Title	Demonstrate advanced knowledge of capacitance, inductance, and magnetism in direct current circuits		
Level	**5**	**Credits**	**4**

Purpose	This unit standard is intended for use in the training and assessment of electricians beyond trade level. It covers theory of capacitance, inductance, and magnetism, at a level more advanced than the requirements for the National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195]. People credited with this unit standard are able to demonstrate knowledge of: – capacitance-resistance timing circuits; – inductance-resistance timing circuits; – integrator and differentiator circuits; – the properties of magnetic materials; and – uses for magnetic core materials.

Classification	Electrical Engineering > Core Electrical

Available grade	Achieved

Guidance Information

1 Recommended skills and knowledge:
National Certificate in Electrical Engineering (Electrician for Registration) (Level 4) [Ref: 1195] or equivalent trade qualification for electricians.

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

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of capacitance-resistance timing circuits.

Performance criteria

1.1 Charge and discharge characteristics of a capacitor through a resistor are explained and sketched.

Range characteristics – voltage across capacitor versus time, charging-discharging current versus time.

1.2 The concept of time constant with respect to a capacitance-resistance circuit is explained in terms of current and voltage in response to the application of a step voltage and a short circuit.

1.3 Time constants are calculated for given combinations of capacitance and resistance, with units.

Range at least three combinations.

1.4 For a given capacitance-resistance circuit the capacitor voltage and current are calculated for 0, 1, and 5 time constants during charging and discharging.

Outcome 2

Demonstrate knowledge of inductance-resistance timing circuits.

Performance criteria

2.1 Charge and discharge characteristics of an inductance through a resistor are explained and sketched.

Range characteristics – voltage across inductance versus time, current versus time.

2.2 The concept of time constant with respect to an inductance-resistance circuit is explained in terms of current and voltage in response to the application of a step voltage and a short circuit.

2.3 Time constants are calculated for given combinations of inductance and resistance, with units.

Range at least three combinations.

2.4 For a given inductance-resistance circuit, the inductive voltage and current are calculated for 0, 1, and 5 time constants during charging and discharging.

2.5 Electrical energy stored in an inductor's magnetic field is calculated for a given circuit at 0, 1, and 5 time constants.

Outcome 3

Demonstrate knowledge of integrator and differentiator circuits.

Performance criteria

3.1 Resistance-capacitance and resistance-inductance integrator circuits are drawn from memory, and the output waveforms sketched for a square wave input.

3.2 Resistance-capacitance and resistance-inductance differentiator circuits are drawn from memory, and the output waveforms sketched for a square wave input.

3.3 Applications of integrator and differentiator circuits in wave shaping are explained.

3.4 Typical values of time constant and input signal period are stated for integrator and differentiator circuits.

Outcome 4

Demonstrate knowledge of the properties of magnetic materials.

Range properties – magnetising force, magnetic flux density, permeability, hysteresis, coercive force, residual flux, saturation.

Performance criteria

4.1 Properties are defined, and where appropriate, their units of measurement are stated.

Range units – tesla, weber, ampere-turns per metre.

4.2 Permeability of a magnetic material is calculated from given values of magnetising force and magnetic flux density.

4.3 Typical hysteresis loops are sketched for a high-loss material and a low-loss material.

4.4 A hysteresis loop is plotted for given values of coercive force, residual flux, and saturation flux.

Outcome 5

Demonstrate knowledge of uses for magnetic core materials.

Range magnetic core materials – silicon-iron alloys, grain-oriented silicon-iron alloys, nickel-iron alloys, ferrites.

Performance criteria

5.1 A typical use for each material is stated, with a reason for its suitability.

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	26 February 2002	31 December 2013
Review	2	19 June 2009	N/A
Rollover and Revision	3	15 March 2012	N/A
Revision	4	15 January 2014	N/A
Rollover and Revision	5	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.