SQA Advanced Unit Specification

General information

Unit title: Computer Systems and Organisation (SCQF Level 8)

Unit code: HT07 48

Superclass: CB

Publication date: August 2017

Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This unit will develop a general understanding of the theories and concepts that underpin the use of computers. It is suitable for a wide range of learners who require to know the basic organisational principles of computer systems. It is particularly suitable for learners who wish to specialise in Computer Science or a similar discipline.

Central to this is how the internal system of the computer is represented and how digital codes can be converted into information that is more easily understood by people. The unit covers how communication channels are used and how the processor deals with tasks as they become available. Data manipulation and translation are also included as part of this process. The final part of the unit will give the learner an appreciation of assembly language programming.

At the completion of this unit, learners will know the fundamental operating principles of computer systems and be able to recognise and manipulate assembly language programs. It will provide foundation knowledge to permit learners to progress to more advanced studies in Computer Science.

Outcomes

On successful completion of the unit the learner will be able to:

1 Describe the organisation of computer systems.
2 Explain the internal representation of text, numbers and images.
3 Explain how the central processing unit executes instructions.
4 Analyse an assembly language program.

Credit points and level

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

Recommended entry to the unit

Access to this unit will be at the discretion of the Centre, however it is recommended that learner should have some prior knowledge and skill in Computing/IT demonstrated by achievement of relevant National courses or units at SCQF level 5 or SCQF level 6, or appropriate work experience. This may be demonstrated by the possession of HP1T 47 Computer Systems Fundamentals or by previous experience of working with PCs at this level.

Learners would also benefit from knowledge of basic computer architecture, binary and hexadecimal number systems.

Because numeracy Core Skills are signposted in this unit it would be beneficial if learners have some numeracy skills. This could be demonstrated by the achievement of the Core Skill components Using Graphical Information at SCQF level 4 and Using Number at SCQF level 6 or equivalent.

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

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.

The Assessment Support Pack (ASP) for this unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website **(http://www.sqa.org.uk/sqa/46233.2769.html)**.

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.

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 SQA.

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. Learners 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

Describe the organisation of computer systems.

Knowledge and/or Skills

- Components of a computer system
- Organisation of a computer system
- Address and data buses
- Registers
- Machine code
- Stored program concept
- Abstraction
- Compilation and translation

Outcome 2

Explain the internal representation of text, numbers and images.

Knowledge and/or Skills

- Binary and hexadecimal number systems
- Computer memory
- Internal representation of text
- ASCII control characters
- Internal representation of numbers (whole, integer and real)
- Internal representation of images

Outcome 3

Explain how the central processing unit executes instructions.

Knowledge and/or Skills

- Architecture of the CPU
- Fetch/execute cycle
- Addressing modes
- Processor performance
- Boolean algebra
- Truth tables
- Gates
- CISC and RISC processors

Outcome 4

Analyse an assembly language program.

Knowledge and/or Skills

- Assembly language instruction sets
- Relationship between machine code and instruction sets
- Direct and indirect addressing
- Types of assembler
- Assembly language programming concepts

Evidence requirements for this unit

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills across all outcomes.

Evidence is normally required for all of the Knowledge and Skills in every outcome. However, sampling may be used in a specific circumstance (see below). The amount of evidence should be the minimum consistent with the stated Knowledge and Skills.

The evidence requirements for this unit will take the form of evidence of **cognitive** competence (Outcomes 1, 2 and 3) and evidence of **practical** competence (Outcome 4).

Evidence of cognitive competence may be written or oral or a combination of these. Evidence may be captured, stored and presented in a range of media (including audio and video) and formats (analogue and digital).

The evidence for Outcomes 1–3 may be based around a real or abstract machine. If a real machine is used, its architecture should be straight-forward. It is sufficient for candidates to demonstrate their competence for one machine (architecture) only. There is no requirement for candidates to repeatedly demonstrate their ability to represent text, number and images internally (Outcome 2). A limited number of representations, for each type of data, are sufficient.

If the evidence for cognitive competence is produced through testing, it is permissible for candidates to sample the Knowledge and Skills. The test must sample widely, and broadly, across all three outcomes. In this circumstance, the test must be done under supervised, closed-book conditions with an appropriate pass mark. The questions may be selected response or extended response or a mix of these types of questions.

The evidence for Outcome 4 must comprise candidates analysing at least one assembly language program. The analysis must involve the interpretation of assembly language code that interfaces with one or more system support chips in order to configure and control a specific peripheral device. Candidates may access reference material while generating this evidence.

When evidence is produced in uncontrolled or loosely controlled conditions it must be authenticated. The Guide to Assessment provides further advice on methods of authentication.

Unit support notes

Unit title: Computer Systems and Organisation (SCQF Level 8)

Unit support notes are offered as guidance and 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 is intended to provide the learner with an understanding of the internal workings of a computer. The learner will learn the components of a computer and how they communicate within the processor and without.

An understanding of numerical systems and their translation to machine code, as well as how to configure and understand machine code, will be the main outcomes of this unit. These skills will be useful to all computing jobs, eg software developers, networkers etc. The unit is intended to be levelled at 8 on the SCQF scale and acts as a basis for other units eg Networking Technology, Software Development: Object Oriented Programming.

