Title	**Demonstrate knowledge of power engineering mathematics**		
Level	**5**	**Credits**	**15**

Purpose	People credited with this unit standard are able to demonstrate knowledge of: • algebraic, logarithmic and linear expressions and equations used by power engineering technicians • solving, manipulating and applying mathematical functions and graphs in relation to power engineering problems • solving, manipulating and applying techniques of trigonometry to power engineering problems • differentiation and integration techniques • differentiation to solve power engineering problems • solving power engineering problems using integration. and: • apply knowledge of complex numbers to solve power engineering problems • demonstrate and apply knowledge of using spreadsheets to manipulate and graph data. This standard provides electricity supply industry power technicians with the fundamental knowledge of power protection and control network theory, and hardware.

Classification	Electricity Supply > Electricity Supply - Power System Maintenance

Available grade	Achieved

Guidance Information

1 Evidence presented for assessment against this unit standard must be consistent with safe working practices and be in accordance with applicable legislative and industry requirements.

2 Legislation, regulations, and /or industry standards relevant to this unit standard include but are not limited to:
- Electricity Act 1992
- Health and Safety at Work Act 2015
- Electricity supply industry codes of practice and documented enterprise procedures, including *Safety Manual – Electricity Industry* (SM-EI) and relevant EEA guides available at www.eea.co.nz

and any subsequent amendments and replacements.

3 Definitions
CR circuit – a circuit with a capacitor and a resistor in series.
LR circuit – a circuit with an inductor and a resistor in series.
RMS – root mean square.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of algebraic, logarithmic and linear expressions and equations used by power engineering technicians.

Performance criteria

1.1 Algebraic equations are identified, described and solved for electrotechnology problems.

Range expansion, factorisation, multiplication and division.

1.2 Exponents and logarithms are identified, described, applied and solved for power engineering problems.

1.3 Linear equations are identified, described and solved for power engineering problems.

Outcome 2

Demonstrate knowledge of solving, manipulating and applying mathematical functions and graphs in relation to power engineering problems.

Performance criteria

2.1 Graphs based on engineering data are drawn and interpreted.

2.2 The relationship for transforming logarithmic to exponential and exponential to logarithmic forms are described and calculations are performed.

2.3 Practical engineering solutions using exponential functions are applied to solve simple problems.

Range growth and decay in LR and CR circuits.

2.4 Practical engineering solutions using simultaneous equations are applied to solve problems involving multiple voltage sources.

2.5 Quadratic equations are described and solved using factorisation and formula.

Outcome 3

Demonstrate knowledge of solving, manipulating and applying techniques of trigonometry to power engineering problems.

Performance criteria

3.1 Degree and radian measure are defined and applied to an identified engineering problem.

3.2 Amplitude, frequency and period of a graph are defined, and trigonometric functions of the form $y = k \sin(\omega t + \alpha)$ with maximum of two transformations of k, ω or α α are graphed.

3.3 Trigonometric equations including the type $k \sin(\omega t + \alpha) = a$ are solved.

3.4 Basic trigonometric identities including reciprocals are described and solved.

Outcome 4

Demonstrate knowledge of differentiation and integration techniques.

Performance criteria

4.1 Use of notational forms is explained.

4.2 The derivatives of powers of x, logarithmic and exponential functions are explained and used to solve a practical problem.

4.3 The derivative of sums, products and quotients are used to solve a practical problem.

4.4 Second derivatives are explained and calculated.

Outcome 5

Demonstrate knowledge of differentiation to solve power engineering problems.

Performance criteria

5.1 The gradient and the tangent to a curve at a given point on the curve are determined.

5.2 The maximum and minimum values of functions of one independent variable are determined.

5.3 Optimisation techniques are described and applied to power engineering problems which may involve more than one variable.

5.4 Rates of change of time dependent variables are calculated and interpreted.

Outcome 6

Demonstrate knowledge of solving power engineering problems using integration.

Performance criteria

6.1 Formulation as definite integrals are described and applied.

Range areas between curves, mean, volumes, RMS or first and second moments.

6.2 Simpson's rule is described and applied to estimate the values of definite integrals.

Range area, volume.

Outcome 7

Apply knowledge of complex numbers to solve power engineering problems.

Performance criteria

7.1 Complex numbers are described and manipulated for practical power engineering applications.

Range applications include – rectangular and polar conversion, solving quadratic equations with complex roots.

Outcome 8

Demonstrate and apply knowledge of using spreadsheets to manipulate and graph data.

Performance criteria

8.1 Spreadsheets are explained and used for manipulation of data and graphing.

Range data in tables, use of formulas.

Planned review date	31 December 2025

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	20 July 2017	N/A
Rollover and Revision	2	2 March 2023	N/A

Consent and Moderation Requirements (CMR) reference	0120

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 at qualifications@WaihangaAraRau.nz if you wish to suggest changes to the content of this unit standard.