Title	**Demonstrate and apply knowledge of power electronics technology engineering**		
Level	**6**	**Credits**	**15**

Purpose	This unit standard covers the concepts and applications of power electronics and includes the basic types of converters. People credited with this unit standard are able to: - describe power switching devices; - describe power conversion systems; - demonstrate knowledge of a.c. to d.c. conversion; - demonstrate knowledge of d.c. to a.c. and d.c. to d.c. conversion; - demonstrate knowledge of a.c. to a.c. conversion; and - describe power control applications.

Classification	Electronic Engineering > Core Electronics

Available grade	Achieved

Guidance Information

1 This unit standard is intended for use in engineering courses at diploma level with assessment primarily against laboratory assignments.

2 It is recommended that competency in Unit 22721, *Demonstrate and apply fundamental knowledge of electrical circuit engineering principles*; Unit 22722, *Demonstrate and apply introductory knowledge of electrical circuit engineering principles*; Unit 22723, *Demonstrate and apply intermediate knowledge of the elements of power engineering*; Unit 22724, *Demonstrate and apply knowledge of electrical machines*; and Unit 22726, *Demonstrate and apply introductory knowledge of electronic engineering;* be achieved before assessment against this unit standard is attempted; or equivalent knowledge and skills demonstrated.

3 Reference
Health and Safety in Employment Act 1992;
and all subsequent amendments and replacements.

4 Definitions
a.c. – alternating current.
BJT – bipolar junction transistor.
d.c. – direct current.
di/dt – rate of current change expressed in amps per second. A positive number representing an increase and a negative number representing a decrease.

dv/dt – rate of voltage change expressed in volts per second. A positive number representing an increase and a negative number representing a decrease.
GTO – gate turn off.
IGBT – isolated gate bipolar transistor.
Industry practice – practice used and recommended by organisations involved in the electrotechnology industry.
MOSFET – metal oxide semiconductor field-effect transistor.
MOV – metal-oxide varistor.
PWM-VSI – pulse width modulated voltage source inverter.
VDR – voltage dependent resistor.

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 elements of this unit standard must comply with the Health and Safety in Employment Act 1992;
- b laboratory and workshop safety practices are to be observed at all times.

Outcomes and performance criteria

Outcome 1

Describe power switching devices.

Range may include but is not limited to – power and fast recovery diodes, thyristors, GTO, BJT, MOSFET, IGBT, smart power control devices.

Performance criteria

1.1 Power switching devices are described in terms of their characteristics, ratings, safe operating areas, and applications in power electronics in accordance with industry practice.

1.2 Methods of protecting power switching devices against excessive currents, short circuits, dv/dt, and di/dt are described in accordance with industry practice.

Range fuses, circuit breakers, MOVs, VDRs, snubbers, voltage clamps.

1.3 Methods of driving power switching devices are described in accordance with industry practice.

Range may include but is not limited to – pulse transformers, optical couplers, smart drivers, phase, zero crossing and burst modes.

Outcome 2

Describe power conversion systems.

Performance criteria

2.1 Power conversion systems are described with the aid of diagrams.

Range a.c. to d.c., d.c. to a.c., a.c. to a.c., d.c. to d.c.

2.2 The generation, effect, and measurement of harmonics in conversion systems are demonstrated in accordance with industry practice.

Outcome 3

Demonstrate knowledge of a.c. to d.c. conversion.

Performance criteria

3.1 The operation of single-phase and three-phase power rectifiers is described in accordance with industry practice.

Range single-phase half wave, single-phase full wave, three-phase full-wave bridge to a maximum of 12 pulses.

3.2 Operation of single-phase and three-phase controlled rectifiers is described and waveforms drawn.

Range calculations and waveforms limited to resistive and inductive loads.

3.3 Practical applications are investigated and tested in accordance with industry practice.

Range evidence of at least two applications is required.

Outcome 4

Demonstrate knowledge of d.c. to a.c. and d.c. to d.c. conversion.

Performance criteria

4.1 Operation of d.c. to a.c. square-wave and sine-wave power converters is explained in accordance with industry practice.

Range single ended configurations, bridge configurations.

4.2 Typical operational features of d.c. to a.c. and d.c. to d.c. converters are explained in accordance with industry practice.

Range may include but is not limited to – soft-starting, start-up lock-out, current and voltage control, limits.

4.3 Component requirements for d.c. to a.c and d.c. to d.c. converters are described.

Range diodes, capacitors, inductors, transformers, isolation circuits.

4.4 Practical applications are investigated and tested in accordance with industry practice.

Range evidence of at least two applications is required.

Outcome 5

Demonstrate knowledge of a.c. to a.c. conversion.

Performance criteria

5.1 Operation of single and three phase power controllers is described and compared.

Range may include but is not limited to – static relay, integral control, phase control for resistive and inductive loads.

5.2 Practical applications are investigated and tested in accordance with industry practice.

Range evidence of at least two applications is required.

Outcome 6

Describe power control applications.

Performance criteria

6.1 Characteristics and operational requirements of a.c. and d.c. machines are described in accordance with industry practice.

Range shunt and series motors, single-phase and three-phase squirrel cage induction motors, linear motors.

6.2 Electric motor speed control systems are described in accordance with industry practice.

Range may include but is not limited to – suitable drives for single-phase d.c. motors, three-phase induction motors.

6.3 Electronic drives are investigated and compared in accordance with industry practice.

Range may include but is not limited to – square-wave inverters, current source inverters, PWM-VSI, vector control, two quadrant and four quadrant d.c. drives.

6.4 Other relevant old and new applications are described in accordance with industry practice.

Range may include but is not limited to – soft starters, welders, induction and dielectric heating, active power factor correction, building management, load control.

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	24 February 1998	31 December 2024
Revision	2	12 December 2000	31 December 2024
Review	3	18 December 2006	31 December 2024
Review	4	24 August 2023	31 December 2024

Consent and Moderation Requirements (CMR) reference	0003

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