National Unit Specification: general information

UNIT Engineering Dynamics: An Introduction (SCQF level 6)

CODE F5K6 12

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

This mainly theory based Unit is designed to provide candidates with basic knowledge and understanding of engineering dynamic quantities, laws and principles so that they can use these to solve problems in dynamics. During the delivery of this Unit, candidates will learn about the basic quantities, and their units, used in engineering dynamics. They will also develop the knowledge and understanding to solve linear system problems involving the use of the equations of motion, velocity/time diagrams and Newton's Laws. Candidates will also learn to solve linear system problems involving work, energy, conservation of energy and power. They will also develop the knowledge and understanding to solve angular dynamic system problems.

This Unit is suitable for candidates training to be mechanical or multi-disciplinary engineering technicians.

OUTCOMES

1 State terms and solve problems involving linear dynamic systems.
2 Solve problems involving work, energy, conservation of energy and power in linear dynamic systems.
3 State and use Newton's Laws to solve problems involving linear dynamic systems.
4 State terms and solve problems involving angular dynamic systems.

Administrative Information

Superclass: RC

Publication date: May 2011

Source: Scottish Qualifications Authority

Version: 02

National Unit Specification: general information (cont)

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- Standard Grade Mathematics at credit level
- Standard Grade Physics at credit level
- Intermediate 2 Physics

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6).

**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.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- Numeracy (SCQF level 5)
- Problem Solving (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

State terms and solve problems involving linear dynamic systems.

Performance Criteria

(a) State correctly the meaning of terms commonly used in linear dynamic systems.
(b) State correctly the units of terms commonly used in linear dynamic systems.
(c) Apply correctly the equations of motion for constant acceleration to the solution of problems involving linear dynamic systems.
(d) Apply correctly a velocity/time diagram to the solution of a problem involving a linear dynamic system.

OUTCOME 2

Solve problems involving work, energy, conservation of energy and power in linear dynamic systems.

Performance Criteria

(a) Solve problems correctly using equations for work, energy and power.
(b) Solve problems correctly by applying the principle of the conservation of energy.

OUTCOME 3

State and use Newton's Laws to solve problems involving linear dynamic systems.

Performance Criteria

(a) State correctly the meaning of the term momentum.
(b) State correctly Newton's Laws of motion.
(c) Perform calculations involving Newton's Laws including friction force.

OUTCOME 4

State terms and solve problems involving angular dynamic systems.

Performance Criteria

(a) State correctly the meaning of terms commonly used in angular dynamic systems.
(b) State correctly the units of terms commonly used in angular dynamic systems.
(c) Convert accurately angular velocity between revolutions per minute and radians per second and vice versa.
(d) Solve correctly problems involving angular and linear motion.
(e) Solve correctly problems involving thin rim wheels with given moment of inertia.

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that a candidate has achieved all Outcomes and Performance Criteria.

Outcomes 1, 2, 3 and 4 may be assessed on an individual basis, as a combination of Outcomes (eg Outcomes 1 and 2 assessed together and Outcomes 3 and 4 together), or as a single, holistic assessment covering all four Outcomes. The total time for assessment(s) of the four Outcomes must not exceed 2 hours. Assessment(s) must be conducted under supervised, closed-book conditions in which candidates may use reference materials provided by the centre but are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. Candidates should be allowed to use a non-programmable scientific calculator during assessment.

With regard to Outcome 1

- candidates must define a minimum of four terms from the following list: mass, weight, force, pressure, distance, speed, velocity, acceleration, work, potential energy, kinetic energy or power
- candidates must state a minimum of four units for terms from the following list: mass, weight, force, pressure, speed, velocity, acceleration, work, energy or power

With regard to Outcome 3

- problems involving friction should be limited to the horizontal plane only

With regard to Outcome 4

- candidates must define a minimum of three terms from the following list: angular displacement, angular velocity, angular acceleration, torque or kinetic energy.
- candidates must state a minimum of three units for terms from the following list: angular displacement, angular velocity, angular acceleration, torque or kinetic energy.
- a thin rim wheel may take the form of an engine flywheel or bicycle wheel with given moment of inertia. Problems could involve the calculation of such quantities as mass, angular velocity, kinetic energy and torque.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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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 forms part of the National Qualification Group Award (NQGA) in Mechanical Engineering at SCQF level 6, but may also be offered on a free standing basis.

