



Advanced Higher
Course
Specification



Advanced Higher Engineering Science Course Specification (C723 77)

Valid from August 2015

This edition: April 2015, version 2.0

This specification may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged. Additional copies of this Course Specification can be downloaded from SQA's website: www.sqa.org.uk.

Please refer to the note of changes at the end of this Course Specification for details of changes from previous version (where applicable).

© Scottish Qualifications Authority 2015

Course outline

Course title: Advanced Higher Engineering Science

SCQF: level 7 (32 SCQF credit points)

Course code: C723 77

Mandatory Units

H23B 77 Electronics and Control (Advanced Higher) 8 SCQF credit points

H23D 77 Mechanisms and Structures (Advanced Higher) 8 SCQF credit points

H805 77 Engineering Project Management (Advanced Higher) 8 SCQF credit points

Course assessment 8 SCQF credit points

This Course includes eight SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course. Further information on the Course assessment is provided in the Assessment section.

Recommended entry

Entry to this Course is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- ◆ Higher Engineering Science
- ◆ Higher Mathematics

Progression

This Course or its components may provide progression to:

- ◆ degrees in Engineering and related disciplines
- ◆ a range of engineering related Higher National Diplomas (HNDs)
- ◆ careers in engineering

Further details are provided in the Rationale section.

Equality and inclusion

This Course Specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence. For further information, please refer to the *Course/Unit Support Notes* and the *Course Assessment Specification*.

Rationale

All new and revised National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide more time for learning, more focus on skills and applying learning, and scope for personalisation and choice.

In this Course, and its component Units, there will be an emphasis on skills development and the application of those skills. Assessment approaches will be proportionate, fit for purpose and will promote best practice, enabling learners to achieve the highest standards they can.

This Course provides learners with opportunities to continue to acquire and develop the attributes and capabilities of the four capacities, as well as skills for learning, skills for life and skills for work.

All Courses provide opportunities for learners to develop breadth, challenge and application, but the focus and balance of the assessment will be appropriate for the subject area.

Relationship between the Course and Curriculum for Excellence values, purposes and principles

Engineering is a broad area of human endeavour which brings together elements of technology, science and mathematics, and applies these to real-world challenges. The Course therefore provides an excellent opportunity for making links across learning in the senior phase.

The Course encourages learners to become successful, responsible and creative independent learners, and to continue to acquire and develop the attributes and capabilities of the four capacities, including: creativity, flexibility and adaptability; enthusiasm and a willingness to learn; perseverance, independence and resilience; responsibility and reliability; and confidence and enterprise.

The Course provides progression from Higher Engineering Science.

Purposes and aims of the Course

Engineering, a core STEM subject, is vital to everyday life — socially, technologically and economically; it shapes the world in which we live and its future. Engineers play key roles in meeting the needs of society today and for the future, in fields as diverse as climate change, medicine, IT, aeronautics, the oil and chemical industries, infrastructure projects, transport and many more.

Our society needs more engineers, and more young people with an informed view of engineering. The Course provides a broad and challenging exploration of engineering. Learners will deepen their understanding of core engineering disciplines – mechanisms, structures, control – but also have opportunities to choose and explore other areas of engineering, for example renewables technology, aeronautics or civil engineering. Because of its focus on developing transferable skills, it will be of value to many learners, and particularly beneficial to learners considering a career or further study in any branch of engineering.

The purpose of the Course is to build on the knowledge and understanding and practical skills developed by the learner in the Higher Engineering Science Course, and to provide a useful bridge towards further study of engineering in higher education. This is achieved by a Course which consolidates and extends learning, provides opportunity for independent and investigative work, while encouraging teamwork, and requires candidates to undertake and report on a challenging engineering project.

The aims of the Course are to enable learners to:

- ◆ extend and apply knowledge and understanding of key engineering concepts, principles and practice through independent learning
- ◆ understand and apply the relationships between engineering, mathematics and science
- ◆ develop skills in investigation and research in an engineering context
- ◆ analyse, design, construct and evaluate creative solutions to complex engineering problems
- ◆ communicate advanced engineering concepts clearly and concisely, using appropriate terminology
- ◆ develop an informed understanding of the role and impact of engineering in changing and influencing our environment and society, including ethical implications

The Course develops a number of pervasive and integrative themes, including the systems approach, energy and sustainability. These are used to explore varied engineering systems through simulation, practical projects and investigative tasks in a range of contexts.

