SQA Advanced Unit specification

General information for centres

Unit title: Engineering Principles

Unit code: HT74 47

Unit purpose: The purpose of this Unit is to provide candidates with an opportunity to develop knowledge, understanding and skills in basic mechanical engineering principles.

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

1 Demonstrate a knowledge and understanding of statics and strength of materials.
2 Demonstrate a knowledge and understanding of dynamics.
3 Demonstrate a knowledge and understanding of thermofluids.

Credit points and level: 1 SQA 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 National 1 to Doctorates.*

Recommended prior knowledge and skills: It would be an advantage if candidates had a basic knowledge and understanding of mechanical engineering principles and technology but this is not essential. This may be evidenced by the possession of Higher Physics and non-advanced units covering Statics, Strength of Materials, Dynamics and Thermofluids.

Core Skills: There may be opportunities to gather evidence towards the following listed Core Skills components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Critical Thinking	SCQF level 6
Written Communication	SCQF level 5

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: This Unit should be assessed on an outcome-by-outcome basis. Outcomes 1, 2 and 3 should each be assessed by an assignment in which candidates are asked to complete a test laboratory experiment and write a report on the results obtained. The time allocated for the practical part of each assignment should be 1 hour. Reports should be written up in the candidate's own time.

Centres should make every reasonable effort to ensure the assignment report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

SQA Advanced 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.

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

Demonstrate a knowledge and understanding of statics and strength of materials

Knowledge and/or skills

- Units
- Static equilibrium
- Types of force (Compressive, Tensile and Shear)
- Vectors
- The effects of force (Compression, Tension, Shear, Bending and Deflection)
- Interpretation of Shear Force and Bending Moment Diagrams to practical applications
- Deflection and stress in simply supported beams and cantilevers influenced by:
  - solid, hollow and rolled sections
  - material
  - forces in plane frame members (pin-jointed frames)
  - shear planes (single/double shear)

Evidence Requirements

Evidence for the knowledge and/or skills items for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that she/he can produce correct responses based on a sample of **five out of seven** knowledge and/or skills items.

Evidence will be provided by candidates undertaking a laboratory assignment consisting of one of the following:

- a beam or cantilever OR
- a pin-jointed frame OR
- shear planes

Each laboratory assignment must be designed to ensure that the minimum of five out of seven knowledge and/or skills items can be covered.

One hour should be allocated to undertake the practical part of the laboratory assignment.

Candidates will be required to produce a written report which must include:

- the test procedure
- a sketch of the test apparatus
- a table of results
- a comparison of experimental data to theoretical data
- conclusions

Reports should be written up in the candidate's own time. Centres should make every reasonable effort to ensure the assignment solution is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Re-assessment should consist of an alternative laboratory assignment in which a different sample of **five out of seven** knowledge and/or skills items is sampled from those in the original assessment.

Assessment guidelines

Centres may wish to issue candidates with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words in length plus diagrams.

Outcome 2

Demonstrate a knowledge and understanding of dynamics

Knowledge and/or skills

- Units
- Linear motion
- Angular motion
- Combined motion
- Impulse
- Momentum
- Work
- Power
- Energy

Evidence Requirements

Each candidate will need to demonstrate that she/he can produce correct responses based on a sample of **five out of nine** knowledge and/or skills items.

Evidence will be provided by candidates undertaking a laboratory assignment consisting of one of the following:

- combined motion OR
- impulse-momentum OR
- work-energy power

Each laboratory assignment must be designed to ensure that the minimum of five out of nine knowledge and / or skills items can be covered.

One hour should be allocated to undertake the practical part of the laboratory assignment.

Candidates will be required to produce a written report which must include:

- the test procedure
- a sketch of the test apparatus
- a table of results
- a comparison of experimental data to theoretical data
- conclusion

Reports should be written up in the candidate's own time. Centres should make every reasonable effort to ensure the assignment solution is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Re-assessment should consist of an alternative laboratory assignment in which a different sample of five out of nine knowledge and/or skills items is sampled from those in the original assessment.

Assessment guidelines

Centres may wish to issue candidates with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words in length plus diagrams.

Outcome 3

Demonstrate a knowledge and understanding of thermofluids

Knowledge and/or skills

- Units
- Pressure, Volume and Temperature
- Manometry
- Hydrostatic Pressure
  - pressure head
  - pressure at depth
  - thrust on submerged plates
- Flow through pipes
- Nozzles
- Bends

Evidence Requirements

Evidence for the knowledge and/or skills for this Outcome will be provided on a sample basis. Each candidate will need to demonstrate that she/he can produce correct responses based on a sample of **three out of seven** knowledge and/or skills items.

