Title	**Demonstrate and apply knowledge of electrical machines**		
Level	**5**	**Credits**	**15**

Purpose	This unit standard covers knowledge and the application of DC and AC electrical machines for engineers. People credited with this unit standard are able to: – demonstrate knowledge of DC motor and generator operation – demonstrate knowledge of transformer theory – demonstrate and apply knowledge of induction motor theory – demonstrate knowledge of and apply the theory of synchronous machines – describe the requirements and characteristics of selected motors and generators for a given application.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

Guidance Information

1 Recommended skills and knowledge:
Unit 22722, *Demonstrate and apply introductory knowledge of electrical circuit engineering principles;* or demonstrate equivalent knowledge and skills.

2 This unit standard is intended for use in engineering courses at diploma level.

3 References
Electricity Act 1992
Health and Safety at Work Act 2015
and all subsequent amendments and replacements.

4 Definitions
AC – alternating current.
DC – direct current.
kVA – kilo-volt ampere.

5 All measurements are to be expressed in Système International (SI) units, and, where required, converted from Imperial units into SI units.

6 All activities must comply with: any policies, procedures, and requirements of the organisations involved; the standards of relevant professional bodies; and any relevant legislative and/or regulatory requirements.

7 Range
- a performance in relation to the outcomes of this unit standard must comply with the Health and Safety at Work Act 2015.
- b laboratory and workshop safety practices are to be observed at all times.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of DC motor and generator operation.

Performance criteria

1.1 Concepts and operating principles of DC motors are explained.

Range single loop conductor in a constant two-pole magnetic field; direction of rotation; factors influencing torque; shunt wound motor; series wound motor; cumulatively compounded motor; output calculations.

1.2 Concepts and operating principles of DC generators are explained.

Range single loop conductor in a constant two-pole magnetic field, direction of rotation; the shunt generator; output calculations.

Outcome 2

Demonstrate knowledge of transformer theory.

Performance criteria

2.1 Theory and application of single-phase and three-phase transformers are explained in accordance with industry practice.

Range primary, secondary, turns ratio, kVA rating, equivalent circuit, operation on no-load and full-load, regulation, step up, step down, isolating, autotransformers.

2.2 Transformer losses are explained and simple efficiency calculations are performed in accordance with industry practice.

Range magnetising current, core losses, copper loss, hysteresis losses, the narrow hysteresis loop, explanation of eddy current generation, and the purpose of laminations.

2.3 Three-phase transformer configurations are explained in accordance with industry practice.

Outcome 3

Demonstrate and apply knowledge of induction motor theory.

Performance criteria

3.1 Operating principles of single-phase and three-phase induction motors are explained in accordance with industry practice.

Range electrical and mechanical power, torque, slip, efficiency, power factor; speed control using pole switching, slip ring motor, and variable frequency drives; testing, analysis and prediction of motor performance using transformer equivalent circuit model; induction machine as a generator (wind or hydro) running on the grid or stand alone.

3.2 Induction motor starting and protection methods are described and compared.

Range motor control using traditional and solid state starters.

3.3 Miscellaneous AC motors for given applications are selected and described in accordance with industry practice.

Range single-phase induction motors, split-phase, capacitor start, capacitor run, shaded pole and small synchronous; universal motor, stepper motor.

Outcome 4

Demonstrate knowledge of and apply the theory of synchronous machines.

Range generator; operation on, and synchronisation with an infinite bus; motor starting methods, operating at variable power factors, as a synchronous capacitor start.

Performance criteria

4.1 Three-phase synchronous machines are described and implemented in accordance with industry practice.

4.2 Synchronous impedance, stability, and operational charts are explained in accordance with industry practice.

Range calculations using the equivalent circuit of the three-phase synchronous machine.

Outcome 5

Describe the requirements and characteristics of selected motors and generators for a given application.

Range may include but is not limited to – pumps, compressors, fans, high inertia loads, conveyors, winding machines, hydro generation, wind generation, thermal generation, gas turbine generation.

Performance criteria

5.1 The characteristics of selected motors and generators, and the factors that must be considered when selecting a motor or generator for given applications are described.

Range at least three motors or generators.

5.2 A motor or generator is selected for given applications in accordance with industry practice.

Range at least three given applications.

5.3 Motors or generators are selected for given applications and the selection justified in accordance with industry practice.

Range at least three given applications.

Replacement information	This unit standard replaced unit standard 11564.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	18 December 2006	31 December 2025
Rollover and Revision	2	15 March 2012	31 December 2025
Revision	3	15 January 2014	31 December 2025
Rollover and Revision	4	28 January 2021	31 December 2025
Review	5	27 April 2023	31 December 2025

Consent and Moderation Requirements (CMR) reference	0003

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.