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].
	<ul> <li>People credited with this unit standard are able to demonstrate knowledge of:</li> <li>capacitance-resistance timing circuits;</li> <li>inductance-resistance timing circuits;</li> <li>integrator and differentiator circuits;</li> <li>the properties of magnetic materials; and</li> <li>uses for magnetic core materials.</li> </ul>

Classification	Electrical Engineering > Core Electrical			
X.O.				
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, chargingdischarging 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.

This unit standard is expiring. Assessment against the standard must take place by the last date for assessment set out below.

### 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	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	27 April 2023	31 December 2025

Consent and Moderation Requirements (CMR) reference	0003

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