The units above can be mapped to the national Occupational Standards published by Tech Partnership, in particular to two disciplines within the IT Professional Standards. https://www.thetechpartnership.com/standards-and-quality/it-professional-standards/

- Architecture, Analysis and Design (level 3)
  - Systems Architecture - ESKITP4013

- Solution Design and Implementations (level 3)
  - Systems Integration - ESKITP4013

Outcome 1 — Describe the organisation of computer systems.

- Components of a computer system — the central processing unit (CPU), motherboard, hard drive, memory, monitor and peripherals.
- Address and data buses.
- Registers — including MBR, MAR, PC and IR.
- Machine code.
- Stored program concept.
- Abstraction.
- Compilation and translation.

Outcome 2 — Explain the internal representation of text, numbers and images.

- Binary and hexadecimal number systems — students will be required to convert between bases. Students should also be able to Add and subtract two Binary or two hexadecimal values.
- Computer memory a sample of currently available types, may include RAM, ROM, DRAM, PROM, SRAM, EPROM, Flash memory. Described in terms of access speed and cycle time.
- Internal representation of text — ASCII code and Unicode.
- ASCII control characters - the representation of ASCII characters as binary patterns can be used to highlight the idea that all data held by a computer system is held in a binary representation.
- Internal representation of numbers -whole, integer and real.
- Internal representation of images — including resolution, DPI, RGB system, bit depth and how images are saved/stored.

Outcome 3 — Explain how the central processing unit executes instructions.

- Architecture of the CPU - State the function and operation of all the internal components of the processor including timing and control unit, decoder, instruction register, data buffer, MAR (memory address register), PC (program counter), general purpose register and ALU (arithmetic and logic unit).
- Fetch/execute cycle - Detail the activities involved in the fetch/execute cycle. The candidate will be required to provide a trace of the activities of the processor as it performs two different assembly level instructions. One instruction should be adding a value from memory to the accumulator; the second should be an indirect load of a value from memory to a general purpose register. Evidence will be collected on a supplied pro-forma with spaces to record the values in registers as they change when the cycles of the fetch/execute cycle progress.
- Addressing modes — Modes you may include are Immediate, Index, Indirect and Absolute (Direct) Modes.
- Processor performance — including circuit speed (clock, MHz), processor technology (how many transistors on a chip), type of processor (ILP), configuration of the memory hierarchy, type of I/O devices and number of processors in the system.
- Boolean algebra - using basic logic symbols and block diagrams.
- Truth tables — using NOT, AND, OR, XOR, NAND, NOR.
- Gates - using NOT, AND, OR, XOR, NAND, NOR.
- CISC and RISC processors.

Outcome 4 — Analyse an assembly language program.

- Assembly language instruction sets.
- Relationship between machine code and instruction sets.
- Direct and indirect addressing.
- Types of assembler — one pass assembler, two pass assembler, load and go assembler.
- Assembly language programming.

Guidance on approaches to delivery of this unit

Although not compulsory it is advised that Outcomes 1 and 2 are delivered before Outcome 3. Outcome 4 can be done first or last depending on the preference of the centre. It is advisable that a large part of the unit is spent on practical tasks so that the learner has a chance to develop the skills necessary and then becomes conversant with the common calculations and operations carried out. The learner may be presented with contextual examples that aid their understanding of the major concepts in the unit.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of instruments of assessment. The following are suggestions only. There may be other methods that would be more suitable to candidates.

Centres are reminded that prior verification of centre devised assessments would help to ensure that the national standard is being met. Where candidates experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

It is recommended that Outcome 1 and 2 of this unit be assessed as a Multiple Choice assessment and is carried out under closed-book and supervised conditions. The assessment instrument delivered via a centre's VLE would seem the easiest method.

Outcome 3 is a more complex and although it is advised that the centre uses a pro-forma with extended response questions using diagrams and tables to test the candidate's knowledge of this outcome. This could also be done via a VLE if available. The assessment is best carried out under supervised conditions so that the authenticity of the candidates work is assured.

Outcome 4 is the most practical of the three assessments and should be carried out under open-book conditions. However, to assure the authenticity of the work it must be supervised.

Opportunities for 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 Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

This unit while not specifically certifying Core Skills will have some of them signposted. The clearest example of this is *Numeracy*, but *Problem Solving* may also be signposted and depending on delivery methods the learner may also gain some skills in *Working with Others* SCQF level 5.

History of changes to unit

Version	Description of change	Date

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.

General information for learners

Unit title: Computer Systems and Organisation

This unit is designed to help you get a good understanding of the internal workings or a computer system, how it communicates, its main components and concepts.
On completion of this unit you should be able to:

1 Describe the organisation of computer systems.
2 Explain the internal representation of text, numbers and images.
3 Explain how the central processing unit executes instructions.
4 Analyse an assembly language program.

In Outcome 1 you will learn the main components of the computer, eg the CPU, memory, Internal buses and Registers (MAR, MDR). This outcome will also look at machine code and its uses. You will gain insight in to how a simple programme works and how it can be configured for different uses.

In Outcome 2 you will learn about numerical systems and how to convert between bases. You will also gain understanding in why computers use certain numerical systems and not others. This outcome also considers data storage and internal representation of text, numbers and images.

In Outcome 3 you will look at the architecture of the CPU and how the CPU executes instructions. This outcome also looks at the use of Boolean algebra.

In Outcome 4 you will analyse assembly language programs, using machine code and instruction sets. You will also investigate various types of assemblers.

The assessments in this unit will be both closed and open-book and most will be conducted under supervised conditions.