



Higher National Unit specification: general information

Unit title: Digital Audio Theory

Unit code: H1M5 35

Superclass: XL

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Unit purpose

This Unit is designed to give candidates a clear knowledge and understanding of the principles of digital audio theory and of the processes behind practical digital audio work. This Unit is intended primarily for candidates who are interested in pursuing a career in all aspects of sound production.

On completion of the Unit the candidate should be able to:

- 1 Describe the principles of analogue to digital conversion.
- 2 Describe the principles of digital to analogue conversion.
- 3 Describe and specify a digital audio workstation.

Recommended prior knowledge and skills

Entry to this Unit will be at the discretion of the centre. However, it is recommended that candidates should have completed the HN Unit *Sound Production Theory 2* prior to attempting this Unit.

Credit points and level

1 Higher National Unit 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 Access 1 to Doctorates.*

General information (cont)

Core Skills

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

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

Context for delivery

This is a mandatory Unit in the framework for HNC/D Sound Production. It is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The assessment exemplar for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable Instrument of Assessment. Centres wishing to develop their own assessments should refer to the assessment exemplar to ensure a comparable standard. Assessment exemplars are available on SQA's secure website.

Higher National Unit specification: statement of standards

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The sections of the Unit stating the Outcomes, Knowledge and/or Skills, and Evidence Requirements are mandatory.

Outcome 1

Describe the principles of analogue to digital conversion.

Knowledge and/or Skills

- ◆ The principles of analogue to digital conversion
- ◆ Nyquist's Theorem
- ◆ Anti-aliasing within the audio sampling process
- ◆ Sample and hold within the audio sampling process
- ◆ Dither within the audio sampling process
- ◆ Noise shaping within the dither process
- ◆ The concept of quantisation within the audio sampling process

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ describe how an analogue signal can be converted to a digital signal
- ◆ explain Nyquist's Theorem
- ◆ describe the requirement and use of an anti-aliasing filter within the audio sampling process
- ◆ explain the use of sample and hold within the audio sampling process
- ◆ explain the use of dither within the audio sampling process
- ◆ explain the use of noise shaping with reference to dither
- ◆ demonstrate an understanding of the concept of quantisation within the audio sampling process

Written and/or oral evidence must be generated for this Outcome. The assessment should be undertaken using controlled open-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Digital Audio Theory

Outcome 2

Describe the principles of digital to analogue conversion.

Knowledge and/or Skills

- ◆ The principles of digital to analogue conversion
- ◆ Oversampling
- ◆ Jitter and jitter correction
- ◆ Reconstruction filters

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ describe how a digital signal can be converted to an analogue signal
- ◆ explain the key benefits of oversampling in a DAC
- ◆ explain the cause of jitter in the sampling process
- ◆ explain how the problem of jitter can be corrected
- ◆ explain the need for a reconstruction filter subsequent to the digital to analogue converter

Written and/or oral evidence must be generated for this Outcome. The assessment should be undertaken using controlled open-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Digital Audio Theory

Outcome 3

Describe and specify a digital audio workstation.

Knowledge and/or Skills

- ◆ Computer systems and peripherals
- ◆ Workstation specification and interconnection
- ◆ Digital audio and MIDI signal paths
- ◆ Digital audio storage requirements
- ◆ The effects of different sampling rates and bit depths on audio integrity
- ◆ Digital audio processing requirements

Evidence Requirements

Candidates will need to provide evidence to demonstrate their Knowledge and/or Skills by showing that they can:

- ◆ identify computer component architecture and peripheral bus systems, with an explanation of their specification relating to the transfer of digital audio data
- ◆ specify the main components of a digital audio workstation and explain hardware interfacing and interconnection protocols
- ◆ identify the audio and MIDI signal paths for a digital audio workstation, with an explanation of their integration for music and audio production
- ◆ explain the storage requirements of digital audio data relating to industry standard sampling frequencies and bit depth resolutions
- ◆ explain the effects of different sampling rates and bit depths on audio integrity
- ◆ describe the processing requirements for digital audio signals relating to industry standard sampling frequencies, bit depth resolutions and data transfer rates

Written and/or oral evidence must be generated for this Outcome. The assessment should be undertaken using controlled open-book conditions.

Each candidate will need evidence to show that they can, with reference to digital audio workstations, provide an accurate and clear explanation of system types, system functions and system specifications relating to industry standards and requirements.

Higher National Unit specification: support notes

Unit title: Digital Audio Theory

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 is intended to give candidates knowledge of the principles of digital audio theory and of the processes behind practical digital audio work. Some essential knowledge is required, and this is covered in the HN Unit *Sound Production Theory 2*. It is recommended that the HN Unit *Sound Production Theory 2* be completed prior to this Unit.

