SQA Advanced Unit Specification

General information for centres

Unit title: Process Control by Computer

Unit code: HV60 48

Unit purpose: This Unit is designed to enable candidates to gain knowledge and understanding of using a computer to perform sequence control, continuous control and data logging.

On completion of the Unit candidates should be able to:

1   Apply a computer based system to perform sequence control.
2   Apply a computer based system to perform continuous control of a process.
3   Apply a computer based system to perform signal processing and data logging functions.

Credit points and level: 1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*).

*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 National 1 to Doctorates.

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the centre and the following recommendations are for guidance only. Candidates should have a wide knowledge of measurement and control engineering. This could be evidenced by the possession of the SQA Advanced Units HV63 47 Distributed Control Systems and HV67 47 Measurement Systems 1. It would also be an advantage in possessing or working towards the Units HP6L 47 Information Technology: Applications Software 1, HT1K 47 Applications of Programmable Logic Controllers and HT9X 47 Process Control.

Core Skills: There are opportunities to develop the Core Skills of Written Communication (Writing), Written Communication (Reading) and Working with Others at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Assessment: It is recommended that Outcomes 1, 2 and 3 in this Unit should each be assessed by a separate assignment. The tasks in each assignment will involve explaining features of the type of control system and a practical element that will involve writing a programme to meet the given specification, entering the programme into the computer, editing the programme and demonstrating its correct operation.

Candidates should complete each assignment in approximately five hours, included in class time. This time is to include planning, inputting and testing of the programme.

Candidates should have access to a computer that contains relevant high level language programming software (eg QBasic, Labview, C, Visual Basic) and associated interface and peripheral equipment.

The candidates should be allowed to use relevant notes and textbooks when completing the assignments.

Each assignment should be carried out at the end of the delivery of the related Outcome.

It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass the Unit.

Unit specification: statement of standards

Unit title: Process Control by Computer

Unit code: HV60 48

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Apply a computer based control system to perform sequence control

Knowledge and/or skills

♦ Event based sequence control
♦ Time based sequence control
♦ Generation of sequence control by a computer system
♦ Sequence control programme
♦ Sequence control programme entry
♦ Operation of a sequence control programme

Evidence Requirements

This is a practically based Outcome and all of the knowledge and/or skills items above should be assessed. The evidence should be presented in response to a practical assignment in which the candidate is set the task of explaining about sequence control and applying a computer to perform sequence control of a process.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

♦ explain event based sequence control
♦ explain time based sequence control
♦ explain how a computer based system can be used to perform sequence control
♦ produce a well commented programme that contains both event based and time based sequence control and is used to control a process that has a minimum of five inputs and five outputs
♦ enter the sequence control programme into a computer
♦ demonstrate the correct operation of the sequence control programme

The control problem in this assignment should be based on an industrial process but it is not necessary that the physical process should be controlled. The operation of the process could be mimicked by connecting the inputs to switches and the outputs to LEDs. However, if a real or simulated process is available at the centre, then the candidate should be encouraged to test his/her final programme by connecting to the hardware.

Candidates should have access to relevant programming notes and textbooks. If the candidate's programme does not function properly then the candidate should be allowed to correct the faults and retest the operation of the programme. Centres should make every reasonable effort to ensure that the control solution is the candidate's own work.

Assessment guidelines

The assessment of this Outcome should take the form of an assignment. The recommended time allocated for the assignment is 5 hours. It is recommended that centres develop checklists to support the assessment requirements.

It is essential that centres ensure that evidence generated is the candidate's own work. Centres can choose to issue each candidate with a different process to control or the same process. If each candidate is issued with a different process specification then the degree of difficulty for each one should be equal. If the same process specification is assigned to each candidate then the specification should be such that each candidate is required to interpret it and offer his/her unique design solution.

Outcome 2

Apply a computer based system to perform continuous control of a process

Knowledge and/or skills

♦ Operation of a computer based control system that is used to perform continuous control
♦ Importance of selecting a valid sample rate
♦ Continuous control programme
♦ Continuous control programme entry
♦ Operation of a continuous control programme

Evidence Requirements

This is a practically based Outcome and all of the knowledge and/or skills items above should be assessed. The evidence should be presented in response to a practical assignment in which the candidate is set the task of explaining about sampling and continuous control and applying a computer to perform continuous control of a process.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:-

♦ explain how a computer based system can be used to perform continuous control of a process
♦ explain the importance of selecting a valid sample rate for a continuously controlled system
♦ produce a well commented programme that is used to perform continuous control of a process
♦ enter the continuous control programme into a computer
♦ demonstrate the correct operation of the continuous control programme

Candidates should have access to relevant programming notes and textbooks. If the candidate's programme does not function properly then the candidate should be allowed to correct the faults and retest the operation of the programme. Centres should make every reasonable effort to ensure that the control solution is the candidate's own work.