Courses in Engineering Science and in Physics (and other pure sciences) are designed to be complementary; a combination of this Course and a pure science Course will provide a very strong foundation for further study in engineering or the sciences.

Information about typical learners who might do the Course

The Course is designed for all learners who can respond to a level of challenge, especially those considering further study or a career in engineering and related disciplines. It provides sufficient flexibility and choice to meet the needs of all learners.

The Course will suit learners who are interested in, and want to develop a deeper understanding of, the central role of engineers as designers and creative problem-solvers, able to conceive, design, implement and operate complex systems, and of the far-reaching impact of engineering on our society and the environment. Learners will also continue to develop a range of transferable skills for learning, life and work, opening up a wide range of career and study opportunities.

On completing the Course, learners will have developed strong skills in analysis and problem solving, engineering design, the use of equipment and materials, and evaluation.

Course activities also provide opportunities to enhance generic and transferable skills in planning and organising, working independently and in teams, creative problem solving, critical thinking and decision-making, research, communication, and self- and peer-evaluation, in engineering contexts.

Course structure and conditions of award

Course structure

The Course enables learners to develop and extend a range of engineering skills, including skills in analysis and problem solving, application of mathematical processes, creative design skills, and skills in evaluating products and systems.

The Course also enables learners to develop and extend knowledge and understanding of advanced engineering concepts and processes, and the ability to apply these to a variety of problems; and an awareness of the impact of engineering on society and the environment.

These skills, knowledge and awareness are developed through a range of contexts within the broad discipline of engineering, including (but not limited to) mechanical, structural, electronic and control systems.

As well as the Course assessment, the Course includes three mandatory Units. Each of these Units is designed to provide progression from related Units at Higher.

Units are statements of standards for assessment and not programmes of learning and teaching. They can be delivered in a number of ways.

Electronics and Control (Advanced Higher)

This Unit explores a range of key concepts and devices related to electronic control systems. Mathematical techniques, and skills in problem solving and evaluating, are developed through simulation and practical projects. Learners will choose and investigate an aspect of engineering related to electronic, electrical or control engineering, and apply this in practical situations.

Mechanisms and Structures (Advanced Higher)

This Unit develops a deepening mathematical understanding of mechanisms and structures. Skills in problem solving and evaluating are developed through simulation, practical projects and investigative tasks in a range of contexts. Learners will choose and investigate an aspect of engineering related to mechanical or civil engineering, and apply this in practical situations.

Engineering Project Management (Advanced Higher)

In this Unit, learners will develop knowledge and skills of project management, as it applies to an engineering project. Learners will investigate a real-world engineering project, and consider its environmental, social and ethical impact. Learners will select an appropriately challenging engineering problem, carry out research in relation to the problem, and develop a proposal for a solution to the problem. The design may be carried forward, implemented and evaluated as part of the Course assessment.

Conditions of award

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. The required Units are shown in the Course outline section. Course assessment will provide the basis for grading attainment in the Course award.

Skills, knowledge and understanding

Further information on the assessment of skills, knowledge and understanding for the Course is given in the *Course Assessment Specification*. A broad overview of the mandatory subject skills, knowledge and understanding that will be assessed in the Course is given in this section.

This covers:

- ◆ researching and investigating complex engineering problems
- ◆ designing, developing, simulating, building, testing and evaluating solutions to complex engineering problems in a range of contexts
- ◆ applying mathematical techniques to analyse and solve engineering problems
- ◆ communicating complex engineering concepts clearly and concisely, using appropriate terminology
- ◆ knowledge and understanding of the wide role and impact of engineering on society and the environment, including ethical implications
- ◆ in-depth knowledge and understanding of aspects of electronic and microcontroller-based systems, and their application
- ◆ in-depth knowledge and understanding of aspects of mechanisms and structures, and their application
- ◆ knowledge and understanding of the relevance of energy, efficiency and sustainability to complex engineering problems and solutions
- ◆ applying engineering knowledge, understanding and skills in a range of contexts
- ◆ ability to plan, manage and implement a challenging engineering project

Skills, knowledge and understanding to be included in the Course will be appropriate to the SCQF level of the Course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.sqa.org.uk/scqf).

