



National Unit Specification: general information

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

CODE F5KX 12

SUMMARY

This Unit can be delivered as part of a National Qualification Group Award but can also be taken as a free-standing Unit.

This Unit is designed to enable candidates to develop knowledge and understanding of signal conditioning and transmission methods that are used in process measurement and control.

This Unit is suitable for candidates studying the subject for the first time and acts as a basis for progression to employment and/or further study.

This Unit will develop a knowledge and understanding of a range of signal conditioning devices in terms of their application, construction, operation and input/output characteristics; transmission methods for pneumatic, analogue electronic, digital electronic and optical signals. It will also develop knowledge and skills in setting up equipment to measure signal changes in measurement and control engineering systems, measuring the signal changes and interpreting the results.

OUTCOMES

- 1 Apply signal conditioning methods.
- 2 Explain transmission methods.
- 3 Set up and determine signal changes and conditioning in measurement and control engineering systems.

Administrative Information

Superclass: XM

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National Unit Specification: general information (cont)

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following Units:

- ◆ Standard Grade Mathematics — General/Credit Level
- ◆ Standard Grade Technological Studies and/or Science — General/Credit Level

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

Problem Solving (SCQF level 6)
Information Technology (SCQF level 6)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Apply signal conditioning methods.

Performance Criteria

- (a) Methods of signal conditioning are correctly selected for given applications.
- (b) Selected signal conditioning devices are correctly explained.
- (c) Graphs of the input/output characteristics are accurately plotted for the signal conditioning devices.

OUTCOME 2

Explain transmission methods.

Performance Criteria

- (a) Methods of pneumatic and electronic analogue transmission are correctly explained.
- (b) Methods of electrical and optical digital transmission are correctly explained.
- (c) Transmission methods are correctly selected for given applications.

OUTCOME 3

Set up and determine signal changes and conditioning in measurement and control engineering systems.

Performance Criteria

- (a) A schematic diagram of the measurement and control engineering system is correct with respect to the transmission types and values of signals.
- (b) Equipment required to measure the signal changes in the measurement and control engineering system is correctly set up.
- (c) Signal changes in the measurement and control engineering system are accurately recorded.
- (d) Results are correctly interpreted with respect to the relationship between the input and output signals.

National Unit Specification: statement of standards (cont)

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 1 and Outcome 2 to the standard specified in the Outcome and Performance Criteria. The evidence for these Outcomes should be obtained under closed-book, controlled supervised conditions, lasting approximately 1 hour 15 minutes.

Performance evidence, supplemented with an assessor observation checklist and written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 3 to the standard specified in the Outcome and Performance Criteria. Evidence will be collected under open-book, controlled supervised conditions. The practical exercise should last approximately 1 hour.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the assessment support pack to ensure a comparable standard.

National Unit Specification: support notes

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a mandatory Unit within the National Certificate in Measurement and Control Engineering, but it is also available for candidates wishing to study the Unit on a free-standing basis.

This Unit aims to develop the candidate's knowledge and understanding of signal conditioning and communications used in measurement and control engineering systems.

The range of topics that will be covered in the delivery of the Unit will be as follows:

Outcome 1

- ◆ Current-to-pneumatic converter
- ◆ Pneumatic-to-current converter
- ◆ Analogue-to-digital converter
- ◆ Digital-to-analogue converter
- ◆ Current-to-voltage converter
- ◆ Voltage-to-current converter
- ◆ Millivolt-to-current converter
- ◆ Ohms-to-current converter
- ◆ Square root extractor
- ◆ Square extractor
- ◆ Multiplexer and demultiplexer
- ◆ Optical devices
- ◆ Protection barriers (opto-isolation, isolation transformer, zener barriers)

Outcome 2

- ◆ Pneumatic transmission:
 - flapper/nozzle devices
 - air amplifier
 - volume booster
 - time lags
 - transmission tubing (size and material)
 - true and live zeros
- ◆ Analogue electronic transmission:
 - true and live zeros
 - 4-20mA transmission

National Unit Specification: support notes (cont)

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

- ◆ Digital electronic transmission:
 - bits
 - serial transmission methods (synchronous and asynchronous)
 - parallel transmission methods
 - common codes
- ◆ Optical transmission:
 - transmission of fibre optic signal
 - Gray code disc

Outcome 3

- ◆ Industrial measurement and control engineering systems containing pneumatic, electronic and/or optical signal conditioners and transmission systems
- ◆ Methods of measuring the input/output signals in a measurement and control engineering system

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

There is a progressive nature to the learning and teaching of measurement and control engineering and every opportunity should be taken to revise and consolidate prior knowledge, eg the NQ Units, *Engineering: Process Control*, *Engineering: Process Control Systems* and *Engineering: Measurement Technology* contain knowledge and skills which form a foundation for this Unit.

The use of ICT (Information and Communication Technology) should be used to support the delivery of this Unit. This could take the form of candidates researching different types of signal conditioning and communication equipment on the internet or using simulation software.

The Unit requires access to a measurement and control engineering laboratory with candidates having access to a range of process control systems and signal conditioning equipment. Demonstrations and laboratory exercises can be used to improve the candidates understanding of signal conditioning and transmission in measurement and control systems. This will help to relate theory to practice.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Aspects of the Core Skill of *Problem Solving*, that is, critical thinking, planning and organising, reviewing and evaluating, will be naturally developed in this Unit, which requires application of knowledge to a practical task. Candidates identify and explain significant factors before safely setting up measurement equipment and determining signal changes in measurement and control engineering systems. Demonstration and discussion during formative work would be particularly useful in developing analytical evaluation of the work.

Researching background technical information on line would develop confidence and skill in the use of technology. Computer simulation packages could also be used. Candidates should be made aware of the effective and responsible use of equipment and software.

National Unit Specification: support notes (cont)

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Achievement of this Unit requires the Evidence Requirements for each Outcome to be met. A candidate who does not initially achieve the specified standard can have a further opportunity, attempting only the Outcome(s) not previously achieved.

Outcome 1 and Outcome 2 should be integrated into one closed-book test that lasts approximately 1 hour 15 minutes. The closed-book test could consist of a series of short answer, restricted response and structured questions.

The candidate could be given two applications and they must select suitable signal conditioning devices and explain their operation. The candidate could also be given input/output data for two signal conditioning devices and they must plot a graph which shows the input/output characteristics of the devices. This relates to Outcome 1.

The assessment could also incorporate questions which involve explaining analogue and digital transmission methods. The candidate could also be given three industrial applications and they must select a suitable transmission method for each. This relates to Outcome 2.

It is recommended that this assessment is taken after the completion of the delivery of Outcome 1 and Outcome 2.

Outcome 3 could be assessed by a practical exercise that involves setting up measurement equipment and determining signal changes in measurement and control engineering systems. An observation checklist should be used to record candidate performance. The assessment may also require a schematic diagram of the system and the results of the practical exercise presented in a short report. The assessment should be completed in approximately 1 hour.

It is recommended that the practical assessment should be carried out towards the end of the Unit.

Candidates can have access to notes, reference books and manufacturers data sheets for this assessment.

National Unit Specification: support notes (cont)

UNIT Engineering: Signal Conditioning in Telemetry (SCQF level 6)

CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).