Assessment guidelines

The assessment of this Outcome should take the form of an assignment. The recommended time allocated for the assignment is five hours. It is recommended that centres develop checklists to support the assessment requirements.

It is essential that centres ensure that evidence generated is the candidate's own work. Centres can choose to issue each candidate with a different process to control or the same process. If each candidate is issued with a different process specification then the degree of difficulty for each one should be equal. If the same process specification is assigned to each candidate then the specification should be such that each candidate is required to interpret it and offer his/her unique design solution.

Outcome 3

Apply a computer based system to perform signal processing and data logging functions

Knowledge and/or skills

♦   Computer used to enhance the display of signal data
♦   Signal conditioning devices and examples of such devices
♦   Signal conversion devices and examples of such devices
♦   Data logging programme
♦   Data logging programme entry
♦   Operation of a data logging programme

Evidence Requirements

This is a practically based Outcome and all of the knowledge and/or skills items above should be assessed. The evidence should be presented in response to a practical assignment in which the candidate is set the task of explaining about data logging and signal processing and applying a computer to perform signal conditioning and data logging functions.

A candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

♦   explain how a computer system can be used to enhance the display of signal data
♦   explain the need for signal conditioning devices in a system that is controlled by a computer and give two examples
♦   explain the need for signal conversion devices in a system that is controlled by a computer and give two examples
♦   produce a well documented programme that is used to perform data logging
♦   enter the data logging programme into a computer
♦   demonstrate the correct operation of the data logging programme

Candidates should have access to relevant programming notes and textbooks. If the candidate's programme does not function properly then the candidate should be allowed to correct the faults and retest the operation of the programme. Centres should make every reasonable effort to ensure that the control solution is the candidate's own work.

Assessment guidelines

The assessment of this Outcome should take the form of an assignment. The recommended time allocated for the assignment is five hours. It is recommended that centres develop checklists to support the assessment requirements.

It is essential that centres ensure that evidence generated is the candidate's own work. Centres can choose to issue each candidate with a different process to control or the same process. If each candidate is issued with a different process specification then the degree of difficulty for each one should be equal. If the same process specification is assigned to each candidate then the specification should be such that each candidate is required to interpret it and offer his/her unique design solution.

SQA Advanced Unit Specification

Administrative information

Unit code: HV60 48

Unit title: Process Control by Computer

Superclass category: VE

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History of Changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

Unit specification: support notes

Unit title: Process Control by Computer

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 Unit has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:

1   Apply a computer based system to perform sequence control.
2   Apply a computer based system to perform continuous control of a process.
3   Apply a computer based system to perform signal processing and data logging functions.

This Unit is at SCQF level 8 and has been devised as an optional Unit within the SQA Advanced Certificate/Diploma in Measurement and Control Engineering award. However this does not preclude the use of this Unit in other awards where award designers feel this to be appropriate.

In designing this Unit, the Unit writer has identified the range of topics that they would expect to be covered by lecturers. The writer has also given recommendations as to how much time should be spent on each Outcome. This has been done to help lecturers decide what depth of treatment should be given to the topics attached to each of the Outcomes. While it is not mandatory for centres to use this list of topics, it is recommended that they cover them.

A list of topics for each Outcome is given below.

