Title	**Demonstrate and apply intermediate knowledge of instrumentation and control system engineering**		
Level	**5**	**Credits**	**15**

Purpose	This unit standard covers intermediate knowledge of the concepts used in industrial measurement and control systems for engineers. People credited with this unit standard are able to: – demonstrate knowledge of transmitters and standard transmission signals; – demonstrate knowledge of and apply measurement system performance terminology and standards; – describe and apply feedback control systems principles; and – demonstrate and apply knowledge of controller strategies.

Classification	Industrial Measurement and Control > Industrial Measurement and Control - Theory

Available grade	Achieved

Guidance Information

1 This unit standard is intended for use in engineering courses at diploma level.

2 This unit standard is one of two that cover the concepts used in industrial measurement and control systems for engineers and provides a basis for Unit 22745, *Demonstrate and apply advanced knowledge of instrumentation and control principles*. It is recommended that competency in this unit standard be achieved before assessment against unit standard 22745 is attempted.

3 References
Health and Safety at Work Act 2015.
ISA S5.1 – ANSI/ISA-5.1-2009 – Instrumentation Symbols and Identification.
and all subsequent amendments and replacements.

4 Definitions
DCS – differential scanning calorimetry.
Industry practice – practice used and recommended by organisations involved in the electrotechnology industry.
Intermediate knowledge – means employing a broad knowledge base, with substantial depth in some areas of the subject matter, to analyse and interpret a wide range of information.
ISO – International Standards Organisation.
PID – proportional, integral, derivative.

PLC – programmable logic controller.
RTD – resistance temperature detector.
SAMA – Scientific Apparatus Manufacturers' Association.

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

6 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.

7 Range
- a performance in relation to the elements 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.

8 It is recommended that competency in Unit 22722*, Demonstrate and apply introductory knowledge of electrical circuit engineering principles* be achieved before assessment against this unit standard is attempted, or equivalent knowledge and skills demonstrated.

Outcomes and performance criteria

Outcome 1

Demonstrate knowledge of transmitters and standard transmission signals.

Performance criteria

1.1 Control system transmitters are described in terms of type, and application.

Range measuring element, transmitter, receiver, adjustments, calibration.

1.2 Transmission signals are described in terms of type and application.

Range standard signals (4-20 mA, 1-5 V, 20-100 kPa, 3-15 psi, digital formats); interconnection compatibility of equipment from various manufacturers; transmission of signals over long distances and through noisy environments.

Outcome 2

Demonstrate knowledge of and apply measurement system performance terminology and standards.

Performance criteria

2.1 Measurement system performance terminology and standards are explained in accordance with industry practice.

Range zero, span, range, accuracy, error, sources of error, calibration, repeatability, reproducibility, linearity, hysteresis, dead-band, time response, traceability, primary standards, secondary standards.

2.2 Measurements are conducted and/or observed and recorded in accordance with measurement system standards.

Range adjust pressure transmitter/gauge/switch with dead-weight tester; calibration of temperature system including element (RTD, Thermocouple) and transmitter.

Outcome 3

Describe and apply feedback control systems principles.

Performance criteria

3.1 Process instrument diagrams are prepared and interpreted in accordance with industry practice.

Range loop drawings, single-line drawings, selection of standard symbols from ISA S5.1, SAMA, ISO.

3.2 Feedback control systems principles are described in accordance with industry practice.

Range open loop, automatic, manual closed loop, closed loop, feedback; set point, bias point, deviation, error, measured variable, controlled variable, underdamped increasing amplitude, underdamped decreasing amplitude, overdamped, constant amplitude oscillation, quarter amplitude damped, critically damped, settling time, settling band, overshoot, offset.

3.3 Characteristics of control system elements are described in accordance with industry practice.

Range plant dynamic characteristics (first order transfer function representation, dead time, process gain, integrating process, self-regulating process, runaway, second order).

3.4 Control systems principles are used to design and create a system suitable to demonstrate the principles.

Outcome 4

Demonstrate and apply knowledge of controller strategies.

Range on/off, floating, PID.

Performance criteria

4.1 Basic controller strategies are described in accordance with industry practice.

Range multi-position control, control controller hardware (pneumatic, analogue electronic, stand-alone microprocessor, PLC, DCS)

4.2 Principles of controller tuning are explained in accordance with industry practice.

Range Ziegler-Nicholls open-loop and closed-loop methods; Initial controller settings; systematic trial and error; safety and operational aspects.

4.3 Controller hardware is applied to practical projects in accordance with industry practice.

Range pneumatic, analogue electronic, stand-alone microprocessor, PLC, DCS; bumpless transfer.

4.4 Control loops are utilised to demonstrate control loop and tuning principles in accordance with industry practice.

Range laboratory environment;
any two of the following is required – pressure, temperature, flow, level, position, velocity.

Planned review date	31 December 2021

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	28 June 2018	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.