



## Engineering Science (National 4)

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## Draft National Course Specification

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**Valid from August 2013**

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

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## Course outline

**Course title:** Engineering Science (National 4)

**SCQF:** level 4 (24 SCQF credit points)

**Course code:** to be advised

### Mandatory Units

**Engineering: Contexts and Challenges (National 4) 6 SCQF credit points**

**Electrical and Electronic Systems (National 4) 6 SCQF credit points**

**Mechanical Systems (National 4) 6 SCQF credit points**

#### Added Value Unit

**Engineering Project (National 4) 6 SCQF credit points**

This Course includes six SCQF credit points for the assessment of added value in the Added Value Unit. Further information on this Unit 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 and knowledge required by the following or by equivalent qualifications and/or experience:

- ◆ Design and Technology (Access 3) Course or relevant component Units

In terms of prior learning and experience, relevant experiences and outcomes may also provide an appropriate basis for doing this Course. Further information on relevant experiences and outcomes will be given in the *Course Support Notes*.

## **Progression**

This Course or its components may provide progression to:

- ◆ other SQA qualifications in Engineering Science or related areas
- ◆ further study, employment or training

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 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 in their use of technologies 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 mainly from craft, design, engineering and graphics experiences and outcomes. It also builds on some science experiences and outcomes, prior learning in mathematics and numeracy, and aspects of technological developments in society.

## **Purpose and aims of the Course**

Engineering is vital to everyday life; it shapes the world in which we live and its future. Engineers play key roles in meeting the needs of society in fields which include climate change, medicine, IT and transport.

Our society needs more engineers, and more young people with an informed view of engineering. The Course provides a broad introduction to 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 in engineering, or one of its many branches.

The aims of the Course are to enable learners to:

- ◆ apply knowledge and understanding of key engineering facts and ideas
- ◆ understand the relationships between engineering, mathematics and science
- ◆ apply skills in analysis, design, construction and evaluation to a range of straightforward engineering problems
- ◆ communicate engineering concepts clearly and concisely using appropriate terminology
- ◆ develop an understanding of the role and impact of engineering in changing and influencing our environment and society

The Course develops a number of pervasive and integrative themes, including information, control, 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 learners who have a general interest in engineering, as well as those considering further study or a career in engineering and related disciplines. It provides sufficient breadth, flexibility and choice to meet the needs of all learners.

Learners will develop an understanding of the far-reaching impact of engineering on our society and of the central role of engineers as designers and problem solvers, able to conceive, design, implement and operate complex systems. They will also 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 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, critical thinking and decision making, research, communication and self- and peer-evaluation, in a technological context.

## **Course structure and conditions of award**

### **Course structure**

The Course enables learners to develop a range of technological skills, including skills in analysis and problem solving, design skills, skills in the use of equipment and materials, and skills in evaluating products and systems.

The Course also enables learners to develop knowledge and understanding of key 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 mechanical, electrical and electronic systems.

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

The Course has four mandatory Units including the Added Value Unit. The first three Units listed below are designed to provide progression to the corresponding Units at National 5.

#### **Engineering: Contexts and Challenges (National 4)**

This Unit provides a broad context for the Course. Its purposes are to develop an understanding of engineering and its role and impact on our environment and society. It introduces engineering concepts by exploring a range of engineered objects, and straightforward engineering problems and solutions. This Unit also allows the learner to explore some existing and emerging technologies and challenges, and to consider implications relating to the environment, sustainable development, and ethical, economic and cultural issues.

#### **Electrical and Electronic Systems (National 4)**

This Unit explores a range of key concepts and devices used in electrical and electronic systems, including analogue, digital and programmable systems. Skills in problem solving and evaluating are developed through simulation, practical projects and investigative tasks in a range of contexts. This provides learners with a growing understanding of electrical and electronic engineering.

#### **Mechanical Systems (National 4)**

This Unit explores an appropriate range of key concepts involving mechanical systems, such as gears, pneumatics, structures, forces, energy and efficiency. Skills in problem solving and evaluating are developed through simulation, practical projects and investigative tasks in a range of contexts. This provides learners with a growing understanding of mechanical engineering.

