National 5
Course Assessment
Specification

National 5 Engineering Science Course Assessment Specification

Valid from August 2013

This edition: April 2012, version 1.0

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

Course outline

Course title: Engineering Science (National 5)

SCQF level: 5 (24 SCQF credit points)

Course code: to be advised

Course assessment code: to be advised

The purpose of the Course Assessment Specification is to ensure consistent and transparent assessment year on year. It describes the structure of the Course assessment and the mandatory skills, knowledge and understanding that will be assessed.

Course assessment structure

Component 1 — question paper	90 marks
Component 2 — assignment	60 marks
Total marks	**150 marks**

This Course includes six SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course.

Equality and inclusion

This Course Assessment Specification has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled learners and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html.

Guidance on inclusive approaches to delivery and assessment of this Course is provided in the *Course Support Notes*.

Assessment

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. Course assessment will provide the basis for grading attainment in the Course award.

Course assessment

SQA will produce and give instructions for the production and conduct of Course assessments based on the information provided in this document.

Added value

The purpose of the Course assessment is to assess added value of the Course as well as confirming attainment in the Course and providing a grade. The added value for the Course 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.

In this Course assessment, added value will focus on the following:

- breadth — drawing on knowledge and skills from across the Course
- challenge — requiring greater depth or extension of knowledge and/or skills
- application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

Through the Units, learners will develop engineering skills, and knowledge and understanding of key engineering concepts in a variety of contexts, including mechanisms, structures, electronics and control systems.

The added value consists of the following.

To achieve success in the Course, learners must show that they can **apply** the knowledge and skills developed through the Units, in both practical and theoretical contexts.

The assignment requires learners to demonstrate aspects of challenge and application in a practical context. Learners will **apply** knowledge and skills from the Units to solve an appropriately challenging practical engineering problem.

The question paper requires learners to demonstrate aspects of breadth and application in theoretical contexts. Learners will **apply** breadth of knowledge from across the Units and depth of understanding, to answer appropriately challenging questions in engineering contexts.

Grading

Course assessment will provide the basis for grading attainment in the Course award.

The Course assessment is graded A–D. The grade is determined on the basis of the total mark for all Course assessments together.

A learner's overall grade will be determined by their performance across the Course assessment.

Grade description for C
For the award of Grade C, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated successful performance in relation to the mandatory skills, knowledge and understanding for the Course.

Grade description for A
For the award of Grade A, learners will have demonstrated successful performance in all of the Units of the Course. In the Course assessment, learners will typically have demonstrated a consistently high level of performance in relation to the mandatory skills, knowledge and understanding for the Course.

Credit
To take account of the extended range of learning and teaching approaches, remediation, consolidation of learning and integration needed for preparation for external assessment, six SCQF credit points are available in Courses at National 5 and Higher, and eight SCQF credit points in Courses at Advanced Higher. These points will be awarded when a grade D or better is achieved.

Structure and coverage of the Course assessment

The Course assessment will consist of two Components: a question paper and an assignment, titled 'Developing an Engineering Solution'. The question paper will have two Sections.

Component 1 — question paper

The purpose of the question paper is to assess breadth of knowledge from across the Units, depth of understanding, and application of this knowledge and understanding to answer appropriately challenging questions.

This question paper will give learners an opportunity to demonstrate the following skills, knowledge and understanding:

- ability to communicate engineering concepts clearly and concisely, using appropriate terminology
- ability to design and evaluate solutions to engineering problems in a range of contexts
- knowledge of the many types of engineering, and the wide role and impact of engineering (including existing and emerging technologies) on society and the environment
- knowledge and understanding of key concepts related to electronic and microcontroller-based systems, and their application
- knowledge and understanding of key concepts related to mechanisms and structures, and their application
- knowledge of the relevance of energy, efficiency and sustainability to engineering problems and solutions
- application of engineering knowledge and skills in a range of contexts

The question paper will have 90 marks (60% of the total mark).

Approximately 20-30% of the marks will be awarded for questions related to Engineering Contexts and Challenges.

Approximately 30-40% of the marks will be awarded for questions related to Electronics and Control.

Approximately 30-40% of the marks will be awarded for questions related to Mechanisms and Structures.

A standard resource containing relevant data and formulae will be provided for use by candidates while sitting the question paper.

The question paper has two Sections.

Section 1 will have 20 marks, and will consist of short answer questions.

This Section will give learners an opportunity to demonstrate breadth of knowledge from across the areas specified in the 'Further mandatory information on Course coverage' section at the end of this Course Assessment Specification.

Section 2 will have 70 marks, and will consist of extended response questions.

This Section will give learners an opportunity to demonstrate application of knowledge and understanding to answer appropriately challenging context-based questions by drawing on and applying knowledge from the table provided in 'Further mandatory information on Course coverage' section at the end of this Course Assessment Specification.

Component 2 — assignment
The purpose of the assignment is to assess practical application of knowledge and skills from the Units to develop a solution to an appropriately challenging engineering problem. It will assess learners' skills in analysing a problem, designing a solution to the problem, simulating or constructing a solution to the problem, and testing and reporting on that solution.

The assignment will have 60 marks (40% of the total mark).

The assignment will be a meaningful and appropriately challenging task requiring challenge and application.

Time will be required for:

- preparation for the assignment, which could include considering exemplar assignments and practising required skills
- carrying out the stages of the assignment, with teacher guidance and support
- assessing the process and completed solution

The assignment should clearly demonstrate application of knowledge and skills, at an appropriate level, from both the *Mechanisms and Structures* and *Electronics and Control* Units (as defined in the 'Further mandatory information on Course coverage' section of this document).

