Title	**Demonstrate and apply knowledge of electronic filters, oscillators, and frequency synthesisers**		
Level	**4**	**Credits**	**6**

Purpose	People credited with this unit standard are able to demonstrate knowledge of : – passive filters; – active filters; – digital filters; – practical oscillator circuits; – frequency synthesising networks using a PLL; and – apply knowledge of frequency selective, generating, and synthesising networks.

Classification	Electronic Engineering > Core Electronics

Available grade	Achieved

Guidance Information

1 References
Electricity Act 1992;
Electricity (Safety) Regulations 2010;
Electrical Workers Registration Board (*EWRB*) Rules of the Board and Teaching Guidelines available at www.ewrb.govt.nz;
Health and Safety at Work Act 2015;
and all subsequent amendments and replacements.

2 Definitions
A/D – analogue to digital conversion.
CD – compact disc.
CR – capacitance and resistance.
D/A – digital to analogue conversion.
DSP – digital signal processor.
FIR – finite impulse response.
Industry practice – those practices that competent practitioners within the industry recognise as current industry best practice.
IIR – infinite impulse response.
PLL – phase-locked loop.
SAW – surface acoustical wave.
TV – television.

3 Range
a Electrical, radiation, and workshop or laboratory safety practices are to be observed at all times.

b All measurements are to be expressed in Système Internationale (SI) units and multipliers.
c Use of non-programmable calculators is permitted during assessments.
d All activities and evidence presented for all outcomes and performance criteria in this unit standard must be in accordance with:
  i legislation;
  ii company policies and procedures;
  iii ethical codes;
  iv Standards – may include but are not limited to those listed in Schedule 2 of the Electricity (Safety) Regulations 2010;
  v EWRB Rules of the Board;
  vi safe and sound practice;
  vii applicable site, company, and industry practice.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of passive filters.

Performance criteria

1.1 Sketch the frequency responses of single and two-pole low and high pass filters showing gain and phase.

Range Butterworth, Chebyshev, Bessel.

1.2 Describe the properties of a SAW filter.

1.3 Explain the concepts of frequency and time domain analysis of filters.

Outcome 2

Demonstrate knowledge of active filters.

Performance criteria

2.1 Explain the operation of simple two-pole active CR filters and sketch circuits from memory.

Range filters – low pass, high pass.

Outcome 3

Demonstrate knowledge of digital filters.

Performance criteria

3.1 Describe the function of a digital filter and explain the terms FIR and IIR.

3.2 Describe the operation of a digital signal processing system and sketch a functional block diagram.

Range block diagram – A/D, DSP, D/A, reconstruction filter.

3.3 Describe the function of software to control the operation of a digital filter.

Range no requirement for the generation of software code.

3.4 Describe a practical application of a digital filter in a commercial product in the context of the product's overall operation.

Outcome 4

Demonstrate knowledge of practical oscillator circuits.

Performance criteria

4.1 Explain the operation of an amplifier and a selective feedback network to produce a sinusoidal oscillator.

Range positive feedback, phase, gain, conditions for oscillation.

4.2 Explain practical oscillator circuits with reference to operation, frequency determining networks, and properties.

Range types of oscillators –
sine wave oscillator (Wien bridge or phase shift);
non-linear oscillator (for example using a 555 timer integrated circuit);
voltage controlled oscillator (for example LM331, AD654);
crystal oscillator as used with microcontrollers.
evidence of one circuit from each of type of oscillator is required.

4.3 Identify oscillator circuits on given schematic diagrams of commercial products and state their purpose.

Range evidence of two diagrams is required.

Outcome 5

Demonstrate knowledge of frequency synthesising networks using a PLL.

Performance criteria

5.1 Explain the functional operation of a PLL integrated circuit.

5.2 Explain the use of a PLL with a reference crystal oscillator and programmable frequency divider to synthesise a wide range of frequencies.

5.3 Identify applications of PLL circuits in speed control and demodulation circuits and outline their purpose and function.

Outcome 6

Apply knowledge of frequency selective, generating, and synthesising networks.

Performance criteria

6.1 Construct a two-pole active filter and measure its performance.

6.2 Programme a DSP with prepared software to function as a digital filter and plot the frequency response.

6.3 Construct practical oscillators and measure their performance.

Range two of – Wien bridge, phase shift, non-linear, voltage controlled, crystal.

6.4 Test a frequency synthesiser using a PLL and measure its parameters.

Range parameters – frequency range, lock range, hold range, monitoring signals.

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	26 July 2004	31 December 2012
Review	2	21 July 2011	31 December 2022
Review	3	24 June 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.