

Higher National Unit Specification

General information for centres

Unit title: Analytical Methods

Unit code: DP0X 34

Unit purpose: This unit provides the candidate with the fundamental mathematical knowledge and analytical techniques needed to successfully complete the core and specialist optional units in this qualification. This unit has been designed to enable candidates to use fundamental mathematical processes in the solution of Building Services Engineering problems.

It is also intended as a **base** for further study of analytical methods and mathematics needed for candidates progressing to degree qualifications.

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

- ◆ Apply **analytical methods to the management and production** of building services installation processes and operations
- ◆ Apply **analytical methods to surveying, testing and control problems** in building services engineering process
- ◆ Analyse and solve problems using **statistics and probability**.
- ◆ Apply **analytical methods to analyse building services engineering systems** and provide appropriate solutions

Credit points and level: 1 HN Credit at SCQF level 7 (8 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: It would be an advantage for candidates to have a basic understanding and knowledge of mathematical concepts and theorems. Such understanding and knowledge may be evidenced by the possession of a suitable unit at National Certificate level or SCE Standard Grade Mathematics at 1 or 2 or an equivalent level of experience.

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 was developed for the HNC in Building Services Engineering. If this Unit is delivered as part of another group award (s), it is recommended that it should be taught and assessed within the context of the group award (s) to which it contributes.

General information for centres

Assessment: It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. The assessment paper/s should be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be conducted under supervised, controlled conditions. A single assessment covering all outcomes should not exceed 2 hours in duration. It should be noted that candidates must achieve all the minimum evidence specified for each Outcome in order to pass this Unit.

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.

An exemplar instrument of assessment and marking guidelines has been produced to provide examples of evidence required to demonstrate achievement of the aims of this unit.

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.

(If you think holistic assessment is the best assessment strategy for the Unit and you wish to state *Knowledge and/or Skills* and *Evidence requirements* for the Unit as a whole, please add the following statement here: ‘Please refer to *Knowledge and/or skills for the Unit* and *Evidence requirements for the Unit* after the Outcomes.’)

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 **analytical methods to the management and production** of building services installation processes and operations

Knowledge/skills

- ◆ Algebraic equations
- ◆ Graphical representation
- ◆ Space, time and motion diagrams
- ◆ Matrices

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that, in relation to construction and building services projects, they can:

- ◆ analyse human, physical and financial resource requirements on short medium and long term criteria
- ◆ produce resource plans and compare the effectiveness and efficiency of alternative solutions
- ◆ justify the choice of a particular resource plan in quantitative and /or qualitative terms

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **three out of four** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to all three items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Higher National Unit specification: statement of standards (cont)

Unit title: Analytical Methods

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 2, 3, 4 to form a single assessment paper.

Outcome 2

Apply **analytical methods to surveying, testing and control problems** in the building services engineering process

Knowledge

- ◆ Trigonometry
- ◆ Spacial co-ordinates
- ◆ Trapezoidal and Simpsons rules

Evidence requirements

Candidates will need evidence to demonstrate their skills and/or knowledge by showing that they can:

- ◆ apply numerical and trigonometric functions to map and to determine areas and volumes of 2D and 3D regular and irregular shapes and/or
- ◆ use sinusoidal functions and radian measures to solve construction/engineering problems, and/or
- ◆ use trigonometric and hyperbolic identities to solve trigonometric equations and to simplify complex trigonometric expressions.

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1, 3, 4 to form a single assessment paper.

Higher National Unit specification: statement of standards (cont)

Unit title: Analytical Methods

Outcome 3

Analyse and solve problems using **statistics and probability**

Knowledge and/or skills

- ◆ Tabular and graphical representations
- ◆ Measures of central tendency and variance
- ◆ Determination and application of probability

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ use statistical techniques in the recording and analysis of data relating to design, manufacturing and installation of building services systems and/or
- ◆ apply probability techniques to establish risk managed criteria for design, manufacturing and installation of building services systems

Evidence for the knowledge and /or skills for this Outcome will be provided on a sample basis. In any assessment of this Outcome a minimum of **two out of three** knowledge and/or skills items should be sampled. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of knowledge/skill items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1, 2, 4 to form a single assessment paper.

Outcome 4

Apply **analytical methods to analyse building services engineering systems** and provide appropriate solutions

Knowledge and/or skills

- ◆ Trigonometry
- ◆ Calculus

Higher National Unit specification: statement of standards (cont)

Unit title: Analytical Methods

Evidence requirements

Candidates will need evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ use trigonometric functions to solve problems such as static forces, relative motion, frameworks, metrology, friction torque, electrical and mechanical energy problems, and/or
- ◆ use the principals of calculus to illustrate/solve problems appropriate to building services engineering such as differential and integral control modes, cumulative demand criteria, work done in pressure/volume processes etc.

In any assessment of this Outcome **all** knowledge and/or skills items should be included. Candidates must provide a satisfactory response to both items.

