

Higher National Unit Specification

General information for centres

Unit title: Audio Electronics 1

Unit code: DJ1X 34

Unit purpose: The purpose of this Unit is to introduce candidates to electronic concepts that impact on the operation and performance of audio equipment. The unit will consider both analogue and digital electronics, and, although the unit is predominantly theoretical, candidates will be encouraged to relate these theories to practical situations so that they can gain an understanding of the key issues that effect equipment performance and that ultimately effect the quality of audio reproduction and processing. This unit is intended for those candidates taking the HNC/D Sound Production but can also be taken on a stand-alone basis.

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

1. Apply basic signal theory and basic signal transmission theory to an audio system.
2. Define the operation of audio transducers.
3. Specify the requirements for basic analogue audio signal processing.
4. Investigate the use of dc power supplies in audio systems.
5. Describe the operation of a simple, generalised digital audio system.

Credit points and level: 2 HN Credits at SCQF level 7 (16 SCQF credit points at SCQF level 7*)

**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.*

Recommended prior knowledge and skills: Although not essential, it would be beneficial for candidates to have an understanding of some technology related principles. This could be evidenced by the achievement of electronics or physics units at SCQF level 5 or 6. Candidates should have good communications skills. These may be evidenced by the achievement of core skills Communications at Higher Level or by possession of a suitable NQ Communications Unit (SCQF level 5/6).

Core skills: There may be opportunities to gather evidence towards core skills in this Unit e.g. Communication and Problem Solving, although there is no automatic certification of core skills or core skills components.

General information for centres (cont)

Context for delivery: This is an optional Unit in the frameworks for HNC/D Sound Production Group Awards. 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: The unit deals mostly with subject matter that is theoretical in nature. However, the purpose of the unit is to improve the candidates' practical ability in the core areas of the award, and, as a consequence, assessment should be used as a vehicle for allowing candidates to relate the theory to practical situations.

Although each outcome can be assessed individually, there is opportunity to combine all outcomes into a large project.

Outcome 1 is assessed by a written graphical exercise, and this can be conducted as project work that candidates can work on within or out with the class.

For Outcome 2, there is an opportunity for candidates to make a 'how it works' type guide which is typically found in Internet pages. Again, there should be the inclusion of appropriate diagrams and equations that relate to the Evidence Requirements. Again, this can be carried out as project work.

Outcome 3 relates to the typical processes found in mixing desks and pre-amplifiers, and, as much of the support literature that accompanies such devices in the form of block diagrams, candidates should be encouraged to approach the assessment with reference to this type of data. Again, this can be carried out as project work.

Outcome 4 relates to an area which has a number of practical implications. Assessment should allow candidates to focus the theory and principles on real life situations. Again, this can be carried out as project work.

Outcome 5 can be integrated with other outcomes from this unit, but centres should be aware that the content is extensive and complex. Written/graphical work is required from candidates, and this can be carried out as project work.

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.

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 basic signal theory and basic signal transmission theory to an audio system.

Knowledge and/or skills

- ◆ The properties of a periodic wave.
- ◆ The constituent parts of a complex wave.
- ◆ The principles of instantaneous and Root Mean Square (RMS) signal values.
- ◆ Expressing signals as decibel values, values, and the conversion from one form to another.
- ◆ The conditions for maximum voltage, maximum current and maximum power transfer.
- ◆ The comparison of unbalanced and balanced circuits and conversion requirements.

Evidence requirements

The candidate will need written/graphical evidence to demonstrate their knowledge and/or skills by showing that s/he can:

- ◆ define the key features of a periodic wave that determine its audio characteristics
- ◆ describe the constituent parts of a complex wave
- ◆ define the conditions for expressing an audio signal in dBm, dBu, dBv and dBW units
- ◆ define the procedure for converting between dB units, i.e from dBm to dBu and so on
- ◆ define the interface conditions for giving for maximum voltage, maximum current and maximum power transfer
- ◆ illustrate the conversion of a non-balanced audio signal to a balanced signal
- ◆ compare the performance of a non-balanced circuit with a balanced circuit.

