Higher National Unit Specification

General information for centres

Unit title: Instrumental Techniques: Theory and Practice 1

Unit code: DH54 35

Unit purpose: This unit is designed to develop knowledge and understanding of a range of instruments used in analytical laboratories and the practical skills required to use these instruments. This unit is suitable for candidates who are studying at HN level in a science based award.

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

1. Select the appropriate method for a particular analysis.
2. Describe the function and method of operation of a range of analytical instruments.
3. Perform experiments using a range of analytical instruments.

Credit value: 1 HN 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.*

Recommended prior knowledge and skills: Access to this unit will be at the discretion of the centre however it would be an advantage if the student had prior experience of working in a science laboratory.

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

Context for delivery: This unit is intended to be part of the framework for the group awards at HN level in a science related discipline. It is recommended that it should be taught and assessed within the subject area of the particular group award to which it contributes.

Assessment: Outcomes 1 and 2 will be assessed using a single case study which addresses the types of instrumentation available and the main types of analyses carried out on these instruments. The case study will also cover instrument design with the candidate required to show an understanding of the main components and their function for at least two instruments. Outcome 3 will be assessed using four practical exercises selected from those suggested in the support notes. The four selected for assessment should be a representative sample from the range of techniques covered in the unit.

Higher National Unit specification: statement of standards

Unit title: Instrumental Techniques: Theory and Practice 1

Unit code: DH54 35

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

Select the appropriate method for a particular analysis

Knowledge and/or skills

- Purpose of the analysis
- Range of options available
- Method to be used
- Choice made

Evidence requirements

The candidate should be presented with two analytical problems where they have to decide on the method to be employed by the technician in the laboratory. The case studies ideally should have more than one possible answer in that a range of techniques could be used. The candidate will then have to evaluate which is the most appropriate and justify that choice.

Assessment guidelines

The assessment of outcomes 1 and 2 is by completion of a case study/assignment. Candidates will be encouraged to access various sources of information before submitting their answers. Two analytical problems will be presented. For each one, the candidate will identify the purpose of the analysis, consider the range of options available before deciding on the most appropriate method to use. The analytical problems presented should be such that more than one method is feasible allowing the candidate to evaluate, which is the most appropriate method and then justifying their choice. The nature of the two analytical problems presented should be sufficiently different that two techniques are chosen have to be described in the answer. This assignment will also be used to assess outcome 2. The pass mark for this assignment will be 60%.

Higher National Unit specification: statement of standards (cont)

Unit title: Instrumental Techniques: Theory and Practice 1

Outcome 2

Describe the function and method of operation of a range of analytical instruments

Knowledge and/or skills

- Qualitative and quantitative analysis
- Types of analysis performed on a range of analytical instruments
- Instrument design and the types of components involved
- Key components and the range of options available
- Methods of optimising the instrument performance

Evidence requirements

The evidence for this outcome will be gathered using the same case studies referred to in outcome 1. The candidate will be asked to describe the main features of the instrument chosen as most suitable for the analysis to be carried out.

Assessment guidelines

The assessment of outcomes 1 and 2 is by completion of a case study/assignment. Candidates will be encouraged to access various sources of information before submitting their answers. Two analytical problems will be presented. Once the candidate has selected the method of analysis, most appropriate for the problems set they should, for each one, describe the instrument chosen. This description should discuss the instrument design and the function of the main components. They should show that they are aware of the range of options available and that they know which components are key to producing the best analytical results. The pass mark for this assignment will be 60%.

Outcome 3

Perform experiments using a range of analytical instruments

Knowledge and/or skills

- Prepare the instrument for the required analysis
- Calibrate the instrument
- Work in a safe manner in line with current Health and Safety practices
- accurate results
- Report the results clearly and concisely

Higher National Unit specification: statement of standards (cont)

Unit title: Instrumental Techniques: Theory and Practice 1

Evidence requirements

Evidence for this outcome will be provided by the candidate performing a range of practical assignments from those suggested in the support notes. For example candidates could be asked to 'determine the saccharin(or caffeine) content of soft drinks using HPLC' or they could 'compare the sodium and potassium content of bottled and tap water using atomic and emission spectroscopy', candidates should be assessed on both their performance in completing the laboratory work and on their ability to produce satisfactory laboratory reports.

Assessment guidelines

It is recommended that the candidates should perform at least 8 practical assignments, 4 of which should be used for assessment purposes. It would be expected that the practicals would each involve 2-3 hours of laboratory time. The practicals selected should cover a number of different instruments, for example spectroscopy and chromatography should be covered. Similarly those used for assessment purposes should be a representative sample from the techniques listed in the support notes. This will allow an overall assessment to the candidates' practical ability to be obtained. It is recognised that centres will have to select the techniques, based on the instruments available. It is suggested that the lecturer uses a checklist to assess the candidate's performance in the laboratory. This checklist should recognise the need for accuracy in analytical work. A laboratory report should also be produced to assess the candidate's ability to plan, analyse and discuss analytical work. A candidate will achieve a pass if they successfully carry out analyses on 4 different instruments. Results should be to an acceptable degree of accuracy and reported in a clear concise manner. Should a candidate fail to submit 4 reports or if they are not of the required standard remediation should be offered and the reports re-submitted.

