



Higher National Unit specification

General information for centres

Unit title: Mathematics for Construction Engineering

Unit code: F02P 34

Unit purpose: This Unit provides the candidate with the opportunity to acquire knowledge of a range of mathematical techniques and will develop his/her understanding of how these techniques can be applied to solve engineering problems. Candidates will also learn the value of mathematics as a method of communicating results.

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

- 1 Solve algebraic equations representing engineering problems using matrices.
- 2 Differentiate using standard functions and applications in an engineering context.
- 3 Use techniques of integration to solve problems in civil engineering.
- 4 Analyse problems using probability and statistics.

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: Candidates should have completed Mathematics for Construction or an equivalent Unit.

Core Skills: There are opportunities to develop the Core Skills of Numeracy and Problem Solving in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

Assessment: Teaching and assessment of this Unit in the context of applications in other Units is likely to assist candidate understanding and is encouraged.

It is possible to assess candidates either on an individual Outcome basis, combinations of Outcomes or by a single holistic assessment combining all Outcomes. Assessment should be conducted under supervised, controlled conditions. A single assessment covering all Outcomes should not exceed two and a half 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.

General information for centres (cont)

Where assessment is conducted separately for each Outcome a duration is stated under Evidence Requirements.

An exemplar instrument of assessment and marking guidelines have been produced to provide examples of the type of evidence required to demonstrate achievement of the aims of this Unit and to indicate the national standard of achievement at SCQF level 7.

Higher National Unit specification: statement of standards

Unit title: Mathematics for Construction Engineering

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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

Construct and solve equations representing engineering problems using matrix methods

Knowledge and/or Skills

- ◆ Add, subtract and multiply matrices
- ◆ Solve simultaneous linear equations using inverse of 2x2 matrices
- ◆ Solve problems involving 3x3 matrices using Gaussian elimination

Evidence Requirements

In any assessment of this Outcome **all** Knowledge and/or Skills items should be included.

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

- ◆ construct and solve algebraic equations representing Civil Engineering problems

Evidence for the Knowledge and/or Skills in this Outcome will be provided by an examination taken at a single assessment event lasting 60 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment. In any assessment of this Outcome all of the Knowledge and/or Skills items should be tested. Candidates should be provided with appropriate formula sheets, but should not have access to a computer algebra for this Outcome.

Assessment Guidelines

Assessment should be conducted under closed-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Mathematics for Construction Engineering

Outcome 2

Differentiation of standard functions and applications

Knowledge and/or Skills

- ◆ Differentiation of standard functions {to include ax^n , $(ax+b)^n$, $e^{(ax+b)}$ and $\ln(ax+b)$ }
- ◆ Determine the maximum and minimum values of functions in one variable
- ◆ Solve optimisation problems

Evidence Requirements

In any assessment of this Outcome **all** Knowledge and/or Skills items should be included.

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

- ◆ apply techniques of differentiation to the solution of problems encountered in Civil Engineering project work

Evidence for the Knowledge and/or Skills in this Outcome will be provided by an examination taken at a single assessment event lasting 45 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment. In any assessment of this Outcome all of the Knowledge and/or Skills items should be tested. Candidates should be provided with appropriate formula sheets, but should not have access to a computer algebra for this Outcome.

Assessment Guidelines

Assessment should be conducted under closed-book conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Mathematics for Construction Engineering

Outcome 3

Use techniques of integration to solve problems in civil engineering

Knowledge and/or Skills

- ◆ definite and indefinite integration of standard functions {to include ax^n , $(ax+b)^n$, $e^{(ax+b)}$ and $\ln(ax+b)$ }
- ◆ use integration to solve engineering problems involving section properties of irregular shapes
- ◆ use Simpson's rule for non standard functions of integration

Evidence Requirements

In any assessment of this Outcome **all** Knowledge and/or Skills items should be included.