Outcome 1

Apply a computer based system to perform sequence control (13 hours)

♦   definition of event based sequence control
♦   industrial applications of event based sequence control
♦   definition of time based sequence control
♦   industrial applications of time based sequence control
♦   configuration of I/O ports
♦   programme code to read in values through the input port
♦   programme code to write out values through the output port
♦   programme code to perform event based sequence control
♦   programme code to perform time based sequence control
♦   flow chart for a sequence control programme
♦   writing a programme to perform sequence control
♦   adding comments to the programme
♦   entering the sequence control programme into the computer
♦   editing the programme
♦   testing procedures for the sequence control programme

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Outcome 2

Apply a computer based system to perform continuous control of a process (14 hours)

- reasons for selecting a valid sample rate
- Sampling Theorem
- loop components required to generate continuous control with a computer
- operation of a microprocessor based control system that is used to perform continuous control
- definitions of proportional, integral and derivative control
- programme code to read in an analogue signal
- programme code to scale a value that is read in by the computer into engineering units
- programme code to write out a value to an actuator
- flow chart for a continuous control programme
- programme code to generate P, PI, PD and PID control
- writing a programme to perform continuous control
- adding comments to the programme
- entering the continuous control programme into the computer
- editing the programme
- testing procedures for the continuous control programme

Outcome 3

Apply a computer based system to perform signal processing and data logging functions (13 hours)

- Advantages of using a computer based data logger as opposed to a chart recorder
- Methods of displaying signal data on a computer that includes
  — trends
  — schematic diagrams
  — lists
- Definitions and examples of signal conversion devices that includes
  — I/P converter
  — P/I converter
  — A/D converter
  — D/A converter
  — V/I converter
  — I/V converter
- Definitions and examples of signal conversion devices that includes
  — amplifiers
  — square root extractors
  — transmitter heads on thermocouples and resistance thermometers
- Programme code to create, open and close files
- Programme code to collect data
- Programme code to write the data that is collected to a file
- Programme code to display data that has been logged
- Flow chart for a data logging program

♦   Writing a programme to perform data logging
♦   Adding comments to the programme
♦   Entering the data logging programme into the computer
♦   Editing the programme
♦   Testing procedures for the data logging programme

Unit assessment

Assignment for Outcome 1	5 hours
Assignment for Outcome 2	5 hours
Assignment for Outcome 3	5 hours

Candidates should complete each assignment in approximately five hours, included in class time. This time is to include planning, inputting and testing of the programme.

Guidance on the delivery and assessment of this Unit

This Unit has been designed to incorporate sufficient time to allow a lecturer to teach, in a student centred way, how a computer can be used to perform sequence control, continuous control and data logging.

The programming part of this Unit should be carried out using any high level programming language that is available in the Centre. The emphasis on this Unit is on using software as opposed to developing software.

In the delivery of this Unit, candidates should be provided with the opportunity to gain as much "hands-on" experience as possible. Ideally each candidate should have a computer to work with but if, due to resource constraints, this is not possible then, for non-assessment purposes, candidates could work in small groups. If candidates are working in small groups for non-assessment purposes it is essential that each candidate participates in the exercises and gets the opportunity to enter and edit the programmes.

Details on approaches to assessment are given under evidence requirements and assessment guidelines under each Outcome in the SQA Advanced Unit specification: statement of standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skills of Written Communication (Writing) and Written Communication (Reading) at SCQF level 5 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support. With regard to assessment, planning would be required of the Centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that written assessment was conducted under controlled, supervised conditions. Arrangements would need to be made to ensure that the candidate could perform practical work on filter circuits. This could involve the candidate attending the Centre or utilising video conferencing. Alternatively, special arrangements could be made for the candidate to demonstrate the practical work to a designated, responsible person local to the candidate.

For information on open learning, please refer to *SQA guide assessment and quality assurance of open and distance learning (A1030, Feb 2001).*

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Process Control by Computer

This Unit has been designed to provide you with the knowledge and/or skills that will enable you to use a computer to perform sequence control, continuous control and data logging.

In Outcome 1 you will learn about how a computer can be used to perform sequence control of a process. You will gain "hands-on" experience of writing a sequence control programme, entering the programme into the computer and demonstrating that the programme satisfactorily performs sequence control of the process.

In Outcome 2 you will learn about how a computer can perform continuous control of a process loop. You will gain "hands-on" experience of writing a programme to perform continuous control of a process loop, entering the programme into the computer and demonstrating that the programme satisfactorily performs continuous control of the process.

In Outcome 3 you will learn about how a computer can be used to perform data logging. You will gain "hands-on" experience of writing a programme to perform data logging, entering the programme into the computer and demonstrating that the programme satisfactorily performs data logging.

Each of the three assignments should normally be completed within five hours. Your centre will provide you with access to a computer that has high level language programming software. You will be allowed to use any relevant notes and text books when carrying out the assignments.

Each of the three assignments will normally be carried out at the end of the delivery of the Outcome.