National Unit Specification: General Information

UNIT Computer Control Systems (Intermediate 1)

NUMBER D970 10

COURSE

SUMMARY
This units is designed to develop an understanding of the operation of computer control systems through a series of practical exercises.

OUTCOMES
1 Operate a prepared control systems using supplied software.
2 Control and monitor signals for various output devices.
3 Mimic and monitor signals for various input devices.
4 Construct and collect data from a computer control system.

RECOMMENDED ENTRY
Access to this unit is at the discretion of the centre. However, it would be beneficial for the candidate to have completed an access course or equivalent.

CREDIT VALUE
1 credit at Intermediate 1.

CORE SKILLS
Information on the automatic certification of any core skills in this unit is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

The achievement of this unit may contribute to the development of core skills, but the assessment arrangements of the unit do not guarantee that the candidate will produce sufficient evidence of core skills achievement. This means that there is no automatic certification of core skills for this unit.

Administrative Information

Superclass: CB

Publication date: December 1998

Source: Scottish Qualifications Authority

Version: 02 (*Version 01 is National Certificate Module 71117*)

National unit specification: statement of standards

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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
Operate a prepared control systems using supplied software.

Performance Criteria
a) The computer system is correctly started.
b) The control software is correctly loaded and operated.
c) The software is used to correctly monitor input and output signals.

Note on range for the outcome
The range for this outcome is fully expressed in the Performance Criteria.

Evidence Requirements
Performance evidence that the computer hardware and software is used correctly, operate the control systems as detailed in Performance Criteria (a) and (b).

Written or oral evidence that the candidate can monitor signals as detailed in performance criteria (c).

OUTCOME 2
Control and monitor signals for various output devices.

Performance Criteria
a) Software is used to correctly to set control levels for output devices.
b) Hardware is used to correctly to measure signals to out put devices.
c) Software is used to correctly to monitor signals to output devices.

Note on range for the outcome
Control levels: numerical output; analogue control output.
Measurements: analogue signals; digital signal.
Monitoring: analogue signals; digital signal.

Evidence Requirements
Performance evidence that the candidate can set control levels as detailed in performance criterion (a).

Written or oral evidence that the candidate can measure and monitor both analogue and digital signal levels as detailed in Performance Criteria (b) and (c) for all classes of the range.

National unit specification: statement of standards (cont)

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OUTCOME 3
Mimic and monitor signals for various input devices.

Performance Criteria
a) Uses hardware to correctly mimic signals from input devices.
b) Uses hardware to correctly measure signals from input devices.
c) Uses software to correctly monitor signals from input devices.

Note on range for the outcome
Mimic signals: analogue digital.
Measurement: analogue signal; digital signal.
Monitoring: analogue signals; digital signal.

Evidence Requirements
Performance evidence that the candidate can set signals as detailed in Performance Criterion (a) for all appropriate classes of the range.

Written or oral evidence that the candidate can measure and monitor signals as detailed in Performance Criteria (b) and (c) for all appropriate classes in the range.

OUTCOME 4
Construct and collect data from a computer control system.

Performance Criteria
a) Select appropriate input and output devices and correctly construct a control system.
b) Load and run a program to successfully operate a control system.
c) Correctly collect data from a control system.

Note on range for the outcome
The range for this outcome is fully expressed in the performance criteria.

Evidence Requirements
Performance evidence that he candidate can construct, operate and collect data from a control systems as detailed in Performance Criteria (a) to (c) for all appropriate classes of the range. The control system should include one input device and two output devices. The data collected must include at least six numerical readings.

National unit specification: support notes

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This part of the unit specification is offered as guidance. None of the sections of the support notes is mandatory.

GUIDANCE ON CONTENT AND CONTEXT

This unit may be delivered as a stand-alone unit or in combination with other units as part of the Information Technology course at Intermediate 1 level. The details and content given earlier provide information on the delivery and assessment of this unit within the context of a coherent course.

This unit is designed to give the candidate insight into the workings of computer control systems together with practical experience of using such systems. A top down approach to teaching the subject is recommended. The system is studied as a complete unit in Outcome 1, broken down to input and output devices in Outcome 2 and Outcome 3, and finally a system has to be constructed for Outcome 4. Output data has also to be produced in Outcome 4 to show the correct operation of a control system.