The evidence for this outcome should be in written/graphical form and should make reference to the interconnection of audio devices. Candidates will be expected to produce evidence that includes simple circuit diagrams for transfer conditions and formulae for dB conversion. Assessment can be carried out as an open book project which is generated in response to a case study or brief.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 1

Assessment guidelines

Although the assessment features subject matter which is predominantly theoretical, effort should be made to relate this theory to a practical context. Although there exists the possibility of combining this outcome with others from the unit, consideration should be given to the capacity of candidates to complete sizeable exercises.

Should there be 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

Define the operation of audio transducers.

Knowledge and/or skills

- ◆ Principles of converting an audio signal to an electrical signal using an electromagnetic mechanism.
- ◆ Principles of converting an audio signal to an electrical signal using an electrostatic mechanism.
- ◆ Principles of converting an electrical signal to an audio signal using an electromagnetic mechanism.
- ◆ The role and structure of the component parts of dynamic and electrostatic microphones.
- ◆ The role and structure of the component parts of dynamic speakers.

Evidence requirements

The candidate will need written and diagrammatical evidence to demonstrate their knowledge and/or skills by showing that s/he can:

- ◆ illustrate the construction of a dynamic microphone
- ◆ describe the electromagnetic principles that allow audio to electrical signal conversion
- ◆ illustrate the construction of an electrostatic microphone
- ◆ describe the electrostatic principles that allow audio to electrical signal conversion
- ◆ illustrate the construction of a dynamic speaker
- ◆ describe the electromagnetic principles that allow electrical to audio signal conversion.

Candidates are required to produce a 'how it works' guide showing the construction and operation of a dynamic microphone, a capacitor microphone and a dynamic speaker. The guide should extend to including the basic equations that show how the energy conversions take place. Candidates should be given a clear brief for this assessment. The assessment can be carried out as an open book project.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 1

Assessment guidelines

Although this outcome features much that is theoretical, assessment exercises should allow the principles to be related to practice by reference to real audio systems and devices.

Should there be 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

Specify the requirements for basic analogue audio signal processing.

Knowledge and/or skills

- ◆ The design features and operation of gain circuits.
- ◆ The design features and operation of equalisation circuits.
- ◆ The design features and operation of signal summation circuits.

Evidence requirements

The candidate will need written/graphical evidence to demonstrate his/her knowledge and/or skills by showing that s/he can:

- ◆ describe the operation of a small signal amplifier
- ◆ describe the significance of the gain/bandwidth characteristic
- ◆ specify the procedure for expressing voltage gain as a decibel figure
- ◆ describe the operation of filter circuits used in audio equalisers
- ◆ interpret frequency response curves for three band tone controls, parametric equalisers and parametric equalisers
- ◆ describe the operation of a summing amplifier.

Candidates will be expected to provide written and graphical evidence to demonstrate that they can specify, with reference to a circuit diagram for a small signal amplifier, a tone control and a summing amplifier, the requirements for analogue audio processes. As in previous outcomes, there should be opportunity to relate the featured theoretical content to practical applications.

The assessment of this Outcome will be open book and can be carried out as project work. Candidates should be given a clear brief for this assessment.

Assessment guidelines

As in previous outcomes, there should be opportunity to relate the featured theoretical content to practical applications.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 1

Should there be 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 4

Investigate the use of dc power supplies in audio systems.

Knowledge and/or skills

- ◆ The role of transformers.
- ◆ The need for full wave rectification.
- ◆ The role of smoothing circuits.
- ◆ The need for voltage stabilisation.
- ◆ Identification of common fault conditions.
- ◆ Exceptions for power amplification power supplies.

Evidence requirements

The candidate will need written and diagrammatical evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ submit a short report that includes a block diagram of a DC power supply, including transformation, rectification, smoothing and voltage stabilisation
- ◆ describe the role and operation of each stage
- ◆ identify and describe how to overcome common short-circuit and open-circuit faults that occur in power supplies
- ◆ describe key features in the design of supplies for power amplification

The assessment of this Outcome will be open book and can be carried out as project work. Candidates should be given a clear brief for this assessment.

