SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Systems and Control (Intermediate 2)

NUMBER D187 11

COURSE Technological Studies (Intermediate 2)

SUMMARY

This unit is designed to enable candidates to study control systems and control programs, and their applications.

OUTCOMES

1 Describe the main types of control systems.
2 Investigate common applications of electronic control systems.
3 Evaluate a program written in PBASIC for use with a microcontroller.
4 Develop a control sequence and use it to control a simple mechatronic system, by means of a microcontroller.

RECOMMENDED ENTRY

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

- Standard Grade Technological Studies at grade 3 or 4

CREDIT VALUE

1 credit at Intermediate 2.

Administrative Information

Superclass: VE

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Version: 03

National Unit Specification: general information (cont)

UNIT Systems and Control (Intermediate 2)

CORE SKILLS

Complete core skills for the unit	Problem Solving	Int 2
Additional core skills for the unit	Using Graphical Information	Int 1

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 Systems and Control (Intermediate 2)

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

Describe the main types of control systems.

Performance criteria

(a) Open loop and closed loop control systems are identified correctly.
(b) The application of error detectors in closed loop control systems is described clearly.
(c) The operation of a control system is described clearly.
(d) Open loop and closed loop control system diagrams are represented correctly.

Evidence requirements

Written and graphical evidence for PCs (a) to (d).

OUTCOME 2

Investigate common applications of electronic control systems.

Performance criteria

(a) The main sub systems of a typical electronic control system are identified correctly.
(b) The differences between analogue and digital transducers are described clearly.
(c) Data sheets are interpreted correctly in the selection of transducers to meet given specifications.
(d) Common applications of electronic control systems are described clearly.

Note on range for the outcome

Common applications: on/off (two state), continuous, sequential.

Electronic control systems: voltage divider based inputs and npn transistor processes with appropriate output transducers.

Evidence requirements

Written and graphical evidence for PCs (a) to (d).

National Unit Specification: statement of standards (cont)

UNIT Systems and Control (Intermediate 2)

OUTCOME 3

Evaluate a program written in PBASIC for use with a microcontroller.

Performance criteria

(a) Number system conversions are carried out correctly.
(b) The basic operation of a microcontroller is described correctly.
(c) PBASIC Instruction Set commands are explained clearly.
(d) The use of PBASIC commands in structured programs is evaluated correctly.

Note on the range for the outcome

Number system conversions: decimal to binary, binary to decimal.

Evidence requirements

Written and graphical evidence for PCs (a) to (d).

OUTCOME 4

Develop a control sequence and use it to control a simple mechatronic system, by means of a microcontroller.

Performance criteria

(a) A specified control sequence is represented correctly by a flowchart using symbols from a data booklet.
(b) A specified control sequence is developed successfully in a high level programming language.
(c) A control sequence written in a high level programming language is used successfully to control a simple mechatronic system.
(d) Interfacing devices, required to provide control of a simple mechatronic system, are used correctly.

Note on the range of the outcome

Simple mechatronic system: 3 inputs, 2 outputs.

Evidence requirements

Written and graphical evidence for PCs (a) and (b). Performance evidence for PCs (c) and (d).

National Unit Specification: support notes

UNIT Systems and Control (Intermediate 2)

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

While the 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

Content

A data booklet will be issued by SQA in connection with this unit.

Guidance for each outcome is given below.

Outcome 1	Principles of operation of control systems. Graphical methods: system diagram; block diagram; circuit diagram, flowchart. Graphical representation of circuit elements such as voltage dividers, error detector and output transducers. Control systems: open loop, closed loop, digital, analogue.
Outcome 2	Input transducers: temperature, light, displacement, moisture, fluid level. Output transducers: light, heat, motion. Common applications of electronic control systems: on/off (two state), sequential, continuous. Evaluation of control systems.
Outcomes 3 and 4	Introduction to microcontrollers including RAM, ROM, ALU, EEPROM, clock. Binary and decimal systems of counting; conversion from one number system to the other. Creating input signals to a microcontroller from analogue and digital devices. Simple control routines: systems with up to 3 inputs and 2 outputs. Use of flowcharts as the basis of a structured, top-down approach to programming. Writing control programs in the high level language, PBASIC; inputs, outputs, loops and time delays. Setting up simple loops; looping through a sequence or program 'N' times and looping continuously. Controlling the speed of a motor by a microcontroller. Controlling simple mechatronic devices by a microcontroller.

NB This unit deals with electronic and microcontroller control systems. Pneumatic control systems are not required.

National Unit Specification: support notes (cont)

UNIT Systems and Control (Intermediate 2)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The purpose of this unit is to consolidate and review concepts associated with control which were established at Standard Grade. The representation of control systems using block diagrams is reviewed. Transistor switching and its application within electronic control circuits is dealt with. The control language PBASIC is introduced. Control sequences are developed to control simple mechatronic devices. The knowledge and understanding of electronic devices developed in the unit Applied Electronics (Intermediate 2) is used in the analysis and evaluation of electronic control systems.

Every opportunity should be taken to ensure that the learning and teaching contexts are of an industrial nature and are seen to be relevant to the candidate. Candidates are expected to develop control sequences to control mechatronic systems.

In presenting courses, teachers and lecturers should ensure that there is a balance between direct teaching and candidate-centred activities.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank materials have been created specifically to assess knowledge and understanding for each outcome. Assessments can take place either at the completion of an outcome or as an end of unit test. Centres must ensure that tests are conducted under appropriate conditions. Candidates should be allowed to use the Technological Studies data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

Outcome 4 requires candidates to carry out practical activities. It is the responsibility of the centre to ensure that evidence of candidate performance is recorded in an appropriate way. All evidence of performance must be retained by the centre. The assessment of this unit is subject to central moderation by the SQA.

Candidates generate evidence by means of their response to written tests, proficiency in practical activities and systems evaluation.

In order to gain success in the written test for an outcome, each candidate must achieve at least the cut-off score for that outcome. Success in the practical activity must be observed by the teacher or lecturer. The practical activity is based on the control of a mechatronic device by a microcontroller. Evidence of performance must be recorded in an appropriate manner. Simulation and construction performance must be observed directly. A candidate's evaluation of a system can be in the form of either a written or oral report. Details should be recorded of the particular system dealt with by each candidate.

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).