Outcome 1

Performance Criteria (a) and Performance Criteria (b).

A series of practical exercises should be carried out using pre-pared control systems. These systems will be models of real-world systems. The relationship between these system and their larger counterparts should be exemplified. The candidate should start up the computer systems, load and run the software in each case.

The type of system which is suitable for these exercises includes:

- environmental control (e.g. temperature sensor input; heater and ventilation output).
- Conveyor colour sorting system (e.g. light sensor input; motor-drive and audio-fail output).
- Vending machine (touch selection input; motor output for first selection; motor output for second selection).

The operational code should be briefly looked at for each system. Log and BASIC are examples of suitable programming languages for this level of control.

Construction of the control systems is encouraged to increase understanding of the operation of the systems and to add interest. Construction, should not however, form the major part of the activities – commercial kits such as Lego Dacta or Fisher Technik would be suitable.

Performance Criteria (c)

For each system used exercises should be set using software to monitor input and output signals. This should be easily achievable with the software offering either icon selection of the devices for monitoring or prompts for data to be monitored.

National unit specification: support notes (cont)

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Outcome 2
This outcome is designed to introduce the candidate to the properties of output transducers. Competence should be gained through a series of practical exercises in which the candidate has to control, measure and monitor various output devices.

Performance Criteria (a)
The type of signals which are required to be sent to various output devices should be studied and reinforced through practical work. Suitable output devices for study include:

- DC Motor – where the level of an analogue output signal (setting the field current) controls the rotational speed.
- Stepper Motor – where the frequency of the output of the digital phase signals controls the output speed.
- Buzzer – where a digital on/off signal controls whether the device produces sound.
- Speaker – where the frequency, shape and magnitude of an analogue output signal controls the sound produced.
- LED – where a digital output signal controls whether the device is illuminated.
- LAMP – where an analogue output signal control the intensity of illumination.

The output signals to the devices have to be modified both using numerical control and using some form of analogue input.

The numerical control can be achieved by:

- setting switches (real or virtual)
- entering numbers at a screen prompt or
- changing values in pre-existing code.

Analogue control input can be achieved by:
- using virtual control devices such as on-screen slider or rotary controls
- using the keyboard or externally connected analogue control devices such as rotary or linear potentiometers.

A series of exercises should be carried out involving setting the levels for differing out devices.

Performance Criteria (b)
The signal outputs from these devices should be measured and recorded using suitable hardware.

For analogue output devices (DC motor, lamp) this will normally involve using a voltmeter to measure the output signal level. If a speaker is used a pre-set oscilloscope could be used to display the output signal. The setting up of the scope would be outside the requirements for this unit.

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In the case of digital codes controlling the output device (stepper-motor) a set of LED indicators would be suitable for displaying the digital signals. For on/off controls such as single LED's a voltmeter should be used to measure actual signal levels.

Performance Criteria (c)
Monitoring of the output signals through software is designed to reinforce understanding through observing in real-time the output signals varying together with gaining experience of using the control software. The monitoring may be achieved by the candidate using virtual control inputs to cause the information to display on-screen or in response to prompts from the control program or by entering an extra line of code to cause the signal to be displayed on the monitor.

The relationship between the levels set, measured using hardware devices and the on-screen levels should be exemplified to reinforce the relationship between these and the associated output produced. In each case both digital and analogue output signals have to be studied both in theory and through practical work.

Outcome 3
This outcome is designed to introduce the candidate to the properties of input transducers. Competence should be gained through a series of practical exercises in which the candidate has to mimic, measure and monitor signals from input devices.

Performance Criteria (a)
The type of signals which are received from various input devices should be studied and reinforced through practical work. These devices are primarily measuring environmental conditions. They may give out either analogue or digital signals. If a digital signal is produced by internal conditioning within the device this should be made clear. Suitable input devices include:

- temperature sensor where an analogue or digital signal represents the measured temperature.
- positional sensor where an analogue or digital signal represents displacement from a datum (linear or rotary)
- light sensor where an analogue or digital signal represents the ambient light level.
- pressure sensor where an analogue or digital signal represents the pressure applied to the sensor.
- Generator, where rotational speed is represented by a signal of changing magnitude or frequency.