Outcome 1 — looks at the analogue to digital conversion. Specifically, it covers Nyquist's Theorem; the quantisation process; the effects of varying bit depths on audio integrity; the use of sample and hold for digitising an analogue signal; calculations of signal to noise ratio in digital systems; and the effect of varying sample rates on audio integrity. So that candidates are able to relate the included theoretical concepts to practical applications, there should be a focus on how changes in digital performance and specification will influence audio quality.

Outcome 2 — looks at how digital signals are restored to analogue form. It also addresses the issues of oversampling and timing errors in the form of jitter. The need for a low pass filter after the conversion should be looked at and how this reconstructs the stepped, sampled signal into a smooth, continuous wave. So that candidates are able to relate the included theoretical concepts to practical applications, there should be a focus on how changes in digital performance and specification will influence audio quality.

Outcome 3 — introduces the candidate to computer systems and peripherals where the digital audio theory is applied. This could cover storage drive, memory, central processing unit, data buses, and external interface buses. Candidates should understand how, when combined, DAW manufacturer software, ADDA interface converters, components and their interconnection facilitate the transfer and processing of digital audio and MIDI signal data. The specification of hard disk storage devices, data transfer rates, DSP/memory processing power versus audio track count should be related to industry standard sampling frequencies and bit depth resolutions.

Guidance on the delivery of this Unit

This Unit is part of the Sound Production framework at SCQF level 8. It provides the core competencies and skills relevant to a candidate working with digital audio.

As such, it is recommended that it is delivered as early as possible in the year as it provides underpinning knowledge the candidate will require for practical Units within the framework.

Higher National Unit specification: support notes (cont)

Unit title: Digital Audio Theory

Guidance on the assessment of this Unit

This Unit has been developed as a mandatory Unit within the HND Sound Production framework. This is a theoretical Unit and it will complement the HN Unit *Digital Audio Workstations 2* and give the candidate a greater knowledge of the processes covered in that Unit. It is recommended that the three Outcomes are assessed individually and in sequence. The assessments are designed to test the candidate's retained knowledge and understanding of digital audio theory and its practical application within DAW work.

Assessment Guidelines

Outcome 1

Outcome 1 — could be assessed through responses relating to a specific brief, case study or scenario.

Candidates' responses may be supported by graphical evidence which accurately describes the process of converting an analogue signal into the digital domain.

Should there be any ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Outcome 2

Outcome 2 — could be assessed through responses relating to a specific brief, case study or scenario.

Candidates' responses may be supported by graphical evidence which accurately describes the process of converting a digital signal into the analogue domain.

Should there be any ambiguity regarding a candidate's response, oral questioning may be used to eliminate any doubt as to the candidate's understanding. The lecturer should note questions and responses.

Outcome 3

Outcome 3 — could be assessed by either:

- ◆ a written report
- ◆ an oral presentation
- ◆ answering questions based on given information
- ◆ a personal research project

Oral presentations should be recorded on a high quality format and kept as evidence for external verification.

Higher National Unit specification: support notes (cont)

Unit title: Digital Audio Theory

Online and Distance Learning

This Unit could be delivered by open or distance learning; however, it would require planning by the centre to ensure the sufficiency and authenticity of candidate evidence. Arrangements would have to be made to ensure that the assessments are delivered in an appropriate manner.

Opportunities for developing Core Skills

There should be opportunities throughout this Unit to develop aspects of the Core Skill of *Numeracy*.

Candidates will produce written and/or oral evidence for each Outcome which provides opportunities to develop aspects of the Core Skill of *Communication*.

Outcome 3 offers good opportunities to develop aspects of the Core Skill of *Information and Communication Technology*.

Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

History of changes to Unit

Version	Description of change	Date
02	Statement on sampling removed from Statement of Standards.	08/01/13

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General information for candidates

Unit title: Digital Audio Theory

This Unit is designed to give you a detailed understanding of digital audio theory. It is primarily intended to enable you to understand the processes behind the digital audio systems you use.

On completion of this Unit you will be able to:

- 1 Describe the principles of analogue to digital conversion.
- 2 Describe the principles of digital to analogue conversion.
- 3 Describe and specify a digital audio workstation.

The Unit will develop your understanding of how the changes in the digital specifications of a system or device will impact on the audio quality. For example, how changing the bit depth of samples influences the audio quality and the reasons for this.

Although much of the Unit is conceptual, Outcome 3 provides the opportunity to investigate and discuss actual digital audio devices and systems to see how the concepts relate to the audio quality of these devices and systems.

In order to complete this Unit, you will be required to achieve a satisfactory level of performance in all three Outcomes. For assessments 1 and 2, you will be required to prepare answers to two assessments under controlled open-book conditions, supporting your answers with diagrams where applicable. For assessment 3, you are required to demonstrate your knowledge of a digital audio workstation by describing and specifying relevant components.