1. Module details

Module name

REFRIGERATION ELECTRICAL

Nominal duration

Half module
It is anticipated that students will achieve the competencies specified in 18 to 20 hours.

Module codes

NR047

Discipline code

0703320

2. Module purpose

This module aims to develop a basic understanding of the principles of alternating current, without in depth calculations. It covers electromagnetism, capacitors, inductors, transformers and AC fundamentals. it is a prerequisite for NR008 Appliance Motors and Circuits.

3. Prerequisites

NE160 - Electrical Principles 1

4. Relationship to competency standards

This modules provides some of the knowledge and skills underpinning competence in the following standards:

- Electrical Contracting Industry Award Standards Refrigeration. Stream Units; 5.2, 5.4, 5.5, 5.6, 5.7, 6.2, 7.3, 8.3, 9.3.

5. Content

1. Permanent magnets and electromagnetism
    - permanent magnets
    - magnetic fields
    - magnetic field around a conductor and solenoid
    - practical appliances of electromagnetism

2. Electromagnetic induction
    - induction
    - mutual and self-induction
    - Lenz's law
    - practical applications of electromagnetic induction
    - operation principle
    - nature of EMF and current produced

3. AC Fundamentals
    - operating principle of an alternator
    - nature voltage and current produced
    - sine waves
    - peak voltage and current
    - calculate RMS voltage and current

4. Capacitors
    - function

- operation principle
- construction
- dielectric
- capacitance
- testing capacitors
- hazards and precautions
- refrig applications commercially available capacitors and their practical applications in refrigeration industry

5. Impedance and reactance
   - inductive reactance
   - capactive reactance
   - impedance
   - impedance calculations

6. Transformers
   - operating principle
   - types
   - calculations of volts/amps and turns ration

7. Power factor
   - definition
   - true power
   - apparent power
   - calculations

8. Three phase alternating current
   - production
   - sine wave
   - star and delta systems
   - nature of commercial supply
   - phase and line voltage and current

9. Three phase motors
   - components

6. Learning outcome details

On the completion of this module, the learner will be able to:

Learning outcome 1

Demonstrate knowledge of permanent and electromagnetic theory.

Assessment criteria

1.1 Describe the characteristics, using appropriate terms, of permanent magnets and their magnetic fields.

1.2 Sketch the magnetic fields associated with permanent magnets.

1.3 Describe the characteristics, using appropriate terms, of the magnetic field produced by a current carrying conductor and solenoid fields.

1.4 Sketch the magnetic field surrounding a current carrying conductor and solenoid.

	1.5 Describe practical applications of electromagnetism.
Learning outcome 2	Describe the effects of electromagnetic induction, so that the production of an alternating current can be established.
Assessment criteria	2.1 Explain the principle of electromagnetic induction.
	2.2 Describe the manner in which back or counter EMF is generated in a coil through electromagnetic induction.
	2.3 Explain Lenz's law.
	2.4 Describe 3 factors which determine the strength of the induced EMF.
Learning outcome 3	Explain the basic terms used to define periodic AC voltage and current waveforms.
Assessment criteria	3.1 Describe the periodic AC voltage and current waveforms in the time domain.
	3.2 Explain how the sinusoidal output is generated in a single turn coil rotating in a uniform magnetic field and sketch the sine wave.
Learning outcome 4	Select a replacement capacitor for a specific application.
Assessment criteria	4.1 Define capacitance and define how capacitor is charged and discharged.
	4.2 List the factors which determine the capacitance of a capacitor.
	4.3 Distinguish between different types of commercially available start and run capacitors.
	4.4 Calculate the equivalent capacitance of series of parallel connected capacitors.
	4.5 Determine through measurement whether a capacitor is faulty.
	4.6 State the hazards and observe the safety precautions when using capacitors.
Learning outcome 5	Explain the operating principles of the ideal transformer.
Assessment criteria	5.1 Describe the basic operation and construction of a transformer, mentioning the need of an AC supply.
	5.2 Define the transformer turns ratio.
	5.3 List refrigeration and air conditioning applications of transformers.

	5.4 Calculate and measure the primary and secondary voltages and currents in step-up and step-down transformer circuits.
Learning outcome 6	Explain the effects of resistance, inductance and capacitance on an AC circuit.
Assessment criteria	6.1 Define inductive reactance, capacitive reactance and impedance.
	6.2 Draw sine waves to show the phase relationship between voltage and current in a pure resistive, pure capacitive and pure inductive circuit.
	6.3 Calculate the impedance of an AC circuit given the voltage and the current.
Learning outcome 7	Explain the effect of power factor of an electrical appliance.
Assessment criteria	7.1 Define true power, apparent power and power factor.
	7.2 Calculate the power factor and power consumed by an electrical appliance.
	7.3 Explain the effect of power on the performance of an electrical appliance.
Learning outcome 8	Describe the features of 3 phase alternating current and its phase arrangements.
Assessment criteria	8.1 Explain how the sinusoidal output is generated in 3, single turn coils rotating in a uniform magnetic field.
	8.2 Sketch the winding arrangements and the sine waves for both star and delta systems.
	8.3 List the standard values for the voltage in a commercial supply.
	8.3 Measure phase and line voltage and current.
Learning outcome 9	Describe the basic operation and construction of 3 phase motors.
Assessment criteria	9.1 List the major components of a 3 phase motor.
	9.2 Sketch the electrical winding connections Star and Delta.

7. Assessment Strategies

Short answer questions.
Written tests.
Practical exercises.

8. Module Delivery Strategies

Delivery strategies must be suitable for both theoretical and/or practical learning and module purpose.

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 body of this module.

Also, an integrated theory/practice approach should be used where students learn by practical exercises through research and workshop reports.

9. Resource Requirements

A range of experimental circuit devices and measuring equipment. Resources should be sufficient for students to carry out experiments on an individual basis.

Useful reference include:
Jenneson, J.R., 1995, Electrical Principles for the Electrical Traces, McGraw-Hill, Sydney.

Phillips, P. 1994, Electrical Fundamentals, Nelson, Melbourne.

Edwares, R.C.L., Meyer, D.F. 1995, Electrical and Electronic Trades Principles and Applications, McGraw-Hill, Sydney.

10. Occupational health and safety requirements

A safe and healthy environment will be provided for students in regards to classroom and workshop safety.