Assessment Guidelines

Although, like the previous outcomes, there is a fair amount of theoretical content, candidates should appreciate the practical implications of this theory since a significant percentage of equipment stems from power supply faults.

Should there be 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.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 1

Outcome 5

Describe the operation of a simple, generalised digital audio system.

Knowledge and/or skills

- ◆ The method of representing continuous waveforms as digital words.
- ◆ The need for a sample and hold facility.
- ◆ Relating analogue dither to audio performance figures.
- ◆ Relating sample rate and sample resolution to audio performance figures.
- ◆ Analogue to digital conversion methods.
- ◆ The need for primary and secondary storage.
- ◆ Digital to analogue conversion methods.
- ◆ The need for a reconstruction filter.

Evidence requirements

Candidates will need written/oral evidence, accompanied by a block diagram of a generalised digital audio system, to demonstrate their knowledge and/or skills by showing that they can:

- ◆ describe of representing an analogue waveform in digital format
- ◆ describe, with the inclusion of a block diagram, the operation of a sample and hold circuit and why it is required
- ◆ describe the effect that chosen sample rates have on audio performance figures
- ◆ describe the effect that chosen sample rates have on system components
- ◆ describe the effect that chosen sample resolutions have on audio performance figures
- ◆ describe the effect that chosen sample resolutions have on system components
- ◆ compare two of analogue to digital conversion methods, including block diagrams of each method
- ◆ describe the role and types of primary and secondary storage formats
- ◆ describe the operation of a digital to analogue converter
- ◆ describe the operation of a reconstruction filter.

The assessment of this Outcome will be open book and can be carried out as project work. Candidates should be given a clear brief for this assessment.

Assessment Guidelines

This assessment can be carried out in open book format, and the focus should be on candidates relating the contained theory to the performance of audio equipment. In particular, candidates should show that they understand the implications that varying sample rates and sample resolution have on audio performance.

Higher National Unit specification: statement of standards (cont)

Unit title: Audio Electronics 1

Should there be 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.

Administrative Information

Unit code:	DJ1X 34
Unit title:	Audio Electronics 1
Superclass category:	XL
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Higher National Unit specification: support notes

Unit title: Audio Electronics 1

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 80 hours.

Guidance on the content and context for this Unit

This unit introduces candidates to a range of concepts that relate to the operation of a number of audio devices. It is expected that, having taken this unit, candidates will have a more than superficial understanding of audio devices, but will have an understanding of the electronics processes involved and the mathematical formulae that model these processes.

Although the content deals largely with principles and processes, the learning context for these could feature a number of practical demonstrations and practical exercises to underpin the learning. It is likely that candidates would benefit from using a virtual electronic workbench tool to experiment with the circuits involved in each outcome.

In Outcome 1, candidates should consider the voltage division and current division equations to adequately explain the transfer of signals from one device to another. A virtual environment would be a useful learning tool as the subject matter may be well be vague for inexperienced candidates.

In Outcome 2, candidates would benefit from practical experimentation that would show clearly the operation of electromagnetic and electrostatic fields. It is expected that candidates would be introduced to such as equations $e = N(d\phi/dt)$; $C = (\epsilon_r \cdot \epsilon_0 \cdot A)/d$ and $Q = C \cdot V$ to explain the operation of the transducers involved. Again, a virtual environment would allow candidates to manipulate circuit values to see the resulting effects on signal output.

In Outcome 3, candidates will be introduced small signal amplifiers and filters. A range of practical exercises would assist candidates in understanding the nature of gain and frequency dependant gain in filters. Filter types should be restricted to 1st order, but should extend to state variable types to demonstrate the operation of the equaliser types listed in the outcome statement. The types of diagrams that candidates should be introduced will extend beyond

block diagrams to circuit diagrams, with candidates appreciating the component values which determine gain and frequency characteristics.