The aim of this Unit is to provide candidates with basic knowledge and understanding of engineering dynamic quantities, laws and principles so that they can use these to solve problems in dynamics. On successful completion of the Unit candidates will be able to state the meaning of basic quantities, and their units, used in engineering dynamics. They will also be able to solve linear system problems involving the use of the equations of motion, velocity/time diagrams and Newton's Laws. Candidates will also be capable of solving linear system problems involving work, energy, conservation of energy and power. They will also be able to solve angular dynamic system problems.

Due to the complementary nature of their content the delivery of this Unit may be integrated with that of the Unit *Engineering Dynamics* at SCQF level 6.

It is important to emphasise that this Unit has been designed to provide an introduction to the subject of engineering dynamics. As such it is suitable as a foundation Unit in the subject on which more advanced studies, at Higher National level, can be built. It is important that during the delivery of the Unit opportunities for candidates to develop a sound knowledge and understanding of the concepts, principles and laws associated with engineering dynamics are maximised. Experience has shown that knowledge and understanding can best be developed by setting the concepts, principles and laws within a practical mechanical engineering context and by encouraging candidates to solve realistic engineering dynamics problems.

In Outcome 1 candidates should be introduced to a range of engineering dynamics quantities including the following: mass, weight, force, pressure, distance, speed, velocity, acceleration, work, potential energy, kinetic energy and power. Candidates should be taught to use the correct units with quantities. Candidates should also learn how to apply the equations of motion shown below to the solution of linear dynamic problems:

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

where u = initial velocity, v = final velocity, s = displacement, t = time and a = acceleration

Candidates should also be taught the relationships between the equations of motion and velocity/time diagrams (eg the area under a velocity/time diagram equals displacement) and use velocity/time diagrams to solve linear dynamic problems.

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In Outcome 2 candidates should learn how to solve linear dynamic problems involving work (W = Fd), potential energy (ie PE = mgh), kinetic energy ($KE = 1/2mv^2$) and power (P = Fv). Candidates should be taught the principle of the Conservation of Energy and be asked to solve linear dynamic system problems where this principle can be applied.

In Outcome 3 candidates should be taught what is meant by the term momentum as a pre-cursor to introducing Newton's laws of motion. They should be taught Newton's three laws of motion with reference to practical applications of these laws. Candidates should also learn how to apply Newton's three laws of motion to the solution of linear dynamic problems using appropriate dynamic equations including the equation.

Average force = change of momentum/time taken.

Candidates should also be introduced to friction and solve problems involving Newton's laws and friction in the horizontal plane only.

In Outcome 4 candidates should learn about quantities commonly used in angular dynamic systems such as angular displacement, angular velocity, angular acceleration, torque and kinetic energy and the units associated with these quantities. Candidates should also learn how to convert angular velocity between revolutions per minute and radians per second and vice versa. They should also learn how to carry out calculations involving angular and linear velocity using the equation $v = \omega r$ and solve problems involving thin rim wheels with given moments of inertia.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. The Unit may be delivered by a combination of lectures, tutorial work, computer simulation and laboratory work. While the majority of the Unit can be delivered in a classroom centres should allow candidates to undertake practical mechanical laboratory experiments so that they have opportunities to relate theory learnt in the classroom to practice. Computer simulation illustrating different dynamic concepts and principles may also provide a good source of learning.

The Internet contains a rich source of materials on engineering dynamics.

Wall charts illustrating different dynamic concepts and principles can also be a very useful learning and teaching aid.

The Unit should be fully supported with relevant learning materials (eg handouts in paper and electronic form, textbooks, on-line materials etc).

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Using Number Core Skill component at SCQF level 5 may be developed in all four Outcomes while candidates are manipulating and evaluating equations to solve problems in engineering dynamics.

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Candidates may have opportunities to develop the Using Graphical Information Core Skill component at SCQF level 5 in Outcome 1 while solving problems involving velocity/time diagrams.

The Critical Thinking Core Skill component at SCQF level 5 may be developed in all four Outcomes while candidates solve problems in engineering dynamics.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Centres are encouraged to use formative assessment extensively as it plays a particularly important role in allowing candidates to develop a sound knowledge and understanding of engineering dynamic concepts, principles and laws.

Regardless of whether assessment is carried out on an individual basis, as a combination of Outcomes or on a single, holistic basis any assessment paper(s) used may comprise a suitable balance of short answer, restricted response and structured questions.

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005).*

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**

National Unit Specification: support notes (cont)

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History of changes:

Version	Description of change	Date
02	Superclass changed from RC to XH. Change agreed on the basis that the Unit is delivered exclusively in a Mechanical Engineering context and is resource intensive.	31/05/2011