Evidence for this outcome will be provided by a laboratory assignment consisting of one of the following:

- manometry OR
- hydrostatic pressure OR
- flow through pipes

Each laboratory assignment must be designed to ensure that the minimum of three out of seven knowledge and skills items are covered.

One hour should be allocated to undertake the practical part of the laboratory assignment.

Candidates will be required to produce a written report which must include:

- the test procedure
- a sketch of the test apparatus
- a table of results
- a comparison of experimental data to theoretical data
- conclusion

Reports should be written up in the candidate's own time. Centres should make every reasonable effort to ensure the assignment solution is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Re-assessment should consist of an alternative laboratory assignment in which a different sample of three out of seven knowledge and/or skills items is sampled from those in the original assessment.

Assessment guidelines

Centres may wish to issue candidates with suitable guidance notes giving advice on the best way to structure their reports. The report may be 250 to 500 words in length plus diagrams.

Administrative Information

Unit code: HT74 47

Unit title: Engineering Principles

Superclass category: XH

Date of publication: August 2017

Version: 01

History of changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit specification: support notes

Unit title: Engineering Principles

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

This Unit has been written to allow candidates to develop knowledge, understanding and skills in the following areas of mechanical and manufacturing engineering:

1 Statics and strength of materials.
2 Dynamics.
3 Thermofluids.

The Unit is a prerequisite for certain more advanced application/analysis units in the SQA Advanced Mechanical and Manufacturing Engineering group awards, eg Statics and Strength of Materials, Dynamics and Thermofluids.

Candidates should be provided with opportunities to develop their knowledge and understanding of mechanical engineering principles by undertaking a series of experiments. Centres should ensure that candidates undertake as many different laboratory exercises as possible. These experiments may be either purchased or made in-house.

Candidates should be made aware of the importance of practical investigations which should include the accurate use of units and using the correct report writing format.

All practical exercises (eg laboratory work, investigations and demonstrations) must be carried out in a safe manner, ensuring centre specific and HSE requirements are met.

It is recommended that wherever possible a non-mathematical approach be adopted during the delivery of this Unit although findings can be compared to answers derived from spreadsheet templates. This will encourage candidates to draw conclusions from the experiment.

The solution of relevant engineering problems by the application of mathematics will be undertaken in the relevant subsequent Units, eg Statics and Strength of Materials, Dynamics and Thermofluids.

Guidance on the delivery and assessment of this Unit

Laboratory exercises can take a number of different forms. The following is a list of suggestions:

- Beam/cantilever deflection for a variety of cross sections and/or materials (eg "I", rectangular, hollow rectangular) with point and uniformly distributed loads.
- Reactions at supports using spring balances for point and uniformly distributed loads.
- Pin-jointed frame stability including ties, struts and null members.
- Single and multiple shear planes analysis.
- Displacement, velocity and time values in combined linear and angular motion.
- Conservation of linear momentum.

- The effects of impulse.
- Conservation of energy progressing to work done and power.
- Manometry balance with a variety of fluids.
- Force and pressure at depths on submerged plates.
- The reduction in fluid velocity caused by pipe bends.

Examples of experiments that can be used with this Unit are contained in the Assessment Exemplar that has been developed to support the delivery and assessment of the Unit.

Opportunities for developing Core Skills

There may be opportunities to gather evidence towards the following listed Core Skills components in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Critical Thinking	SCQF level 6
Written Communication	SCQF level 5

Open learning

Given the highly practical nature of this Unit it is not realistic to deliver it on an open learning basis.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning* (SQA 2000).

Equality and inclusion

This Unit 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.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Engineering Principles

This Unit is an essential element of your course, as it will introduce you to many engineering principles and concepts that you will use throughout your studies and subsequent engineering career.

Almost all of this Unit will relate directly to laboratory exercises. This will allow you to experience, and view first hand, the principles of mechanical engineering, which you will then be able to relate directly to other units within your course.

This unit has been written to allow you to develop knowledge, understanding and skills in the following areas:

1 Statics (stationary structures) and Strength of Materials.
2 Dynamics (the effects of motion).
3 Thermofluids (the effects of fluids).

You will become familiar with units such as newtons (N), second moment of area (m^4), acceleration (m/s^2 or ms^{-2}), radians (rad), pressure (bar) and (kN/m^2), temperature (K). You will also become familiar with engineering notation such as micro (μ), mega (M), giga (G).

This Unit will be assessed on an Outcome-by-Outcome basis. Outcomes 1, 2 and 3 will each be assessed by an assignment in which you will be asked to complete a test laboratory experiment and write a report on the results obtained. The time allocated for the practical part of each assignment is one hour. Reports will be written up in your own time.