Higher National Unit specification

General information

Unit title: Physical Computing Practice and Development (SCQF level 8)

Unit code: HF84 35

Superclass: CB

Publication date: July 2016

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

This Unit is suitable for learners who wish to gain the skills and knowledge necessary for the practical development of embedded processor systems. The Unit will provide learners with the underpinning software development skills necessary for the development of embedded processor system applications. Learners will design, implement and test a working application. The Unit will also cover the use of wiring diagram software and integrated design environments for application development.

The Unit is intended for learners who will be working in the design, software development, or implementation of embedded processor systems used in the field of physical computing.

This Unit will be useful for learners studying Units that form part of HNC Digital Design and Web Development, HND Digital Design and Development and HND Web Development. This Unit forms a useful preparation for learners going on to further study in the field of physical computing.

Outcomes

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

1 Describe the components, uses of and design processes of embedded processor system applications.
2 Write program code for an embedded processor system application.
3 Design, implement and test an embedded processor system application.

Higher National Unit specification: General information (cont)

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Credit points and level

1 Higher National Unit credit at SCQF level 8: (8 SCQF credit points at SCQF level 8)

Recommended entry to the Unit

While entry is at the discretion of the centre, it is recommended that learners should have relevant work experience or studied relevant SCQF level 7 Units, for example HF3G 34 *Physical Computing Fundamentals.*

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill	None
Core Skill component	Critical Thinking at SCQF level 6 Planning and Organisation at SCQF level 6

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

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.

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**.

Higher 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 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 components, uses of and design processes of embedded processor system applications.

Knowledge and/or Skills

- Applications of embedded processor systems
- Embedded system hardware platforms
- Hardware components used in development of embedded processor systems
- Software used in development of embedded processor systems
- Design process of embedded processor systems

Outcome 2

Write program code for an embedded processor system application.

Knowledge and/or Skills

- Organisation of project files
- Use of data types, variables, and operators
- Use of iteration coding constructs
- Use of selection coding constructs
- Use of Functions

Outcome 3

Design, implement and test an embedded processor system application.

Knowledge and/or Skills

- Design proposal
- Wiring diagram
- Pseudocode
- Implementation of program code
- Connecting physical components
- Testing

Higher National Unit specification: Statement of standards (cont)

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Evidence Requirements for this Unit

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

The evidence for this Unit 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). Particular consideration should be given to digital formats and the use of multimedia.

The Evidence Requirements for this Unit will take two forms:

1 Evidence of cognitive competence (Knowledge and Understanding) for Outcome 1.
2 Evidence of practical competence (practical abilities) for Outcomes 2 and 3.

For Outcome 1, candidates will be required to demonstrate that they will be able to:

- describe applications of embedded processor systems — examples of common uses of systems in industry, science, and the arts.
- describe embedded system hardware platforms — examples and features of commonly used embedded processor systems.
- describe hardware components used in development of embedded processor systems - Physical parts and tools used in development, eg breadboards, electronic components.
- describe software tools used in in development of embedded processor systems — wiring diagram applications, software IDEs and programming languages used in development of systems.
- describe design process of an embedded processor system - design proposal, wiring diagrams, pseudocode, coding, implementing, testing, and transfer to manufactured PCBs (printed circuit boards).

For the practical competence in the Outcomes 2 and 3, candidates will be required to carry out the following activities based on a given brief:

- Organise project files — save and organise files; import code libraries.
- Use data types, variables, and operators — make appropriate use of constants and variables, eg integer, float, array. Use operators eg multiplication, division.
- Use iteration coding constructs — make appropriate use of for loops, while loops, or do while loops.
- Use selection coding constructs — make appropriate use of if, if else, or switch statements.

- Use Functions — make appropriate use of setup() and loop(), other built-in functions, user-defined functions, and parameter passing.
- Produce a design proposal for an appropriate embedded processor system application — a brief description (written or oral format) explaining purpose of application.
- Produce a wiring diagram to satisfy requirements for an embedded processor system application — a prototype wiring diagram for the application.
- Produce pseudocode for an embedded processor system application — a pseudocode listing outlining program structure.
- Implement program code to run an embedded processor system application — a listing of program code showing appropriate use of comments and code indentation.
- Connect physical components to build an embedded processor system application — a completed log detailing work carried out in building the physical application.
- Test an embedded processor system application — a test plan and log of test results.

The programming code for the application should make significant use of the Knowledge/Skills from Outcome 2, including at least one iteration or selection construct, and include at least one user-defined function. The finished hardware application should include the use of at least one sensor and one actuator component.

It is recommended that Evidence for Outcomes 2 and 3 is gathered in the form of a single project which covers the Skills/Knowledge for both Outcomes, although this is at the discretion of centres. Outcome 1 contains Knowledge/Skills which underpin some of the practical parts of Outcomes 2 and 3. It is recommended therefore that Outcome 1 is undertaken before Outcomes 2 and 3.

Evidence for practical competence may be produced over an extended period of time under open-book conditions; but where it is generated without supervision some means of authentication must be carried out.

The Guidelines on Approaches to Assessment (see the Support Notes section of this specification) provides specific examples of instruments of assessment.

