

1. Module details

Module name

DC and AC machines for small scale renewable energy systems

Module duration

It is expected that students with the appropriate entry knowledge and skills will successfully complete this module in 20 hours.

Module code

NUER18

Discipline code

1105

2. Module purpose

This module provides knowledge relating to the function, operation and specifications of components used in stand-alone power systems. It is intended as a prerequisite to NUER05 – Micro-hydro Systems and NUER 06 – Wind Energy Conversion Systems 1

3. Prerequisites

NUE058 – Electrical Concepts and Applications
or equivalent modules.

4. Relationship to competency standards

This module provides part of the underpinning knowledge and skills identified in the ‘Evidence Guide’ of specific units in the National Electrotechnology Competency Standards, namely NES113, NES114.

5. Content

DC machines

construction, components, functions
production of emf
DC generator excitation
characteristics of DC generator types
self excitation, DC motor excitation
production of torque
characteristics of DC motor types
efficiency
applications
maintenance

A.C. Machines

alternators:
construction, components, function
excitation methods
voltage control
speed, frequency, number of poles
induction machines:
construction, components, function
operating characteristics
single phase induction machines -types, characteristics

induction generators
efficiency
applications

6. Assessment strategy

Assessment methods

Assessment should encompass both progressive and holistic elements in recognition of the interdependence between learning outcomes to ensure the module purpose is met. To assist in ensuring validity, reliability and fairness assessment instruments should include practical and written exercises, 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 classroom/ laboratory environment.

7. Learning outcome details

Learning outcome 1

Describe the construction, operating characteristics and application of the various types of DC machines as motors and generators.

Assessment criteria

- 1.1 Identify the major components of a DC machine and describe their function.
- 1.2 Outline the different types of excitation used for DC machines.
- 1.3 Determine the appropriate type of motor or generator for a given application.
- 1.4 Describe the conditions under which a DC generator will self excite.
- 1.5 Describe a procedure to rectify a failure to self excite.
- 1.6 Outline how the direction of rotation of different types of DC motors can be reversed.
- 1.7 Calculate the energy conversion efficiency of a DC motor or generator from measured or nameplate data.
- 1.8 Outline the maintenance required on DC machines.
- 1.9 Identify common faults on DC machines and appropriate remedial action.
- 1.10 State two examples of the use of specific types of DC machines in stand-alone power systems.

Learning outcome 2

Describe the construction, operating characteristics and application of the major types of single phase and three phase AC machines.

Assessment criteria

- 2.1 Describe the function of the major components of an alternator and a squirrel cage induction machine.
- 2.2 Describe the method of voltage control on alternators with brushless excitation.
- 2.3 Calculate the synchronous speed of an AC machine.
- 2.4 Explain why an induction machine never operates at synchronous speed.
- 2.5 Describe the starting characteristics of induction motors and the implication for running them from stand-alone power systems.

- 2.6 Describe the major types of single phase AC machines and their main features.
- 2.7 Outline how the direction of rotation of various AC machines can be reversed.
- 2.8 Calculate energy conversion efficiency from measured or nameplate data.
- 2.9 Determine the appropriate type of AC machine for a given application.
- 2.10 State two examples of the use of specific types of AC machines in stand-alone power systems.

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 practical application. It is recommended that learning and assessment be facilitated in a holistic manner which may require learning outcome sequence other than that indicated in the module.

This module contains learning outcomes that require theory, practical instruction and demonstrations. For practical work it is recommended that there be a maximum of six (6) learners per teacher/tutor .

Resource requirements

Resources should be sufficient for students to carry out experiments in pairs. This will require a range of experimental devices and measuring instruments and programming of activities to allow access to costly equipment in turn.

Occupational health and safety requirements

A safe and healthy environment will be provided for students and teachers as well as adherence to safety procedures with regard to learning / teaching activity. Particular care should be exercised when working with rotating machinery.

Minimum physical resources

An electrical laboratory or classroom equipped with motor test bed, A.C. and D.C. machines and meters.

Examples of single phase AC machines, assembled and disassembled

Examples of single phase DC machines, assembled and disassembled