Administrative Information

Unit code: DH54 35

Unit title: Instrumental Techniques: Theory and Practice 1

Superclass category: RA

Date of publication: August 2004

Version: 01

Source: SQA

Higher National Unit specification: support notes

Unit title: Instrumental Techniques: Theory and Practice 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 40 hours.

Guidance on the content and context for this Unit

This unit is intended to be part of the HND science framework. It should be suitable for inclusion in all science HNC/HND awards. The aim is to give candidates the underpinning theoretical and practical knowledge of a range of instrumental techniques to allow them to operate efficiently as a technician. The nature of this unit should allow integration with other units from the group award, with practical exercises being drawn from some of the more theoretical units in the course.

Outcome 1 and 2

Candidates should be introduced to a range of instrumental techniques. It is expected that the design of spectrometers and chromatography instruments form the main part of this unit. The actual instruments discussed should be appropriate to the HN Group award. For example it would be expected that HN Chemistry students would cover more on spectroscopy, while HN Biotechnology would focus more on separation techniques.

Typical instruments that could be discussed are Atomic Absorption, Atomic emission, UV/Vis, Infra-Red, NMR, GLC, HPLC, Electrophoresis, PCR. Students should become familiar with the types of analyses performed on the various instruments, the overall design and the mode of operation of the main components.

Outcome 3

Given the vocational nature of the HN awards this outcome is crucial to the unit. Students should be given every opportunity to gain experience in operating a wide range of instruments. Wherever possible, students should set the instruments from the beginning, switching them on, calibrating them, programming in the method and obtaining the required results.

On completing the unit students should feel confident that they could move into a laboratory position and be able to carry out a range of routine analyses.

As stated above the range of practical exercises carried out should reflect the HN award being undertaken. Typical techniques are listed above. This should not be seen as an exhaustive list and lecturers should feel free to vary the techniques as appropriate. The emphasis should be on instrumentation. It would not be appropriate to introduce practical work, which did not use some kind of instrumental technique.

Higher National Unit specification: support notes (cont)

Unit title: Instrumental Techniques: Theory and Practice 1

Guidance on the delivery and assessment of this Unit

This unit is likely to form part of a group award, which is primarily designed to prepare candidates for employment in a science related post. The emphasis should be on encouraging the students to become familiar with a wide range of analytical techniques. They should become aware of the range of techniques available and be able to select an appropriate method for a particular analysis. In addition they should produce results to the required degree of accuracy and adhere to the safety standards.

Outcomes 1 and 2 will be assessed using a case study, which requires the candidate to decide on a particular analytical method having been given a set analytical problem. The candidate should also be able describe the instrument design and the functions of the main components.

In outcome 3 candidates will complete 4 assessed practicals from the range carried out during the unit. A combination of observation checklist and a written laboratory report should be used to assess the work.

Laboratory reports should be clear and concise, with all results and calculations reported. Candidates should discuss the results in terms of their accuracy and reliability, taking into account inherent experimental errors.

Should a candidate fail to carry out four experiments to the required standard, further attempts can be offered. Ideally candidates will be participating in many experiments, with only 4 required for assessment purposes.

This unit could be integrated with Fundamental chemistry: Theory and Practice, DNA structure and function or DNA molecular techniques: theory and practice for the practical outcomes.

Open learning

While it may be possible to deliver some of the material on instrument design by open learning, it is anticipated that candidates would have to attend classes to cover outcome 3. If a candidate is employed in a laboratory based job then this practical work may well be part of their role. In such circumstances observation could take place in the workplace, and the appropriate laboratory report submitted to the college.

For further information and guidance, please see Assessment and Quality Assurance of Open and Distance Learning *(SQA, February 2001, publication code A1030).*

Higher National Unit specification: support notes (cont)

Unit title: Instrumental Techniques: Theory and Practice 1

Special needs

This Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).

General information for candidates

Unit title: Instrumental Techniques: Theory and Practice 1

This is a 1 credit SQCF level 8 unit, intended to be delivered as part of an HND science qualification. It is likely to be delivered in the second year of an HND programme. It is designed to give you the basic knowledge and practical skills you will need to undertake a role as a higher-grade technician in a wide range of science based industries. The emphasis will be on introducing you to the range of modern instruments used in laboratories.

On completion of this unit you should be able to

1. Select the appropriate method for a particular analysis
2. Describe the function and method of operation of a range of analytical instruments
3. Perform experiments using a range of analytical instruments

The main component of the unit are described in more detail below:

Outcomes 1 and 2

You will be introduced to a range of analytical instruments. The actual instruments discussed will depend on the nature of your course, but will includes a selection from Atomic Absorption, Atomic Emission, UV/Vis, Infra-Red, and NMR spectrometers as well as GLC and HPLC systems.

You will be expected to become familiar with the range of analytical techniques, which can be carried out on each instrument and to use this knowledge to decide on the most appropriate method to solve a range of analytical problems. You will also be expected to know about the design of the instruments and the functions of the main components.

The assessment for outcomes 1 and 2 is by completion of a case study/assignment of which there is a 60% pass mark.

Outcome 3

In this outcome you will be shown how to set up and operate a range of analytical instruments. You will carry out several practical exercises covering both spectroscopy and chromatography techniques. The emphasis will be on your ability to operate the instruments independently with a need to obtain satisfactory results from the experiment.