Higher National Unit Support Notes

Unit title: Physical Computing Practice and Development (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

Embedded processor systems (physical computing systems) are increasingly used in a wide range of electronic devices and interactive systems used in Science, Production and Interactive Art. This Unit is intended to further develop learners' skills in the field of physical computing. It is recommended that learners have previously studied the level 7 Unit HF3G 34 *Physical Computing Fundamentals* which covers electrical theory, hardware components and building of systems, though this is at the discretion of the centre.

While the Unit includes underlying theory it is intended that the emphasis should be on the design and software development process for an embedded processor system. There is no previous programming experience required. By the end of the Unit learners will acquire the software development skills necessary to satisfy the Evidence Requirements. It is recommended that a suitable IDE (integrated development environment) is used to aid the development process, however learners should be able to design and write the actual program code.

The Unit may also be useful for learners studying the HN level Computing, Interactive Media, or Engineering courses.

Guidance on approaches to delivery of this Unit

In Outcome 1 learners should be introduced to the wide range of actual and potential uses of embedded processor systems. This could include the use of presentations, discussions and research. They should be encouraged to explore this as an emerging technology in the context of other developments eg Internet of Things and Interactive art. Learners should explore some of the commonly used hardware platforms (eg Arduino) and hardware and tools used in development (eg breadboards, electronic components). Commonly used wiring diagram applications (eg Fritzing), software IDEs (eg Arduino IDE) and programming languages (eg C, C++) used in development of systems should be described. The typical application development cycle from design proposal, wiring diagrams, pseudocode, coding, implementing, testing, and transfer to manufactured PCBs (printed circuit boards) should be described.

Higher National Unit Support Notes (cont)

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In Outcome 2, learners should be introduced to a hardware platform and IDE (Integrated development Environment). There are a wide range of low cost embedded processor systems available, which could be used in the delivery of the Unit. At the time of writing a suitable system may be the Arduino Uno. The Arduino website (http://www.arduino.org) contains tutorials and a large amount of example projects. The latest version of the Arduino IDE can be downloaded from http://www.arduino.org/download. This IDE allows you to write scratches (small programs) and upload them to the Arduino. Suitable programming languages for the Arduino include C or C++.

For Outcome 3 learners should be encouraged to come up with an imaginative design proposal to meet the requirements of a brief which covers the Evidence Requirements. It would be advisable to introduce example projects to the learners and also to provide guidance in the development of their own ideas. For the wiring diagrams in Outcome 3 a suitable open source application at the time of writing may be Fritzing (http://fritzing.org/home/). The Fritzing website contains large amounts of tutorials and examples.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types 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.

Outcome 1

Outcome 1 could be assessed by a written report of approximately 1,000 words covering the Evidence Requirements. It is recommended that production of the report should include independent research.

Outcomes 2 and 3

For Outcomes 2 and 3 candidates should demonstrate Knowledge/Skills in the form of completed logs. As an alternative to paper-based methods, candidates could provide a digital record of evidence to demonstrate Knowledge and/or Skills. This could include digital logs and screenshots, audio and video narratives, and methods for capturing desktop activity. It is recommended that the evidence for Outcomes 2 and 3 be gathered in the form of a single project which covers the Skills/Knowledge for both Outcomes.

Higher National Unit Support Notes (cont)

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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

During the teaching and assessment of this Unit opportunities should arise for the development of the Core Skills in *Communication, Numeracy, Information and Communication Technology (ICT)*, and *Problem Solving*. Use of team work may also present opportunities for the development of *Working with Others*. In terms of broader skills, the Unit may help with the development of enterprise and employability.

This Unit has the Critical Thinking and Planning and Organising components of Problem Solving embedded in it. This means that when learners achieve the Unit, their Core Skills profile will also be updated to show they have achieved Critical Thinking at SCQF level 6 and Planning and Organising at SCQF level 6.

History of changes to Unit

Version	Description of change	Date
02	Core Skills Components Critical Thinking and Planning and Organisation at SCQF level 6 embedded.	16/11/2016

General information for learners

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This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to enable you to gain the design and software development skills necessary for the practical development of embedded processor systems. Embedded processor systems (physical computing systems) are increasingly used in a wide range of electronic devices and interactive systems used in Science, Production and Interactive Art.

By doing this Unit you will learn how to use wiring diagram software and integrated design environments for application development design. You will also learn how to write and test program code and then implement and test a working application.

While no previous knowledge of the subject is assumed, it is recommended that you should have relevant work experience or studied the relevant SCQF level 7 Unit HF3G 34 *Physical Computing Fundamentals*.

You may be required to produce a report to demonstrate your knowledge and understanding and to carry out activities on a given brief. You may be required to submit completed log books containing a design proposal, wiring diagrams, code, pseudocode listings, details of work carried out as well as a test plan and test results.

This Unit has the Critical Thinking and Planning and Organising components of Problem Solving embedded in it. This means that when you achieve the Unit, your Core Skills profile will also be updated to show you have achieved Critical Thinking at SCQF level 6 and Planning and Organising at SCQF level 6.