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Assessment should be conducted under closed book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Assessment guidelines

Questions used to elicit candidate evidence should take the form of an appropriate balance of short answer, restricted response and structured questions.

The assessment for this outcome might be combined with that for Outcomes 1, 2, 3 to form a single assessment paper.

Administrative Information

Unit code:	DP0X 34
Unit title:	Analytical Methods
Superclass category:	RB
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Higher National Unit specification: support notes

Unit title: Analytical Methods

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

The content comprises all the mathematics needed to achieve the outcomes. The various topic areas should be addressed as and when they are needed to analyse problems in the discipline the candidate is following. There is therefore no requirement for the content to be covered in its entirety and the content can be taken as a guide.

The opportunity to provide evidence of the achievement of a range of key skills will feature strongly in both formative and summative assessments. This unit links with the Project (Integrative Assignment), Services Project Management and the technology units in each occupational pathway.

Recommended time allocations to each outcome are given as guidance towards the depth of treatment which might be applied to each topic. This guidance has been used in the design of the assessment exemplar material provided with the unit.

1 Analytical methods to management and production (10 hours)

Algebra: linear, simultaneous and quadratic equations, laws of indices and logarithms, common and Napierian logarithms, indicial equations, direct and inverse proportion, inequalities, functional notation and manipulation of algebraic problems.

Graphical representation: functions, points of intersection between two graphs, graph sketching (straight line, polynomial, exponential and logarithmic), fit lines to experimental data using least squares method

Space, time and motion: plot space/time and velocity/time diagrams, determine displacement, velocity and acceleration. Laws of motion, momentum, impulse and projectiles

Matrices: multiplication, transposition and inversion, applications.

2 Analytical methods related to surveying, testing and control problems (10 hours)

Trigonometry: Basic trigonometric ratios and their inverses, trigonometric ratios for the four quadrants, solution of triangles, calculation of areas and volumes of solids

Determine co-ordinates: in 2-D and 3-D geometry

Other functions: trapezoidal and Simpson's rule.

Higher National Unit specification: support notes (cont)

Unit title: Analytical Methods

3 Statistics and probability (10 hours)

Tabular and graphical form: data collection methods, histograms, bar charts, line diagrams, cumulative frequency diagrams, scatter plots.

Central tendency and dispersion: introduction to the concept of central tendency and variance measurement, mean, median, mode, standard deviation, variance and interquartile range, application to building services engineering – eg weather and demand data

Probability: interpretation of probability, probabilistic models, empirical variability, events and sets, mutually exclusive events, independent events. Application to building services engineering – eg weather and demand data

4 Analytical methods to analyse structural, building, or building services engineering systems (10 hours)

Trigonometric methods: to solve problems such as static forces, relative motion, frameworks, metrology, friction torque, electrical and mechanical energy problems

Calculus: to differentiate and integrate simple equations and demonstrate applications of calculus such as differential and integral control modes, cumulative demand criteria, work done in pressure/volume processes etc.

Guidance on the delivery and assessment of this Unit

Opportunities for developing Core Skills

This unit may be delivered as a stand-alone unit, or partially integrated into other appropriate units. Centres should design a teaching process applicable to the programmes. For those parts that are to be delivered in a completely integrated way, care must be taken to provide tracking of evidence of outcomes.

The aim of this unit is to provide the **minimum** mathematical knowledge, skills and understanding to successfully complete an SQA Higher National programme of study. Some disciplines require further study of mathematics to underpin particular areas of building services engineering and this unit provides the learning that supports this progression.

The unit is a pre-requisite to the Engineering Mathematics unit that should be completed by those candidates progressing to a higher level course.

It is recommended that evidence for learning outcomes is achieved through well-planned course work, assignments and projects. Assessment may be formative and summative and both may feature as part of the process. Although assessments must be focused on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment. Integrative assignments and project work will help to link this unit with other related units.

Higher National Unit specification: support notes (cont)

Unit title: Analytical Methods

The volume of evidence required for each assessment should take into account the overall number of assessments being contemplated within this unit and the design of the overall teaching programme. In designing the assessment instrument/s, opportunities should be taken to generate appropriate evidence to contribute to the assessment of Core Skills units.

Open Learning

Given that appropriate materials exist this unit could be delivered by distance learning, which may incorporate some degree of on-line support. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessment/s were conducted under controlled, supervised conditions.

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 Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk.

General information for candidates

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On completion of the Unit you should be able to:

- ◆ Apply **analytical methods to the management and production** of building services installation processes and operations
- ◆ Apply analytical methods to **surveying, testing and control** problems in building services engineering process
- ◆ Analyse and solve problems using **statistics and probability**.
- ◆ Apply **analytical methods to analyse building services engineering systems** and provide appropriate solutions

Evidence that you can satisfy the knowledge and skill elements of this unit will be obtained by assessment in controlled, supervised conditions to which you will not be allowed to bring textbooks, handouts or notes to the assessment.