each impedance component and the electrical supply source.
	4.3 Determine the level of fault current possible at a given point in an installation from the fault-loop impedance and data from the electricity supplier.
	4.4 Determine which methods and devices comply with the Wiring Rules for providing protection against the damaging effects of overload and fault current
Learning outcome 5	Explain the structural features and operating principles of devices that provide protection against indirect contact by automatic disconnection of supply and protection against overcurrent.
Assessment criteria	5.1 Explain the operating principles of thermal/magnet circuit breakers and describe the function of each component part.
	5.2 Explain the operating principles of common types of fuses and describe the function of each component part.
	5.3 Explain the operating principles of residual current devices (RCD) and describe the function of each component part.
	5.4 Use time/current curves to explain the tripping characteristics of various types of circuit breakers that comply with the requirements of the Wiring Rules.
	5.5 Use time/current curves to explain the fusing characteristics of various types of fuses that comply with the requirements of the Wiring Rules.
	5.6 Use time/current curves to explain the tripping characteristics of various types of RCDs that comply with the requirements of the Wiring Rules.
	5.7 State the factors in a fault loop that will effect the impedance of the circuit.

	5.8 Determine the maximum impedance of a fault loop to ensure operating of a protection device in compliance with the performance requirements of the Wiring Rules.
Learning outcome 6	Demonstrate knowledge of the need for protection against overvoltage and undervoltage.
Assessment criteria	6.1 Explain the causes of overvoltage and how this may effect the electrical system. 6.2 Describe methods for protection against overvoltage. 6.3 Explain the causes of undervoltage and how this may effect the electrical system. 6.4 Describe methods for protection against undervoltage.

8. Delivery of the module

Delivery strategy	Delivery strategies must be suitable for learning both theoretical and practical aspects described in the module purpose. It is considered that the most effective method to achieve this is by integration of theory and practice where students learn by experimentation, research and reports. It is recommended that learning and assessment be facilitated in a holistic manner that may require a learning outcome sequence other than that indicated in the module.
Resource requirements	Resources should be sufficient for students to carry out exercises on an individual basis. Useful references include: Jenneson, J. R. 1996, *Electrical Principles for Electrical Trades,* 4th Ed., McGraw Hill, Sydney Batty, I. 1996, *Electrical Principles*. Prentice Hall, Sydney. Van den Bergen, B. 1996, *Mathematics for the Electrical Trades*. TAFE Publications, RMIT, Melbourne Pethebridge, K., and Neeson, I., 2001, *Electrical Wiring Practice*, 6th Ed, Vol.1& 2., McGraw Hill, Sydney.

Standards Australia, Standards New Zealand:[1]

AS/NZS 3000:2000 *Wiring rules*

AS/NZS 3008: 1998 *Electrical installations —Selection of cables.* Part 1.1: Cables for alternating voltages up to and including 0/6/1kV – Typical Australian installation doncitions.

HB300:2001 *Electrical Equipment for hazardous area*

HB300:2001 *Electrical installations—A guide to using the wiring rules*

AS/NZS 3018:2001 *Electrical installation – Domestic installations*

AS/NZS 3001:2001 *Moveable premises and their site installation*

AS/NZS 3002:2001 *Electrical installation – shows and carnivals*

AS/NZS 3003:1999 *Electrical installations – patient treatment areas of hospitals and medical and dental practices*

AS/NZS 3004:2001 *Electrical installations*

AS/NZS 3012:1995 *Electrical installation – Construction and demolition sites*

AS/NZS 4836 *Safe working practice on low-voltage electrical installations*

WorkCover Codes of Practice

Local electricity distributor and authority regulations

Where this module is used in an approved Traineeship or Apprenticeship program learners should be advised to obtain, where available, respective EEQSBA[2] ***User Guides*** (*these outline in detail what training and work performance the Learner is required to undertake for the program*)

[1] Standards Australia, Standards New Zealand AS/NZS3008.1.2, Electrical installations - Selection of cables. Part 1.2 Cables for alternating voltages up to and including 0.6/1 kV. Typical New Zealand installation conditions.

[2] EEQSBA – ElectroComms and EnergyUtilities Qualifications Standards Body of Australia Ltd

Occupational health and safety requirements	A safe and healthy environment will be provided for learners and teachers. Safety procedures for the particular learning facilities shall be followed as part of the learning / teaching activity and assessment.