

National Unit Specification: general information

UNIT	Signal Processing and Noise (Higher)
NUMBER	D140 12
COURSE	Electronics (Higher)

SUMMARY

The unit is a specialist unit which enables the candidate to acquire a knowledge of analogue and digital signal processing through investigation of amplifier and filter circuits.

This unit is suitable for inclusion in a study programme for Electronics candidates at technician level.

OUTCOMES

- 1 Evaluate signal conditioning circuits.
- 2 Interpret the action of operational amplifier circuits.

RECOMMENDED ENTRY

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

- Standard Grade Technological Studies or Physics at grade 1 or 2
- Intermediate 2 Electronic and Electrical Fundamentals or Technological Studies
- equivalent National units
- a Scottish Group Award at Intermediate 2 in a related area.

Note: It is recommended that all candidates should have attained a minimum of Standard Grade Mathematics at grade 3 or equivalent National units.

Administrative Information

Superclass:	XL
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National Unit Specification: general information (cont)

UNIT Signal Processing and Noise (Higher)

CREDIT VALUE

0.5 credit at Higher.

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	None
Core skills components for the unit	Using Number Int 2

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Signal Processing and Noise (Higher)

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 the Scottish Qualifications Authority.

OUTCOME 1

Evaluate signal conditioning circuits.

Performance criteria

- (a) The requirements of a signal conditioning circuit are correctly explained.
- (b) The different types of input and output signals to a signal conditioning circuit are correctly identified.
- (c) The origin of different sources of noise (external and internal) that could influence the operation of signal conditioning circuits are correctly explained.
- (d) Methods of noise reduction used in signal conditioning circuits are identified correctly.
- (e) The importance of impedance matching is explained correctly.

Note on range for the outcome

Signal conditioning: power gain, voltage gain, current gain, dB expressions.

Types: analogue voltage, analogue current, digital.

Noise (external and internal): manmade noise, atmospheric noise, electromagnetic pick-up, electrostatic pick-up shot noise, Johnson noise.

Methods: filter circuits (active and passive), screening, elimination of ground loops, EMC design.

Evidence requirements

Written and graphical evidence to show the candidate's ability to explain correctly the requirements of a signal conditioning circuit, different types of analogue and digital input and output signals, internal and external generation and pick-up of noise, and maximum power transfer, ie the importance of impedance matching.

National Unit Specification: statement of standards (cont)

UNIT Signal Processing and Noise (Higher)

OUTCOME 2

Interpret the action of operational amplifier circuits.

Performance criteria

- (a) The characteristics of an open loop operational amplifier are correctly explained.
- (b) The concept of a virtual earth is correctly explained.
- (c) The voltage gain equation for inverting and non-inverting operational amplifier circuits is correctly derived.
- (d) The operation of commonly used operational amplifier circuits is practically investigated.

Note on range for the outcome

Characteristics: input impedance, output impedance, gain, frequency response, offset voltage, common-mode rejection ratio, supply voltages.

Op-amp circuits: low pass filter, summing circuits, regenerative comparator.

Evidence requirements

Written and graphical evidence to show the candidate's ability to explain correctly the characteristics of an open loop op-amp, virtual earth and derivation of the voltage equations for inverting and non-inverting op-amps.

For PC (d), evidence that the candidate can correctly investigate the operation of commonly used op-amp circuits.

National Unit Specification: support notes

UNIT Signal Processing and Noise (Higher)

This part of the unit specification is offered for guidance. The support notes are not mandatory.

It is recommended that you refer to the SQA Arrangements document for Higher Electronics before delivering this unit.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

This is a specialist unit enabling the candidate to acquire a knowledge of analogue and digital signal processing through investigation of amplifier and filter circuits.

GUIDANCE ON CONTENT AND CONTEXT FOR THIS UNIT

This unit is part of Higher Electronics and would be best delivered in an integrated manner in conjunction with the other units of the course. The candidate should achieve a level of competence to enable the understanding of processing analogue and digital signals in an electronic system.

Underpinning knowledge of analogue devices, in particular basic op-amp configurations, is desirable: this may be obtained through the study of the Intermediate 2 unit Semiconductor Applications: An Introduction. It is also important that the candidate is familiar with fundamental electrical principles such as may be obtained in the Intermediate 2 unit Electrical Fundamentals.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This unit should be studied in an environment where theory, simulation and practical investigations can be undertaken. It is envisaged that an overall systems approach be adopted with Outcome 1 outlining the generic purpose of signal processing and the external and internal influences that can be encountered. Candidates will be expected to be familiar with extracting the relevant information from manufacturers' data sheets.

Outcome 2 is designed to show the internal workings of this process by examining op-amp configurations. Suitable IC packages should be used throughout this unit. The candidate will be expected to be able to calculate the appropriate values of R and C given the required cut-off frequency and calculate the required value of resistance given the desired cut-off frequency and standard capacitance value.

National Unit Specification: support notes

UNIT Signal Processing and Noise (Higher)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Examples of instruments of assessment which could be used for each outcome are given below.

Outcome 1

PCs (a), (b), (c), (d) and (e).

The candidate could be presented with a series of short answer questions.

Written questioning could be used to ascertain the candidate's understanding of the underpinning theory.

Outcome 2

PCs (a), (b) and (c).

The candidate could be presented with a series of short answer questions.

Written questioning could be used to ascertain the candidate's understanding of the underpinning theory.

PC (d).

The candidate could be given a practical/simulated exercise or an assignment that would be limited to investigating the action of a low-pass first-order active filter, a summing circuit and a regenerative comparator. The candidate would be asked to produce a report in a prearranged format which would contain evidence of the work undertaken. An observation checklist could be kept by the teacher or lecturer as evidence of the candidate completing practical aspects of the assessment.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).