1. Module details

Module name

Commutators and Slip-rings

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

NUE132

Discipline code

0703105

2. Module purpose

The module will provide the learner with the knowledge and skills to carry out repairs to commutator and slip-rings. This will include problem solving relating to brushes on both commutator and slip-ring machines, conditioning commutators and slip-rings, and selecting the most appropriate grade of brush for a particular application.

3. Prerequisites

NE21 Rotating Electrical Machines - Maintenance and Repair.

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 NUEITAB.

5. Content

Problems relating to commutators and slip-rings
Brush grade selection
Brush gear servicing
Commutator servicing
Slip-ring servicing

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 take place in an environment that is conducive to a learner's development.

7. Learning outcome details

Learning outcome 1 **Identify problems relating to brush performance.**

Assessment criteria

1.1 Explain how the following affect brush wear on a copper based slip-ring or commutator:
- Current density greater than that recommended for a brush
- Current density less than that recommended for a brush
- Brush pressure higher than recommended
- Brush pressure less than recommended
- The presence of traces of sulphur dioxide in the air
- The presence of oil vapour in the air
- Extremely low humidity
- Running at altitudes above 1000 metres
- Machine standing for long periods
- Stalled machine.

1.2 Explain why the brush position of a direct current motor is critical.

1.3 Explain the effect of excessive machine vibration on brush performance.

1.4 Explain the effect of high surface speeds or multiple brushes per slip-ring on slip-ring performance.

1.5 Outline a solution to this problem in 1.4 on ring performance.

1.6 Explain the effect of excessive machine vibration on brush performance.

1.7 List the problems likely to be created due to lack of maintenance on brush gear.

1.8 Specify the maximum running temperature of a commutator or a slip-ring surface.

1.9 Provide qualifications for your specifications in 1.8.

	1.10	Specify probable causes and solutions for the following: - Flexible pig-tail burning - Flexible pig-tail corrosion - Commutator segment grooving - Slip-ring surface flats - Commutator surface flats - Commutator segment blackening - Copper segment picking - Copper segment dragging - Brush noise.
Learning outcome 2	**Select appropriate brushes for a range of applications.**	
Assessment criteria	2.1	Select a grade of brush, number of brushes, sizes of brush and brush pressure for nominated slip-ring applications.
	2.2	Select a grade of brush, number of brushes, size of brushes and brush pressure for nominated commutator applications.
	2.3	Specify the type of brushes normally installed on: - A high voltage generator with flush mica - An AC commutator motor.
Learning outcome 3	**Outline recommended procedures for servicing brush gear with reference to manufacturers' recommendations and Australian Standards.**	
Assessment criteria	3.1	Prepare a maintenance log for the brush gear of a large slip-ring and direct current motor.
	3.2	Provide the clearance expected between the brushes and the brush holders and the commutator or slip-ring surface.
	3.3	Determine the clearance between the brushes and the brush holder for various size of brushes.
	3.4	Detail the method of setting brush pressure.
	3.5	Detail the method of bedding new brushes to a slip-ring and commutator.
	3.6	Nominate an acceptable life for a set of brushes.

	3.7	Describe the characteristics of a tensator spring.
	3.8	Describe the method of setting the neutral position on a DC machine where the brushes are: - All circumferentially in line - Staggered circumferentially.
	3.9	Describe the remedial action to be taken if the brushes of an uni-directional DC machine are sparking when set in neutral.
Learning outcome 4	**Outline recommended procedures for servicing slip-rings with reference to manufacturers' recommendations.**	
Assessment criteria	4.1	Describe the tests and work to be carried out on a large set of slip-rings with helical grooving before they can be fitted on to the shaft of a rewound rotor.
	4.2	Detail the work to be carried out when changing a set of brushes on a slip-ring motor that is in service.
	4.3	Explain why carborundum paper or petrol should not be used to clean commutators or slip-rings.
	4.4	Detail the procedures for insulating the bush and shrink fitting the slip-rings onto it.
Learning outcome 5	**Service commutators with reference to manufacturers' service manuals**	
Assessment criteria	5.1	Details the test and work to be carried out on a large commutator before it can be fitted onto the shaft of an armature.
	5.2	Explain the method of undercutting the mica insulation on a commutator.
	5.3	Explain the reason and procedure for seasoning a commutator.
	5.4	Static seasoning of a commutator.
	5.5	Diamond turns and undercut a commutator.
	5.6	Set up the neutral position on a DC machine.

Learning outcome 6	**Service slip-rings with reference to manufacturers' service manuals.**
Assessment criteria	6.1 Insulate and fit a bush and a set of slip-rings. 6.2 Fit a set of brushes to brush gear tension and bed brushes.

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 learning outcome sequence other than that indicated in the module.
Resource requirements	*Physical resources:* The off the job facilities should be included but be limited to: A regular classroom Audiovisual equipment such as overhead projector and screen, video recorder and monitor. *Human resources:* Minimum qualifications must be relevant to the subject content together with five (5) years industrial experience and the completion of an accredited instructional skills course or equivalent.
Occupational health and safety requirements	A safe and healthy environment will be provided for students and teachers as well as the particular safety procedures followed as part of the learning / teaching activity and content.