Outcome 4 deals with issues which have mains power involved. So that full experimentation can be carried out safely, a virtual environment could be used. Candidates should have a clear understanding of the role of each stage in the power supply. In practical situations, power supply faults are very common, so the teaching approach should consider the practical implications of fault finding construction.

Higher National Unit specification: support notes (cont.)

Unit title: Audio Electronics 1

Outcome 5 introduces candidates to digital audio. It is not unusual for candidates to find the understanding of the principles involved rather difficult, so it is advised that centres allocate sufficient time for this outcome. Although it largely involves conceptual material, centres are encouraged to include as much practical demonstration and experimentation as possible. Candidates should be encouraged to relate technical specification to audio performance, e.g consider the affect sample rate has on bandwidth and harmonic distortion, and the affect sample resolution has on dynamic range.

Guidance on the delivery and assessment of this Unit

While this unit may be delivered as a ‘stand alone’ unit, it is envisaged that it will form an integral part of the HNC/D Sound Production award and as such be taught in the context of the subject. It is likely that the teaching approach that would me most effective is a well conceived mix of lectures, tutorials, practical demonstration and practical exercises.

Although this is an electronics unit, the context is as important to the likely client group as the basis principles. Consequently, it is strongly recommended that the audio context remains centre stage throughout. This can be achieved by constant reference to how the principles relate to specific audio equipment and processes.

Much of the assessment will be in written/graphical form, but centres should consider presenting the exercises in more imaginative ways rather than just written exercises. For example, candidates can be asked to produce materials like Users’ Guides, How It Works articles, Interactive Web Pages etc.

Open learning

This Unit could be delivered by open or distance learning. Appropriate steps should be taken to ensure that assessment is carried out in a supervised environment and under controlled conditions, and that the evidence generated by the candidate is authentic.

For further information and advice please refer to *Assessment and Quality Assurance for Open and Distance Learning (SQA, February 2001 – publication code A1030)*.

Candidates with additional support needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support 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 Arrangements for Candidates with Additional Support Needs (BA 2399, SQA, due 2004)*.

General information for candidates

Unit title: Audio Electronics 1

This unit is designed to give provide you with a fuller understanding of the operation of a range of audio devices and systems. Much of the content of the unit is theoretical but you are encouraged to make every attempt to relate the information learned to practical situations in other units of the programme.

In Outcome 1, you will be introduced to important concepts which relate to the raw material that is processed in devices and systems – audio signals. This will have relevance not just to this unit, but to virtually every other unit in the programme. At this point you will work with the ‘decibel’ – a very misunderstood and misused unit in sound production circles.

In Outcome 2, you will consider the main input and output devices in audio systems. Audio transducers are most commonly microphones and speakers, and this outcome will introduce you to how these work and how they are constructed. You will, then, be expected to have an understanding of how they are built and mathematical formulae that model their operation.

In Outcome 3, you will be introduced to some simple audio processing, typically found in mixing desks, guitar amplifiers and pre-amplifiers. It is intended that, having completed this outcome, you will have a fuller understanding of how these processors work, and so be able to use them more effectively and be more versatile as a sound operator. There will be further mathematical formulae introduced to you in this outcome, but it is basic and will further clarify the design and operation of such processors as pre-amps, tone controls and graphic and parametric equalisers..

In Outcome 4, you will be introduced to an area which causes more equipment problems than any other single area, particularly in live performance. Power supplies are used for virtually every audio device and are essential for their proper operation. It is intended that, by completing this outcome, you will have a greater understanding of how power supplies work, and so be in a better position to take remedial action in the event of a power supply failure.

Much of the discussion that centres around digital audio is either mythical or ill informed. In Outcome 5, you will be introduced to the key concepts that relate to digital audio performance. The emphasis in this outcome will be on encouraging you to consider how technical specification like sample rate and sample resolution impact to the audio quality measures like bandwidth, harmonic distortion and dynamic range.