1. Module details

Module name

Applied Electricity 1

Suggested structured learning time

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

Module code

NUE052

Discipline code

0703120

2. Module purpose

This module provides knowledge of basic and derived units of mechanical and electrical measurement and the skills to manipulate equations to solve problems involving these units. Learners will gain knowledge in the principles of electrical conduction, the electrical characteristics of material and the conversion of electrical energy to other forms and visa versa. Physiological and damaging effects of current and how these are dealt with in practice is also covered.

In addition, Learners will gain an understanding of the relationship between voltage and current and develop skills in working safely with circuits and using and caring for electrical measuring instruments.

3. Learning pathway

Intended use in the structured learning program

This module is intended as an introduction to electrical theory and to supplement exposure to electrical/electronic work.

Before undertaking this module a student should have a general understanding of what electrical/electronic work entails and the need for safety, particularly when working with electricity.

Recommended prerequisites

For the most effective learning, students should have skills in number systems & estimation, summarising & interpreting data; algebraic statements, indices, area & volumes, linear relationships, ratios & rates & its applications, graphs, and transposition of formulae.

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. Fundamental and derived units
   - basic units
   - SI derived units (mechanical, electrical)
   - multiples and sub-multiples
2. Power, work and energy
   - conservation of energy
   - torque
   - losses and efficiency
   - maximum efficiency of machines
3. Electrical characteristics of materials
   - electric theory (conductors, insulators, semi-conductors)
   - electric charge
   - electric current
   - electromotive force
4. The simple circuit
   - source of electrical energy, load, current path, control
   - open-circuit
   - short-circuit
5. Resistance
   - Ohm's law
   - determine V, I, R,
   - power dissipation
6. Effects of current
   - physiological effects
   - principles of protection from physiological effects
7. Effects of current
   - conversion of electrical energy to other forms (heating, light, magnetic, chemical)
   - principles of protection from damaging effects

8. Sources of electrical energy - conversion of other forms to electrical energy
   - chemical reaction
   - magnetism and rotational motion
   - light
   - heat
   - force
9. Using measuring instruments
   - handling measuring instruments
   - selecting an instrument
   - setting-up and connecting into circuits
   - reading scales and read-outs
   - setting up a CRO

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

Use fundamental and derived units in the calculation of electrical and related mechanical quantities.

Assessment criteria

1.1 Identify the basic units of measurement.

1.2 Define the SI derived units for force, pressure, energy/work, temperature and power.

1.3 Convert units to multiple and submultiple units.

1.4 Transpose a given equation for any variable in the equation.

1.5 Perform basic calculations of electrical and related mechanical quantities given in any combination of units, multiple units or submultiple units.

Learning outcome 2	Explain the principle of the conservation of energy and the effects of losses in electrical systems and machines.
Assessment criteria	2.1 Show the relationship between power, work and energy.
	2.2 Determine the input, output, efficiency or losses of electrical systems and machines in terms of units / multiple units of power.
	2.3 State the effect of losses in electrical wiring and machines.
Learning outcome 3	Explain the physical and electrical characteristics of materials.
Assessment criteria	3.1 List the characteristics of solid conductors, electrolytes, insulators and semi-conductors.
	3.2 Describe the mechanisms of electrical conduction in solids, liquids and gases.
	3.3 Define the terms “electric charge”, “electric current” and “electromotive force”.
Learning outcome 4	Set-up and operate simple single load electrical circuits incorporating a switch and circuit protection device.
Assessment criteria	4.1 Identify symbols used to represent an electrical energy source, a load, a switch and a circuit protection device in circuit diagrams.
	4.2 Describe the purpose of each component in the circuit.
	4.3 Observe and describe the effects of an open-circuit, a closed-circuit and a short-circuit.
Learning outcome 5	Demonstrate an understanding of the relationships between voltage, current and resistance and the power dissipated in a circuit.
Assessment criteria	5.1 Show the relationship between voltage and current from measured values in a simple circuit.
	5.2 Calculate the voltage, current and resistance in a circuit given any two of these quantities.
	5.3 Calculate the power dissipated in a circuit from voltage, current and resistance values.
	5.4 Explain the relationship between voltage, current and resistance and the power dissipated in a circuit.
Learning outcome 6	Demonstrate an understanding of the physiological effects of current and the principles for protection against these effects.

Assessment criteria	6.1 Describe the physiological effects of current.
	6.2 Describe the fundamental principles (listed in AS/NZS 3000) for protection against the physiological effects of current.
Learning outcome 7	Describe the effects of electric current in terms of the conversion of electrical energy to other forms and the uses and disadvantages of these effects.
Assessment criteria	7.1 Outline the basic principles by which electric current can result in the production of heat; the production of light; the production of magnetic fields; a chemical reaction.
	7.2 List typical uses of the effects of current.
	7.3 Describe the mechanisms by which metals corrode.
	7.4 Describe the fundamental principles (listed in AS/NZS 3000) for protection against the damaging effects of current.
Learning outcome 8	Describe how other forms to electrical energy are converted to electrical energy and where each is used.
Assessment criteria	8.1 Outline the basic principles by which electricity is produced from a chemical reaction; produced from a magnetic field coupled with motion; produced from light; produced from heat; produced from force.
Learning outcome 9	Use digital and analogue instruments to measure voltage, current and resistance.
Assessment criteria	9.1 Apply safe working procedures when working with instruments.
	9.2 Handle and store instruments to ensure they are protected from damaged.
	9.3 Select and set-up an instrument to measure voltage, current or resistance.
	9.4 Connect instruments into a circuit to measure voltage, current and resistance.
	9.5 Read analogue scales and digital readouts in measuring voltage, current and resistance.
	9.6 Set-up a Cathode Ray Oscilloscope to measure d.c. and a.c. voltages.

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

Standards Australia, Standards New Zealand:

AS/NZS 3000:2000 *Wiring rules*

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

WorkCover Codes of Practice

Where this module is used in an approved Traineeship or Apprenticeship program learners should be advised to obtain, where available, respective EEQSBA[1] ***User Guides*** (*these outline in detail what training and work performance the Learner is required to undertake for the program*).

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.

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