A series of exercises in which inputs are simulated by switches or adjusting a variable resistor to produce different voltage levels should be carried out for differing input devices. The setting of both analogue and digital signals should be included in the exercises. The software will then interpret these levels as signals from the sensor inputs and respond accordingly.

National unit specification: support notes (cont)

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Performance Criteria (b)
Replacing the mimic inputs with the input transducers allows measurement of actual signal outputs. Once again this will generally involve using a voltmeter for analogue signals; digital codes being noted through a set of LED's. Where a more complex signal such as a varying frequency output of a generator represents the input condition, a pre-set oscilloscope may be used to produce an image of its output.

Performance Criteria (c)
Monitoring of the input signals through software is designed to reinforce the understanding gained through the previous exercises. Monitoring may again be achieved by the candidate using virtual control inputs to cause the information to display on-screen or in response to prompts from the control program or by entering an extra line of code to cause the signal to be displayed on the monitor.

The relationship between the signals from the three exercises on input devices should be exemplified. In each case both digital and analogue input signals should be studied.

Outcome 4
This outcome is designed to utilise experience gained in the earlier outcomes is a series of exercises involving building and monitoring simple control systems. The construction should not be complex and would ideally involve the use of commercial kits such as Lego Dacta or Fischer Technik. It is the control system which is to be constructed, involving only the connection if input and output transducers and is not intended to involve the construction of the model systems.

Performance Criteria (a) and Performance Criteria (b)
A series of exercises should be carried out involving the candidate selecting devices for specified control systems. The control systems used for outcome 1 are of a suitable level. The same input and output devices used for outcomes 2 and 3 should be used for these systems. A more detailed explanation of the code operating the system could be covered here, building on the understanding gained in the earlier exercises.

Performance Criteria (c)
Numerical representation in real-time of the output data should be displayed on-screen and collected either by hand, by saving to a file or displayed graphically (and printed out) by using software built-in to the control package.

The requirements for logged data to have a header describing the situation in which the data was collected should be exemplified. A typical header should be used as an example, showing details such as:

- the exercise carried out
- the person collecting the results, and
- the date and time of recording

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The need for basic labelling on graphical output should be emphasised – differentiating clearly between a 'drawing' of the results and a measurement. Examples should show a minimum labelling of:

- a title
- both axis scaled
- both axis labelled

Results obtained from the exercises should be investigated and their relationships to control inputs and outputs exemplified.

GUIDANCE ON TEACHING AND LEARNING APPROACHES

A candidate-centred, resource – based learning approach is recommended. Candidates will require access to appropriate construction hardware and measurement instruments at various stages throughout this unit. The use of video and other multimedia equipment is encouraged.

The recommended teaching approach is for short teaching sessions followed by longer practical exercises. Group sizes for practical exercises should be kept to a size that ensures that each person taking part has a valid role to play in the exercise.

The use of basic model systems which can be quickly constructed and modified is highly recommended. The relationship between the model systems and larger scale control systems should be emphasised. Viewing control systems in real-world settings is highly encouraged.

The unit should be presented in both a class and computer equipped laboratory environment.

Suitable equipment such as multimeters and oscilloscopes are required to view signals from input and output devices. Equipment to generate digital and analogue input signals such as switch banks and signals generators are also required.

Equipment equipped with suitable software for collecting data, displaying it graphically and producing appropriate print-outs is highly recommended.

Whilst the distribution of time between the outcomes will vary, candidates might be expected to complete each outcome within the following timescale:

Outcome 1	10 hours
Outcome 2	10 hours
Outcome 3	10 hours
Outcome 4	10 hours

National unit specification: support notes (cont)

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GUIDANCE ON APPROACHES TO ASSESSMENT

Centres may use the instruments of assessment which are considered to be most appropriate. Examples of instruments of assessment, which could be used, are as follows:

Outcome 1
Practical exercise to assess the candidate's ability to operate a pre-constructed control system.

Outcome 2
Practical exercises to test the candidate's understanding of the operation of output devices within a control system.

Outcome 3
Practical exercises to test the candidate's understanding of the operation of input devices within a control system.

Outcome 4
Practical exercise to test the candidates ability to construct, operate, collect and present data from a control system.

During the course of the unit, terminology should be presented in context. Where the candidate is unsuccessful in achieving an outcome, provision should be made for additional support and re-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* (SQA, 1998).