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

- ◆ apply techniques of integration to the solution of problems encountered in Civil Engineering project work

Evidence for the Knowledge and/or Skills in this Outcome will be provided by an examination taken at a single assessment event lasting 60 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment. In any assessment of this Outcome all of the Knowledge and/or Skills items should be tested. Candidates should be provided with appropriate formula sheets, but should not have access to a computer algebra for this Outcome.

Assessment Guidelines

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Higher National Unit specification: statement of standards (cont)

Unit title: Mathematics for Construction Engineering

Outcome 4

Analyse problems using probability and statistics

Knowledge and/or skills

- ◆ Probability distributions for continuous and discrete variables (including Poisson, Binomial and Normal)
- ◆ Simple statistical quality control

Evidence Requirements

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

- ◆ apply statistical techniques to problems encountered in Civil Engineering projects

Evidence for the Knowledge and/or Skills in this Outcome will be provided by an examination taken at a single assessment event lasting 45 minutes and carried out under supervised, controlled conditions. The evidence may be presented in response to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment. In any assessment of this Outcome all of the Knowledge and/or Skills items should be tested. Candidates should be provided with appropriate formula sheets, but should not have access to a computer algebra for this Outcome.

Assessment guidelines

Assessment should be conducted under closed-book conditions.

Administrative Information

Unit code: F02P 34

Unit title: Mathematics for Construction Engineering

Superclass category: RB

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Version	Description of change	Date
02	Updated by Qualifications Support Team.	07/08/07

Source: SQA

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Higher National Unit specification: support notes

Unit title: Mathematics for Construction Engineering

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.

This Unit underpins most of the other Units in the Higher National Programme. The techniques covered also have specific application in some Units. Importantly, this Unit also provides the necessary mathematical skills to enable candidates to progress to higher studies.

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 Algebraic equations representing engineering problems (12 hours)

Construct and solve algebraic equations representing engineering problems: matrix form of simultaneous linear equations. Role of the inverse matrix. Gaussian elimination. Construct and solve model equations.

Nonlinear equations representing engineering problems: 3pts to find the equation of a circle, intersection of a parabola and line

Gaussian elimination: circle problem

2 Differentiation of standard functions and applications (8 hours)

Differentiating standard functions: negative and fractional powers, transition curves, superelevation, maximum and minimum values, rate of change, second derivatives

Location and classification of stationary points of functions of one variable.

3 Integration of standard functions and applications (12 hours)

Techniques of calculus to calculate areas and/or volumes: calculation of areas and volumes.

Engineering problems: Areas and volumes. Centroids and first and second moments of area, and radius of gyration

Non standard: Simpson's rule, trapezoidal rule

4 Probability and statistics (8 hours)

Interpret raw data represented pictorially and by means of measures of location. Identify and describe the Normal distribution for a continuous variable and its approximation for a discrete variable.

Sampling and confidence limits. Quality control charts. 5%–95% confidence, 15%–85%, 3 sigma test.

Higher National Unit specification: support notes (cont)

Unit title: Mathematics for Construction Engineering

Guidance on the delivery and assessment of this Unit

This Unit underpins many of the analytical techniques required for applications in other Units in the Higher National Programme.

Integrative assignments and project work linking the teaching and assessment of this Unit with applications in other related Units is encouraged.

Although assessments must be focused on the individual achievement of each candidate, group work and role-play activities may contribute to the assessment.

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.

Opportunities for developing Core Skills

The following grid provides a general guide to opportunities for the development of Core Skills in this Unit. Opportunities for the development of Core Skills at the output level are more fully identified in the Core Skills Signposting Guide.

Core Skill	Outcome 1	Outcome 2	Outcome 3	Outcome 4	Outcome 5
1 Communication					
Reading					
Writing					
Oral					
2 Numeracy					
Using Number	X	X	X	X	
Using Graphical Information					
3 IT					
Using Information Technology					
4 Problem Solving					
Critical Thinking	X	X	X	X	
Planning and Organising					
Reviewing and Evaluating					
5 Working with others					

Higher National Unit specification: support notes (cont)

Unit title: Mathematics for Construction Engineering

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 disabilities and/or additional support needs

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. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).

General information for candidates

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