1. Module details

Module name

Electrical Concepts and Applications

Module duration

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 36 – 40 hours.

Module code

NUE058

Discipline code

0703230

2. Module purpose

This module will enable students to develop basic skills in working with and solving problems in series, parallel and series/parallel circuits. It also provides students with the fundamental concepts of alternating current and the terms used to describe sinusoidal waveforms. Additionally it provides students with the basic concepts of electro-magnetism and their application to the operation of electrical motors and generators.

3. Prerequisites

NUE052 Applied Electricity 1.

4. Relationship to competency standards

This module provides some of the knowledge and skills underpinning competency in the following standards:
National Electrotechnology Industry Standards, Units UTE - NES201, NES202, NES401, and the relevant specialisations.
Metals & Engineering Industry Standards, Units 5.1A, 18.57A

5. Content

DC resistive circuits
series
parallel
series parallel
measurement of V, I and R
calculation of R, V, I, and P

Capacitance
concept
unit
time constant
capacitors – basic construction and types

Magnetism
magnetic and non magnetic materials
magnetic field patterns
force between magnetic fields
applications

Electromagnetism

magnetic field around a current-carrying conductor and solenoid
force between current-carrying conductors
applications

Electromagnetic Induction
induced EMF
inductance (concept, unit, time constant, applications)

AC Principles
sine waves
frequency
amplitude
peak voltage
peak to peak voltage
RMS voltage
single phase
three phase
generation of AC voltages
circuit measurement
earthing
electrical supply system

Transformers
construction
principles of operation
primary and secondary voltage and current
applications

Motors
motor action
generator action
DC motors
AC motors
applications

Electrical Safety Testing
regulations

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

Learning and assessment will normally occur in a classroom/laboratory environment

7. Learning outcome details

Learning outcome 1

Describe the effects of voltage, current and resistance in simple single source DC series, parallel and series-parallel resistive circuits.

Assessment criteria

1.1 Set up and connect a simple single source DC series resistive circuit.

1.2 Demonstrate by measurement the relationships between voltage, current and resistance in a DC series circuit.

1.3 Calculate current, voltage and resistance in a simple series resistive circuit.

1.4 Show the relationship between voltage drops and resistance in a simple voltage divider network.

1.5 Set up and connect a simple single source DC parallel resistive circuit.

1.6 Demonstrate by measurement the relationships between voltage, current and resistance in a DC parallel circuit.

1.7 Calculate current, voltage and resistance in a simple parallel resistive circuit.

1.8 Set up and connect a simple single source DC series - parallel resistive circuit.

1.9 Demonstrate by measurement the relationships between voltage, current and resistance in a DC series-parallel circuit.

1.10 Calculate current, voltage and resistances in a simple series-parallel resistive circuit.

Learning outcome 2	**Demonstrate an understanding of the concepts of capacitance, the units by which it is measured, and the characteristics of series DC circuits containing resistance and capacitance.**	
Assessment criteria	2.1	Define capacitance and explain how a capacitor is charged and discharged in terms of its electrostatic field.
	2.2	State the relationship between capacitance, voltage and charge.
	2.3	State the units by which capacitance is measured.
	2.4	Describe the construction of capacitors and list common types together with their application.
	2.5	Briefly describe the behaviour of a series DC circuit containing resistance and capacitance.
Learning outcome 3	**Demonstrate an understanding of magnetism, magnetic induction, the nature of magnetic materials and their application.**	
Assessment criteria	3.1	Identify magnetic and non magnetic materials.
	3.2	Sketch the magnetic flux pattern around a bar magnet.
	3.3	Describe magnetic induction and its effects.
Learning outcome 4	**Demonstrate an understanding of the principles of electromagnetism, the magnetic fields associated with straight and coiled current-carrying conductors and the resultant forces between adjacent current-carrying conductors.**	
Assessment criteria	4.1	Show the magnetic field patterns around a straight conductor and a solenoid carrying current.
	4.2	Apply Fleming's Right-Hand rule to determine the direction in which the magnetic field around a current-carrying conductor acts.
	4.3	Describe the factors affecting the force between adjacent current-carrying conductors and how the force will act.

Learning outcome 5	**Demonstrate an understanding of the effects of electromagnetic induction and state practical examples which make use of this principle.**	
Assessment criteria	5.1	List the factors required and describe the process by which an EMF is induced in a conductor.
	5.2	Describe the construction of an inductor.
	5.3	Describe the concept of inductance and list the actors affecting the inductance of a conductor and coil.
	5.4	Define the unit of inductance.
Learning outcome 6	**Describe alternating current and voltage waveforms and their means of generation.**	
Assessment criteria	6.1	Describe how a sinusoidal voltage is generated in a simple alternator with a single turn coil in a uniform magnetic field.
	6.2	Define the terms ‘frequency’, ‘period’, ‘amplitude’, ‘instantaneous value’, ‘maximum value’, ‘peak value’, ‘peak-to-peak value’ and ‘root-mean-square (RMS) value’ in relation to a sinusoidal waveform.
	6.3	Calculate the rms value and frequency of a sinusoidal waveform the peak value and period.
	6.4	Describe single and three phase voltage generation.
	6.5	Draw sine waves to show the phase relationships between voltage and current.
	6.6	Give an overview of the electricity generation, transmission and distribution system from generator to user.

Learning outcome 7	**Describe the operating principles and function of an ideal transformer and the construction of a practical transformer.**	
Assessment criteria	7.1	Describe the basic operating principles of a transformer.
	7.2	Describe the physical construction of a transformer.
	7.3	Calculate the secondary voltage of an ideal transformer given the primary voltage and turns ratio.
	7.4	Calculate the primary current of an ideal transformer given the secondary current and turns ratio.
	7.5	List typical applications of transformers.
Learning outcome 8	**Describe the basic operating principles and applications of DC and induction motors.**	
Assessment criteria	8.1	State the fundamental principles of operation of electric motors and generators.
	8.2	Describe the construction of a DC motor.
	8.3	Describe the operation of a DC motor.
	8.4	List the applications of a DC motor.
	8.5	Describe the construction of an induction motor.
	8.6	Describe the operation of an induction motor.
	8.7	List the applications of an induction motor.
Learning outcome 9	**State the requirements for electrical safety testing of electrical/electronic equipment.**	
Assessment criteria	9.1	State the need for electrical safety testing.
	9.2	State the regulations governing electrical safety testing of electrical/electronic equipment.

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 way to achieve this is by the integration of theory and practice where students learn by experimentation and through research and laboratory reports. It is recommended that learning and assessment be facilitated in a holistic manner, which may require a learning outcome sequence other than that indicated in the module.

Resource requirements

Resources should be sufficient for students to carry out practical exercises on an individual basis. This will require a range of experimental circuit devices and measuring instruments

Useful references include:
Jenneson, J.R. 1995 *Electrical Principles for Electrical Trades,* McGraw Hill, Sydney.
Phillips, P. 1996, *Electrical Principles 1*, Thomas Nelson, Melbourne
Batty, I 1996, *Electrical Principles*, Prentice Hall, Sydney

Occupational health and safety requirements

A safe and healthy environment will be provided for students and teachers as well as safety procedures followed with regard to teaching/learning activities.