Title	**Demonstrate knowledge of alternating current (AC) theory**		
Level	**4**	**Credits**	**7**

Purpose	This unit standard covers knowledge of basic AC theory for electricians and related trades. People credited with this unit standard are able to demonstrate knowledge of: – vector quantities – phasor quantities – inductance in AC circuits – capacitance in AC circuits – reactive circuit calculations – resonance in series and parallel AC circuits – harmonics in AC circuits.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

Guidance Information

1 This unit standard has been developed for learning and assessment off-job.

2 Reference
AS/NZS 3000 (version as cited by the Electricity (Safety) Regulations 2010) *Electrical installations (known as the Australian/New Zealand Wiring Rules),* including Amendment 1
and all subsequent amendments and replacements.

3 The term *current regulations and standards* is used in this unit standard to refer to the requirements of the above references.

4 For assessment purposes
a Candidates shall be supplied with formulae involving more than three quantities.
b Use of a calculator during assessment is permitted.
c Candidates are expected to express calculated values in the relevant Système International (SI) units, including multiples and sub-multiples (pico, nano, micro, milli, kilo, mega, etc) and be able to convert between them.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of vector quantities.

Performance criteria

1.1 The term *vector* is defined in terms of magnitude, direction, and point of application.

1.2 Examples of vector quantities are stated.

Range force, velocity.

1.3 Vectors are combined graphically to form the resultant, using a parallelogram of vectors.

1.4 Vectors are resolved graphically into their vertical and horizontal components.

1.5 Components, resultants, and angles are calculated from given data and verified by graphical construction.

Outcome 2

Demonstrate knowledge of phasor quantities.

Performance criteria

2.1 The term *phasor* is defined in terms of magnitude and angular rotation.

2.2 Conventional direction of rotation of phasors is stated.

2.3 Phasor quantities are added by calculation and by phasor diagram to find a resultant.

Range voltage and current phasors, each with a maximum of three component phasors, one in phase, one leading, one lagging.

2.4 Phasor quantities are resolved by calculation and by phasor diagram into their in-phase and quadrature components.

Outcome 3

Demonstrate knowledge of inductance in AC circuits.

Performance criteria

3.1 Inductance is defined in terms of induced electromotive force (e.m.f.) and rate of change of current and its unit stated.

3.2 Characteristics of inductors are described.

Range laws of inductance, creation and effects of back-e.m.f; factors affecting inductance, inductive time constant, equivalent inductance of series, parallel inductors, self-induction, mutual induction.

3.3 Effects of inductors in AC circuits are described.

Range phase relationships, inductive reactance, current flow, variation of inductive reactance with frequency.

3.4 Practical applications of inductors in AC circuits are described.

Range current limiting, controlling, smoothing, solenoids.

Outcome 4

Demonstrate knowledge of capacitance in AC circuits.

Performance criteria

4.1 Capacitance is defined in terms of charge and potential difference and its unit is stated.

4.2 Characteristics of capacitors are described.

Range ability to store a charge, factors affecting capacitance, capacitive time constant, equivalent capacitance of series and parallel capacitors, energy stored.

4.3 Effects of capacitors in AC circuits are described.

Range phase relationship, capacitive reactance, current flow, variation of capacitive reactance with frequency.

4.4 Practical applications of capacitors in AC circuits are described.

Range high frequency coupling, smoothing, power factor improvement, reduction of arcing, radio frequency interference suppression.

4.5 Requirements to promptly discharge certain capacitors are described according to current regulations and standards.

Outcome 5

Demonstrate knowledge of reactive circuit calculations.

Performance criteria

5.1 Impedance is defined in terms of the combined effects of resistance and reactance in an AC circuit, and the unit stated.

5.2 Ohm's Law relating to AC circuits is stated.

5.3 Calculations involving inductance, capacitance, and resistance combinations in series are carried out.

Range phasor sum of voltage drops across components, power factor, phase angle, current, impedance, supply voltage.

5.4 Calculations involving inductance, capacitance, and resistance combinations in parallel are carried out.

Range phasor sum of currents in branches, power factor, phase angle, voltage, impedance, supply current.

Outcome 6

Demonstrate knowledge of resonance in series and parallel AC circuits.

Performance criteria

6.1 Resonance is defined in terms of frequency and the phase relationship between voltage and current.

6.2 Conditions for resonance in a series circuit are stated in terms of magnitudes of inductive and capacitive reactances.

6.3 Voltage phasor diagram for a series resonant circuit is drawn for given data.

6.4 Dangers of series resonance are explained.

Range magnified voltage and current, breakdown of components, risk of shock, fire.

6.5 Applications of series resonance are described.

Range acceptor circuits, tuned circuits, diverting harmonics.

6.6 Conditions for resonance in a parallel circuit are stated in terms of phasor currents.

6.7 Current phasor diagram for parallel resonant circuit is drawn for given data.

6.8 Applications of parallel resonance are described.

Range rejector circuits, tuned circuits, blocking harmonics.

6.9 Resonant frequency of a reactive circuit is found by graphical means.

Range for particular values of inductance and capacitance, values of inductive reactance and capacitive reactance are plotted against frequency.

Outcome 7

Demonstrate knowledge of harmonics in AC circuits.

Performance criteria

7.1 The term *harmonic* is defined according to current regulations and standards.

7.2 Effects of harmonics in AC circuits are described.

Range interference, overheating.

7.3 Requirement to limit consumer-generated harmonic levels is stated according to current regulations and standards.

Replacement information	This unit standard replaced unit standard 1201 and unit standard 1202.

Planned review date	31 December 2028

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	10 February 1999	31 December 2013
Review	2	26 May 2005	31 December 2025
Rollover and Revision	3	15 March 2012	31 December 2025
Revision	4	15 January 2014	31 December 2025
Rollover and Revision	5	28 January 2021	31 December 2025
Review	6	28 March 2024	N/A

Consent and Moderation Requirements (CMR) reference	0003

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

Comments on this unit standard

Please contact Waihanga Ara Rau Construction and Infrastructure Workforce Development Council qualifications@WaihangaAraRau.nz if you wish to suggest changes to the content of this unit standard.