Title	**Demonstrate and apply introductory knowledge of electrical circuit engineering principles**		
Level	**4**	**Credits**	**15**

Purpose	This unit standard covers general intermediate circuit theory principles and skills needed for electrotechnology engineering. People credited with this unit standard are able to: – demonstrate knowledge of electromagnetism and magnetic circuits; – demonstrate knowledge of induction and inductance; – demonstrate and apply knowledge of a.c. circuit theory; and – use electrical measuring and test instruments.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

Guidance Information

1 Recommended skills and knowledge:
Unit 22721, *Demonstrate and apply fundamental 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 This unit standard is one of two that cover knowledge of electrical circuit engineering, the other being Unit 22721, *Demonstrate and apply fundamental knowledge of electrical circuit engineering principles*, which this unit standard builds on.

4 Reference
Health and Safety at Work Act 2015;
and all subsequent amendments and replacements.

5 Definitions
a.c. – alternating current.
C – capacitance.
d.c. – direct current.
di/dt – rate of current change expressed in amps per second.
e.m.f. – electromotive force.
Industry practice – practice used and recommended by organisations involved in the electrotechnology industry.
Introductory knowledge – means employing a broad knowledge of the subject matter, incorporating some theoretical concepts, to make an informed judgement.

L – inductance.
M – mutual inductance.
PF – power factor.
R – resistance.

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

7 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.

8 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 electromagnetism and magnetic circuits.

Performance criteria

1.1 Magnetisation curves are described and evaluated with the aid of diagrams.

Range soft and hard materials and hysteresis.

1.2 Simple series magnetic circuits are analysed in terms of industry applications.

Range magnetic units, single air-gap circuit.

1.3 Faraday’s and Lenz's laws are stated, explained, and calculations are performed.

Range average voltage only for a conductor moving perpendicular to a constant magnetic field, a stationery conductor in a changing magnetic field.

Outcome 2

Demonstrate knowledge of induction and inductance.

Performance criteria

2.1 Self-induction is explained in terms of industry applications.

Range motors, transformers, relays.

2.2 Inductive d.c. transients are described, graphed and calculated.

Range charge and discharge curves, time constants.

2.3 Mutual induction is defined and explained with reference to voltage induced in the secondary coil and the coefficient of coupling.

2.4 Calculations involving mutual inductance, e.m.f., and di/dt are performed to solve problems based on practical circuits.

Range series aiding, series opposing;
$e_2 = M\frac{di}{dt}; \quad k = \frac{M}{\sqrt{L_1 L_2}}$;
evidence of one of each is required.

Outcome 3

Demonstrate and apply knowledge of a.c. circuit theory.

Performance criteria

3.1 The behaviour of inductive components in simple a.c. circuits containing R, L, and C combinations is explained with the aid of diagrams.

Range LR, LCR in series and LR in parallel with C, phasor and impedance diagrams are drawn.

3.2 Calculations are performed on a simple series resonant circuit and impedance diagrams are sketched.

3.3 Simple calculations involving real, reactive, and apparent power are performed for an a.c. circuit and phasor diagrams are drawn in accordance with industry practice.

3.4 The use of capacitors for PF correction is described and calculated for one application.

Range calculations for close to unity PF only to be used.

3.5 Reasons why unity PF is not normally used in practical applications are explained.

3.6 The nature and application of three phase sinusoidal alternating currents are described with the aid of diagrams.

Range voltages and currents in delta and star, phasor diagrams, calculations are performed on three phase systems with balanced loads.

Outcome 4

Use electrical measuring and test instruments.

Performance criteria

4.1 Instruments are set and connected in accordance with manufacturer specifications and in a manner that causes no danger to persons, instruments, or the equipment under test.

Range may include but is not limited to – watt meters, power factor meters.

4.2 Measurements or indications are observed and recorded in accordance with industry practice.

Range circuits containing combinations of – L, R, C, LR, LC, RC, RLC in series, parallel, series/parallel.

Planned review date	31 December 2022

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

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 The Skills Organisation reviewcomments@skills.org.nz if you wish to suggest changes to the content of this unit standard.