Guidelines for the assignment will include a list of questions/tasks/prompts which will lead learners through the task in clear stages.

Marks will be awarded for:

- Analysing the problem 10 marks
- Designing a solution 10 marks
- Constructing/simulating a solution 20 marks
- Testing the solution 10 marks
- Reporting on the solution 10 marks

Evidence should include:

- the completed solution
- a record of progress through the assignment (such as an informal electronic log or diary maintained by the learner)
- a short report on the testing of the solution (in written, electronic and/or oral form)

Setting, conducting and marking of assessment

Question paper

This question paper will be set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA. Learners will complete this in 1 hour and 30 minutes.

Controlled assessment — assignment

The assignment is:

- set by SQA
- conducted under some supervision and control

Evidence will be internally marked by centre staff in line with SQA marking instructions.

All marking will be quality assured by SQA.

Setting the assessment

Set by SQA.

A bank of assignments will be provided, and there will be choice from this bank.

Conducting the assessment

Conducted under some supervision and control.

The assignment will be carried out under open book conditions, but supervised to ensure that the work presented is the candidate's own work.

The teacher/lecturer may give learners support and guidance to help them progress through each stage of the assignment; where any significant amount of support is provided, this should be reflected in the marks awarded.

The assignment is designed to discriminate between candidates, and therefore would be expected to provide a wide range of marks. Stronger candidates should be able to complete the assignment successfully with minimal support and guidance. Weaker candidates may not be able to complete all aspects of the assignment within a reasonable time, or may require significant assistance, and so would achieve a lower total mark.

Once the assignment has been completed and assessed, it should not be returned to the candidate for further work to improve their mark.

Further mandatory information on Course coverage

The following gives details of mandatory skills, knowledge and understanding for the Engineering Science (National 5) Course. Course assessment will involve sampling the skills, knowledge and understanding. This list of skills, knowledge and understanding also provides the basis for the assessment of Units of the Course.

The Course assessment will require learners to draw on and apply knowledge of any of the concepts listed below. This table should be read in conjunction with the descriptions of the question paper and assignment.

Course themes	
The systems approach	systems and sub-system diagrams function of a system in terms of input — process — output and feedback loops open and closed loop control interaction of sub-systems
Energy and efficiency	application of the law of conservation of energy calculations involving forms of energy (kinetic, potential, electrical, heat) energy transfers, losses and transformations in a system energy audits and calculation of overall efficiency applied calculations involving efficiency, work done and power, using: $E_w = Fd$ $P = E/t$, $E_k = ½ mv^2$ $E_p = mgh$ $E_e = VIt$ $E_h = cm\Delta T$ Efficiency $\eta = E_{out}/E_{in} = P_{out}/P_{in}$
Calculations	manipulating given formulae to obtain answers

Engineering Contexts and Challenges	
Engineering roles and disciplines	examples of applications of environmental, civil, structural, mechanical, chemical, electrical and electronic engineering examples of the contribution of branches of engineering to solve engineering challenges that integrate branches of engineering the varied roles of engineers in designing, implementing, testing and controlling complex systems
Impacts of engineering	examples of social and economic impacts (positive and negative) of engineering examples of environmental impacts (positive and negative) of engineering ways in which engineering solutions contribute to tackling climate change

Electronics and Control	
Analogue electronic control systems	function and purpose within a circuit of: battery; switch; resistor; variable resistor; LDR; thermistor, LED; diode; motor; lamp; ammeter and voltmeter description of function of a circuit in terms of input, process and output calculations involving the relationship between voltage, current and resistance (Ohms' Law) calculations involving resistors in series and parallel calculations of voltage, current and unknown values in a fixed voltage divider design of a voltage divider to provide an input signal for a control circuit interpretation of information from given tables for an LDR and a thermistor function of a relay and a protection diode in an electronic circuit explanation of the switching function of a transistor the operation of an electronic control circuit which includes a variable voltage divider, transistor, relay and output transducer
Digital electronic control systems	AND, OR and NOT gates, and combinations with up to three inputs, using truth tables and Boolean expressions examples of the use of microcontrollers in commercial and industrial applications advantages and disadvantages of microcontroller-based control systems compared to a hard-wired electronic equivalent use of correct symbols (start, stop, input, output, branch, loop) to construct flowcharts showing solutions to simple control programs, involving time delays, continuous and fixed loops use of suitable commands, including high, low, for…next, if…then, pause, end (or their equivalents) to construct programs to solve simple control problems, involving time delays, continuous and fixed loops

Mechanisms and Structures	
Drive systems	motion in mechanical systems - rotary, linear, reciprocating and oscillating simple gear train systems, including idler gears, (diagrams and conventions for representation) compound gear trains calculation of speed (velocity) ratio of simple and compound gear trains the effects of friction in drive systems

	appropriate British Standard symbols
Pneumatics	symbols and operation of standard pneumatic components (including restrictor, uni-directional restrictor, 5/2 valve and actuators: diaphragm, solenoid) pressure decay control circuits calculation of relationships between force, pressure and area in single and double acting cylinders. control of speed and force
Structures and forces	examples of effects of a force concurrent forces, equilibrium use of triangle of forces and free body diagrams non-concurrent forces, parallel forces moment of a force calculations involving the principle of moments balance beam, simply supported beam, reaction forces
Materials	selection of appropriate material for given application, with justification calculation of the relationship between direct stress, force and area. calculation of strain

Administrative information

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Superclass: to be advised

History of changes to Course Assessment Specification

Course details	Version	Description of change	Authorised by	Date