

<b>Title</b>	<b>Demonstrate and apply fundamental knowledge of electrical circuit engineering principles</b>		
<b>Level</b>	<b>3</b>	<b>Credits</b>	<b>15</b>

<b>Purpose</b>	<p>This unit standard covers general fundamental electrical circuit theory and testing principles, and skills needed for electrotechnology engineering.</p> <p>People credited with this unit standard are able to demonstrate:</p> <ul style="list-style-type: none"> <li>– and apply knowledge of basic d.c. circuit theory;</li> <li>– and apply knowledge of d.c. circuit theory as applied to capacitors;</li> <li>– and apply knowledge of elementary magnetic fields and electromagnets;</li> <li>– knowledge of basic a.c. circuit theory; and</li> <li>– apply knowledge of electrical measuring instruments.</li> </ul>
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<b>Classification</b>	Electrical Engineering > Core Electrical
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<b>Available grade</b>	Achieved
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### Guidance Information

- 1 This unit standard is intended for use in engineering courses at diploma level with assessment primarily against laboratory assignments.
- 2 This unit standard is one of two that cover knowledge of electrical circuit engineering and provides a basis for Unit 22722, *Demonstrate and apply introductory knowledge of electrical circuit engineering principles*. It is recommended that competency in this unit standard be achieved before assessment against unit standard 22722 is attempted.
- 3 Reference  
Health and Safety at Work Act 2015;  
and all subsequent amendments and replacements.
- 4 Definitions  
A – ampere.  
a.c. – alternating current.  
C – capacitance.  
d.c. – direct current.  
e.m.f. – electromotive force.  
*Fundamental knowledge* – means employing some relevant theoretical knowledge of the subject matter with the ability to use that knowledge to interpret available information.

*Industry practice* – practice used and recommended by organisations involved in the electrotechnology industry.

*R* – resistance.

*V* – volt.

- 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 and apply knowledge of basic d.c. circuit theory.

#### Performance criteria

- 1.1 Concepts of e.m.f., voltage, and current are explained.
- 1.2 Concepts of resistance, Ohm's Law, power, and energy are explained.
- 1.3 Kirchhoff's laws are used to analyse simple resistor networks.
 

Range minimum of two d.c. sources and three resistors.
- 1.4 All branch currents and all node voltages are calculated for circuits containing resistors in series, parallel, and series-parallel.
 

Range evidence is required for – three series resistors, three parallel resistors, three resistors connected in a series-parallel combination.
- 1.5 Voltage dividers are used in practical applications.
 

Range minimum of three resistor networks.

### Outcome 2

Demonstrate and apply knowledge of d.c. circuit theory as applied to capacitors.

#### Performance criteria

- 2.1 Capacitor operation in a d.c. circuit is explained using a simple constructional model and basic electrostatic principles.

2.2 The relationships between current, voltages, and time for a capacitor that is charged and discharged in a simple RC circuit are explained with the aid of diagrams.

Range charge and discharge curves are calculated and verified experimentally; evidence for two resistance values and two capacitance values is required.

### Outcome 3

Demonstrate and apply knowledge of elementary magnetic fields and electromagnets.

#### Performance criteria

3.1 Magnetic fields and permanent magnets are described.

3.2 Fields around current carrying conductors are described.

3.3 Faraday's law is stated, explained, and calculations performed.

3.4 Faraday's law is demonstrated experimentally.

Range qualitatively only.

### Outcome 4

Demonstrate knowledge of basic a.c. circuit theory.

#### Performance criteria

4.1 The nature of sinusoidal alternating voltages and currents are explained with the aid of diagrams.

4.2 The behaviour of capacitive reactive components in an a.c. circuit is described with the aid of diagrams.

Range C in parallel and series with R; phasor diagrams are drawn for series and parallel RC circuits.

4.3 The operation of a double wound transformer is described with the aid of diagrams.

Range calculation of turns ratio, voltage ratio, VA rating.

### Outcome 5

Demonstrate and apply knowledge of electrical measuring instruments.

Range a.c. and d.c. voltage, a.c. and d.c. current, resistance, continuity, insulation resistance.

## Performance criteria

- 5.1 Analogue and digital electrical measuring instruments are described in terms of their principles of operation and their applications.
- Range instruments – multimeter, clip-on ammeter, insulation tester, d.c. ammeter, d.c. voltmeter, ohmmeter;  
applications – a.c. and d.c. voltage and current, resistance, insulation, continuity, diode testing, use of series and parallel shunts, battery, potentiometer, other specialised functions.
- 5.2 Instruments are selected to match the type of measurement and inspected to ensure safety before testing.
- 5.3 Instruments are set and connected in accordance with manufacturers' specifications and in a manner that causes no danger to persons, instruments, or the equipment under test.
- 5.4 Measurements are taken and recorded in accordance with safe industry practice to ensure that components under test and test equipment are not damaged and personnel are not injured.
- 5.5 The approximate tolerance for each measurement is stated, in accordance with industry practice.

<b>Planned review date</b>	31 December 2022
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### Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	18 December 2006	N/A
Rollover and Revision	2	15 March 2012	N/A
Revision	3	15 January 2014	N/A
Rollover and Revision	4	28 January 2021	N/A

<b>Consent and Moderation Requirements (CMR) reference</b>	0003
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This CMR can be accessed at <http://www.nzqa.govt.nz/framework/search/index.do>.

### Comments on this unit standard

Please contact The Skills Organisation [reviewcomments@skills.org.nz](mailto:reviewcomments@skills.org.nz) if you wish to suggest changes to the content of this unit standard.