#### **Added Value Unit: Engineering Project (National 4)**

This Unit requires the learner to apply and integrate skills and knowledge from the other Units to solve an appropriately challenging engineering problem.

## **Conditions of award**

To achieve the Engineering Science (National 4) Course, learners must pass all of the required Units, including the Added Value Unit. The required Units are shown in the Course outline section.

*National 4 Courses are not graded.*

## **Skills and knowledge**

Full skills and knowledge for the Course will be given in the *Course Assessment Specification*. A broad overview of the mandatory subject skills, knowledge and understanding that will be assessed in the Course includes:

- ◆ analysing, with guidance, straightforward engineering problems
- ◆ designing, developing, simulating, building and testing, with guidance, solutions to straightforward engineering problems in a range of contexts
- ◆ investigating, with guidance, some existing and emerging technologies
- ◆ communicating basic engineering facts and ideas clearly and concisely using appropriate terminology
- ◆ basic knowledge of the many types of engineering, including (but not limited to) mechanical, electrical and electronic engineering
- ◆ basic knowledge of the wide role and impact of engineering on society and the environment
- ◆ basic knowledge of the workings of a range of simple everyday engineered objects
- ◆ knowledge of key facts and ideas related to electrical, electronic and microcontroller-based systems, and their application
- ◆ knowledge of key facts and ideas related to mechanical and pneumatic systems, and their application
- ◆ basic knowledge of the relevance of energy, efficiency and sustainability to straightforward engineering problems and solutions
- ◆ applying engineering knowledge and skills in a range of straightforward contexts

## Assessment

Information about assessment for the Course will be included in the *Course Assessment Specification*, which will provide 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.

#### **Engineering: Contexts and Challenges (National 4)**

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

- ◆ technological skills in a range of contexts and challenges
- ◆ knowledge of engineering contexts and challenges
- ◆ awareness of the impact of engineering on society and the environment

#### **Electrical and Electronic Systems (National 4)**

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

- ◆ technological skills in the context of electrical and electronic systems
- ◆ knowledge of electrical and electronic systems
- ◆ awareness of the impact of electrical and electronic systems on society and the environment

#### **Mechanical Systems (National 4)**

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

- ◆ technological skills in the context of mechanical systems
- ◆ knowledge of mechanical systems
- ◆ awareness of the impact of mechanical systems on society and the environment

### Added Value Unit

Courses from National 4 to Advanced Higher include assessment of [added value](#)<sup>1</sup>. At National 4, added value will be assessed in an Added Value Unit. The Added Value Unit will 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.

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<sup>1</sup> Definitions can be found here: [www.sqa.org.uk/sqa/45528.html](http://www.sqa.org.uk/sqa/45528.html)

*successful learner, confident individual, responsible citizen, effective contributor*

In this Course, the Added Value Unit will focus on challenge and application.

The learner will draw on, extend and apply the skills and knowledge they have learned during the Course. These will be assessed through a [project](#)<sup>2</sup> which involves application of skills and knowledge from the other Units to solve an appropriately challenging engineering problem.

Exemplification of possible assessment approaches for Units will be provided in the *National Assessment Resource*.

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<sup>2</sup> Definitions can be found here: [www.sqa.org.uk/sqa/45528.html](http://www.sqa.org.uk/sqa/45528.html)

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

*(Note: The information given below reflects the initial thinking on significant opportunities for development of skills for learning, skills for life and skills for work. These may be subject to change as the development process progresses.)*

It is expected that learners will also develop broad, generic skills through this Course. The skills that are likely to be appropriate for this 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

### **4 Employability, enterprise and citizenship**

- 4.2 Information and communication technology (ICT)

### **5 Thinking skills**

- 5.1 Remembering
- 5.2 Understanding
- 5.3 Applying
- 5.5 Creating

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

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**Published:** April 2011 (version 1.0)

**Superclass:** to be advised

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## History of changes to National Course Specification

Course details	Version	Description of change	Authorised by	Date

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