National Unit Specification: general information

UNIT Engineering Dynamics (SCQF level 6)

CODE F5K7 12

SUMMARY

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

This Unit is designed to provide candidates with knowledge and understanding of engineering dynamic quantities, laws and principles so that they can use these to solve problems in dynamics. During delivery of the Unit, candidates will learn to solve problems involving velocity vector diagrams. They will also learn the commonalities and differences between linear and angular dynamic quantities and equations and use the angular equations to solve problems involving angular dynamic systems including those associated with solid uniform discs. Candidates will also learn to solve problems involving a system containing one linear and one angular element. They will also develop knowledge and understanding to solve problems involving centripetal and centrifugal forces and will also learn to apply the principle of the conservation of momentum to the solution of linear dynamic problems.

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

OUTCOMES

1 Solve problems involving velocity vector diagrams.
2 Compare linear and angular dynamic quantities and equations and solve problems involving angular dynamic systems.
3 Solve problems involving accelerating or decelerating a solid uniform disc.
4 Solve problems involving centripetal and centrifugal forces.
5 Explain the principle of the conservation of momentum and solve problems using this principle.

Administrative Information

Superclass: RC

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Source: Scottish Qualifications Authority

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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 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

Solve problems involving velocity vector diagrams.

Performance Criteria

(a) Solve problems involving the resolution of a velocity vector into its vertical and horizontal components.
(b) Draw accurately a velocity vector diagram to determine the resultant of a number of vectors.

OUTCOME 2

Compare linear and angular dynamic quantities and equations and solve problems involving angular dynamic systems.

Performance Criteria

(a) State correctly the meaning of the terms Moment of Inertia and Radius of Gyration.
(b) Complete correctly a table which compares linear and angular dynamic system quantities and equations.
(c) Apply correctly the equations of motion for constant acceleration to the solution of problems involving angular systems.
(d) Apply correctly a velocity/time diagram to the solution of a problem involving an angular system.
(e) Apply correctly equations of motion for constant acceleration to solve problems involving a system containing one linear and one angular element.

OUTCOME 3

Solve problems involving accelerating or decelerating a solid uniform disc.

Performance Criteria

(a) Calculate correctly the Moment of Inertia of a solid uniform disc.
(b) Calculate correctly mechanical quantities associated with accelerating and/or decelerating a solid uniform disc.
(c) Calculate correctly mechanical quantities associated with accelerating and/or decelerating a solid uniform disc by applying the principle of the conservation of energy.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Solve problems involving centripetal and centrifugal forces.

Performance Criteria

(a) State correctly the meaning of the terms centripetal force and centrifugal force.
(b) State correctly the relationship between centripetal and centrifugal force and mass, angular velocity and radius.
(c) Solve correctly problems involving centripetal and centrifugal forces.

OUTCOME 5

Explain the principle of the conservation of momentum and solve problems using this principle.

Performance Criteria

(a) Explain correctly the principle of the conservation of momentum.
(b) Solve correctly problems on linear dynamic systems involving the equations of motion and the principle of the conservation of momentum.

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, 4 and 5 may be assessed on an individual basis, as a combination of Outcomes (eg Outcomes 1, 2 and 3 assessed together and Outcomes 4 and 5 together), or as a single, holistic assessment covering all five Outcomes. The total time for assessment(s) of the five Outcomes must not exceed 2 hours and 30 minutes. 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.

National Unit Specification: statement of standards (cont)

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With regard to Outcome 1

- the resultant of a maximum of three vectors should be determined

With regard to Outcome 2

Candidates must be given a table of the form shown below with six entries missing and asked to complete the table by filling in the missing entries:

Linear Quantity	**Symbol/Equation**	**Symbol/Equation**	**Angular quantity**
Displacement	x	Θ	Angular displacement
Velocity	v	ω	Angular velocity
Acceleration	a	$\acute{\alpha}$	Angular acceleration
Mass	m	I	Moment of Inertia
Force	F = ma	$T = I\acute{\alpha}$	Torque
Momentum	P = mv	$L = I\omega$	Angular momentum
Work done	W = Fx	$W = T\Theta$	Work done
Kinetic energy	$KE = \frac{1}{2} mv^2$	$KE = \frac{1}{2}I\omega^2$	Kinetic energy
Power	P = Fv	$P=T\omega$	Power

With regard to Outcomes 3, 4 and 5

The Evidence Requirements are implicit within the stated Performance Criteria.

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

UNIT Engineering Dynamics (SCQF level 6)

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 the Unit is to provide candidates with knowledge and understanding of engineering dynamic concepts, 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 solve problems involving velocity vector diagrams. They will also be able to state the commonalities and differences between linear and angular dynamic quantities and equations and use the equations of motion to solve problems involving angular dynamic systems including those associated with solid uniform discs. Candidates will also be able to solve problems involving a system containing one linear and one angular element. They will also be capable of solving problems involving centripetal and centrifugal forces and will be able to apply the principle of the conservation of momentum to the solution of linear dynamic problems.

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

This Unit provides a suitable basis 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 learn to solve problems involving the use of velocity vector diagrams (drawn to scale) and the resolution of velocity vectors into their horizontal and vertical components. Such techniques could also be applied to other types of vectors (eg displacement, acceleration etc).

In Outcome 2 candidates should be introduced to the concepts of Moment of Inertia and Radius of Gyration relating Moment of Inertia to mass in a linear system. A largely non-mathematical treatment should be used when introducing the two concepts. Candidates should be taught the similarities and differences between linear and angular dynamic quantities and equations as well as learning how to apply the equations of motion and velocity/time diagrams to the solution of angular dynamic systems problems. The delivery of this could be integrated with the applications of the equations of motion and velocity/time diagrams to the solution of linear dynamic system problems in Outcome 2 of the Unit *Engineering Dynamics: An Introduction* (SCQF level 6). Candidates should also learn to solve problems involving a system containing one linear and one angular element

National Unit Specification: support notes (cont)

UNIT Engineering Dynamics (SCQF level 6)

In Outcome 3 candidates should learn how to solve problems relating to solid uniform disc as a way of further consolidating work on Moment of Inertia and Radius of Gyration.

In Outcome 4 candidates should be introduced to the concepts of centripetal and centrifugal forces and learn how to solve problems involving these types of forces using equations such as $F = m\omega^2 r$ and $F = mv^2/r$.

In Outcome 5 candidates should be taught the principle of the conservation of momentum and learn how to apply this principle to the solution of problems involving linear dynamic systems.

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 1–4 Outcomes while candidates are manipulating and solving equations to solve problems in engineering dynamics.

Candidates may have opportunities to develop the Using Graphical Information Core Skill component at SCQF level 5 in Outcome 1 while drawing velocity vector diagrams and in Outcome 2 while solving problems involving velocity/time diagrams.

The Critical Thinking Core Skill component at SCQF level 5 may be developed in all five 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.

National Unit Specification: support notes (cont)

UNIT Engineering Dynamics (SCQF level 6)

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**

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