1. Module details

Module name

Applied Electricity 4

Suggested structured learning time

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

Module code

NUE056

Discipline code

0703120

2. Module purpose

This module helps prepare Learners for further learning in the power applications of electricity. It provides Learners with the fundamentals concepts of alternating current and the terms used to describe waveforms and sine waves in particular. They will gain an understanding of how resistive, inductive and capacitive components behave in an a.c. circuit.

Learners will develop skills in working with and solving problems in single source series and parallel a.c. circuits. An introduction to transformers and basic transformer principles is also covered.

3. Learning pathway

Intended use in the structured learning program

This module is intended to supplement exposure to electrical/ electronic work. In particular it applies to the application of single phase in circuits and equipment.

Therefore before undertaking this module a student should have a clear understanding of d.c. circuits.

Recommended prerequisites

For the most effective learning this module should be undertaken only after module NUE054 Applied Electricity 2 has been completed. Also, learners need skills in Pythagoras Theorem and trigonometry.

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. Sinusoidal alternating voltage and current
   - generation of a sinusoidal waveform
   - sinusoidal waveform characteristics
   - measuring and calculating values
   - phase relationships
2. Phasors
   - phase relationship terms
   - phasor representation conventions
   - phase relationships using phasors
3. Resistance in a.c. circuits
   - determine V, I, R, P
   - relationship between voltages and currents
4. Inductance in a.c. circuits
   - reactance
   - inductance in series
   - inductance in parallel
   - Applying Ohm's law
   - inductive components in power circuits and systems
5. Capacitance in a.c. circuits
   - reactance
   - capacitance in series
   - capacitance in parallel
   - Applying Ohm's law
   - capacitance components in power circuits and systems
6. AC circuits
   - definition of impedance
   - relationship between resistive and reactive components
   - series, parallel and series-parallel R L C circuits
   - determine V, I, R, P in R L C circuits
   - phasor diagrams of R L C circuits

7. Resonance
   - conditions
   - resonance and frequency
   - effects on current
8. Ideal transformer
   - operating principles
   - primary and secondary voltage and current
   - applications

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 alternating voltage and current waveforms and how they are generated.

Assessment criteria

1.1 Explain how a sinusoidal voltage is generated in a single turn coil rotated in a uniform magnetic field.

1.2 Define the terms ‘period’, ‘maximum value’, ‘peak-to-peak value’, ‘instantaneous value’, ‘average value’, ‘root-mean-square (r.m.s.) value’, ‘crest factor’ and ‘form factor’ in relation to a sinusoidal waveform.

1.3 Calculate the instantaneous value of induced voltage of a generated sinusoidal waveform.

1.4 Measure the instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform.

1.5 Calculate the root-mean-square (r.m.s.) value and frequency of a sinusoidal waveform from values of peak voltage and period.

	1.6	Determine the phase relationship between two or more sinusoidal waveforms from a given diagram or measurements.
Learning outcome 2	Show the phase relationship between sinusoidal alternating voltages and current.	
Assessment criteria	2.1	Define 'in-phase', 'out-of-phase', 'phase angle', 'lead', and 'lag'.
	2.2	Determine the phase angle between two or more alternating quantities from a given sinusoidal waveform diagram.
	2.3	Show the convention for representing voltage, current and the reference quantity in a phasor diagram.
	2.4	Draw phasor diagrams to show the relationship between two or more a.c. values of voltage and/or current.
Learning outcome 3	Work with single-source resistive a.c. circuits and solve problems related to voltages, currents and power dissipated in such circuit.	
Assessment criteria	3.1	Set up and connect a single-source a.c. circuit and take resistance, voltage and current measurements.
	3.2	Determine the voltage, current, resistances or power dissipated from measured or given values of any two of these quantities.
	3.3	Show the relationship between voltage drops and current in a resistance a.c. circuit.
Learning outcome 4	Explain how inductance behaves in an a.c. circuit.	
Assessment criteria	4.1	Define 'inductive reactance'.
	4.2	Calculate the inductive reactance of a given inductor and show the relationship between inductive reactance and frequency.
	4.3	Apply series and parallel circuit rules to determine the equivalent inductive reactance in an a.c. circuit or any part of a circuit.
	4.4	Apply Ohm's law to determine voltage, current or inductive reactance in a purely inductive a.c. circuit given any two of these quantities.

	4.5	Give examples of inductive components in power circuits and systems and describe their effect on the phase relationship between voltage and current.
	4.6	Compare the current limiting characteristics of inductors and resistors.
Learning outcome 5	Explain how capacitance behaves in an a.c. circuit.	
Assessment criteria	5.1	Define 'capacitive reactance'.
	5.2	Calculate the capacitive reactance of a given capacitor and show the relationship between capacitive reactance and frequency.
	5.3	Apply series and parallel circuit rules to determine the equivalent capacitive reactance in an a.c. circuit or any part of a circuit.
	5.4	Apply Ohm's law to determine voltage, current or capacitive reactance in a purely capacitive a.c. circuit given any two of these quantities.
	5.5	Give examples of capacitive components in power circuits and systems and describe their effect on the phase relationship between voltage and current.
Learning outcome 6	Work with single-source a.c. circuits and solve problems related to voltages, currents and impedance in such circuits.	
Assessment criteria	6.1	Define 'impedance'.
	6.2	Determine the impedance of series, parallel and series-parallel circuits and draw diagrams showing the relationship between resistive, inductive and capacitive components (impedance triangle).
	6.3	Set up and connect a single-source a.c. circuit and take resistance, voltage and current measurements.
	6.4	Determine the voltage, current or impedance from measured or given values of any two of these quantities.
	6.5	Use phasor diagrams to solve problems and show the relationship between voltages and currents in a.c. circuits.
Learning outcome 7	Demonstrate a basic understanding of resonance and its effects.	
Assessment criteria	1.1	Describe the conditions in a circuit that produce resonance.

	1.2 Show the relationship between resonance and frequency. 1.3 Describe the effect on the current of series resonance and parallel resonance conditions.
Learning outcome 8	Demonstrate an understanding of the operating principles and function of an ideal transformer.
Assessment criteria	8.1 Describe the basic operating principles of a transformer. 8.2 Calculate the secondary voltage of a transformer given the primary voltage and turns ratio. 8.3 Calculate the primary current of a transformer given the secondary current and turns ratio. 8.4 List typical applications of transformers.

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 4836 *Safe working practice on low-voltage electrical installations*

	Work Cover 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.