Assessment

Information about assessment for the Course is included in the *Course Assessment Specification*, which provides full details including advice on how a learner's overall attainment for the Course will be determined.

Unit assessment

All Units are internally assessed against the requirements shown in the *Unit Specification*.

They can be assessed on a Unit-by-Unit basis or by combined assessment.

They will be assessed on a pass/fail basis within centres. SQA will provide rigorous external quality assurance, including external verification, to ensure assessment judgments are consistent and meet national standards.

The assessment of the Units in this Course will be as follows.

Electronics and Control (Advanced Higher)

For this Unit, learners will be required to provide evidence of:

- ◆ engineering and mathematical skills in the context of electronics and control systems
- ◆ knowledge and understanding of electronics and control systems
- ◆ ability to research and investigate an aspect of engineering related to electronic, electrical or control engineering

Mechanisms and Structures (Advanced Higher)

For this Unit, learners will be required to provide evidence of:

- ◆ engineering and mathematical skills in the context of mechanisms and structures
- ◆ knowledge and understanding of mechanisms and structures
- ◆ ability to research and investigate an aspect of engineering related to mechanical or civil engineering

Engineering Project Management (Advanced Higher)

For this Unit, learners will be required to provide evidence of:

- ◆ ability to research and investigate a real-world engineering project
- ◆ ability to carry out relevant research into an engineering problem, develop a design proposal to solve the problem, and produce a project plan to implement the proposal

Course assessment

Courses from National 4 to Advanced Higher include assessment of [added value](#)¹. At National 5, Higher and Advanced Higher, the added value will be assessed in the Course assessment. The added value for the Course must address the key purposes and aims of the Course, as defined in the Course rationale. It will do this by addressing one or more of breadth, challenge or application.

In the Advanced Higher Engineering Course, added value will focus on breadth, challenge and application.

The learner will draw on and apply the skills, knowledge and understanding they have developed during the Course. These will be assessed through a combination of a [project](#)² and a [question paper](#)³.

The Engineering Science project adds value by requiring challenge and application. Learners will apply knowledge and skills from the Units to implement, evaluate and report on a solution to solve a challenging engineering problem.

The question paper introduces breadth to the assessment. It requires depth of understanding and application of knowledge from the Units.

¹ Definitions can be found here: www.sqa.org.uk/sqa/58409.html

² See link above for definitions.

³ See link above for definitions.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Course. The skills that learners will be expected to improve on and develop through the Course are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Course where there are appropriate opportunities.

2 Numeracy

- 2.1 Number processes
- 2.3 Information handling

3 Health and wellbeing

- 3.1 Personal learning

4 Employability, enterprise and citizenship

- 4.2 Information and communication technology (ICT)

5 Thinking skills

- 5.3 Applying
- 5.4 Analysing and evaluating

Amplification of these skills is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work*. The level of these skills will be appropriate to the level of the Course. Further information on building in skills for learning, skills for life and skills for work for the Course is given in the *Course Support Notes*.

Administrative information

Published: April 2015 (version 2.0)

History of changes to National Course Specification

Version	Description of change	Authorised by	Date
2.0	In the 'Course structure' and 'Assessment' sections, aspects of the Engineering Project Management Unit have been re-phrased for clarification of standards. Removal of Skills for Learning, Life and Work 4.1 and 5.5.	Qualifications Development Manager	April 2015

This specification may be reproduced in whole or in part for educational purposes provided that no profit is derived from reproduction and that, if reproduced in part, the source is acknowledged. Additional copies of this specification can be downloaded from SQA's website at www.sqa.org.uk.

Note: You are advised to check SQA's website (www.sqa.org.uk) to ensure you are using the most up-to-date version of the Course Specification.

© Scottish Qualifications Authority 2015