Advanced Higher Applied Mathematics (Mechanics)

Draft National Course Specification

Valid from August 2015

This edition: May 2012, draft version 1.0

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

Contents

Course outline

Course title: Advanced Higher Applied Mathematics (Mechanics)

SCQF: level 7 (32 SCQF credit points)

Course code: to be advised

Mandatory Units

Motion (Advanced Higher)	**8 SCQF credit points**
Work, Power, Energy and Momentum (Advanced Higher)	**8 SCQF credit points**
Further Mathematical Techniques in the Study of Mechanics (Advanced Higher)	**8 SCQF credit points**
Course assessment	**8 SCQF credit points**

This Course includes eight SCQF credit points to allow additional time for preparation for Course assessment. The Course assessment covers the added value of the Course. Further information on the Course assessment 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, knowledge and understanding required by the following or equivalent qualifications and/or experience:

- Higher Mathematics Course

Progression

This Course or its Units may provide progression to:

- other qualifications in Mathematics or related areas
- further study, employment and/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

Mathematics is important in everyday life, allowing us to make sense of the world around us and to manage our lives. Mechanics uses mathematics to enable us to model real-life situations and to equip us with the skills we need to interpret and understand how things work, simplify and solve problems, identify limitations and draw conclusions.

Mechanics encourages independent thinking and demands an enquiring approach. It will engage and fascinate learners of all ages, interests and abilities, helping them become more self-reliant. Learning in mechanics develops questioning skills, logical reasoning, analysis, problem-solving skills, creativity and the ability to communicate explanations concisely. Mechanics equips us with many of the skills required for life, learning and work. Being aware of one's physical world in many aspects of life is crucial. This reinforces the need for applied mathematics to play an integral part in lifelong learning and be appreciated for the richness it brings.

This Course allows learners to acquire and develop the attributes and capabilities of the four capacities. For example, success in mathematical learning and activity leads to increased confidence as an individual, being able to think logically helps towards being a responsible citizen, and being able to understand, use and communicate mathematical ideas will assist in becoming an effective contributor.

Purpose and aims of the Course

Mechanics is the branch of mathematics concerned with the study of forces that act on bodies and any resultant motion that they experience. It will offer learners an enhanced awareness of the range and power of mathematics and the importance of mathematical applications to society in general.

The Course will enable learners to:

- use and extend mathematical skills needed to solve problems in mechanics
- consider the state of equilibrium or the movement of a body and interpret the underlying factors using known mathematical methods
- analyse the physical factors impacting bodies
- understand, interpret and apply the effects of both constant and variable forces on a body
- create mathematical models to simplify and solve problems
- analyse results in context, and interpret the solution in terms of the real world
- develop skills in effectively communicating conclusions reached on the basis of physical factors and calculation

The Course is highly relevant in many areas of science, engineering and technologies, and offers a sound foundation for future studies in these beyond Advanced Higher.

Information about typical learners who might do the Course

This Course is suitable for learners who are secure in their attainment of the Higher Mathematics Course or an equivalent qualification.

Learners will develop skills in creating mathematical models and selecting and applying complex mathematical techniques in a variety of situations requiring knowledge of mechanics. These skills will enable progression to further learning and to employment.

Mechanics is widely used in developments in physics and technology. Engineering design places heavy reliance on mechanics. In this Course, learners develop knowledge and skills both in mechanics and in the mathematics which makes the use of these skills possible. Learners will find applications in many careers in science, the technologies and engineering. These careers can involve the improvement, redesign and invention of equipment for uses such as in agriculture, medicine, civil engineering and space exploration.

Course structure and conditions of award

Course structure

This Course will develop, deepen and extend the mathematical skills necessary at this level and beyond.

Learners will acquire and apply operational skills necessary for exploring ideas in mechanics through symbolic representation and mathematical modelling. In addition, learners will develop mathematical reasoning skills and will gain experience in making informed decisions.

The Advanced Higher Applied Mathematics (Mechanics) Course has three Units, totalling 24 SCQF credit points, with an additional eight SCQF credit points to allow the use of an extended range of learning and teaching approaches, consolidation of learning, integration, and preparation for external assessment.

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

Motion (Advanced Higher)
Learners consider motion in a straight line under the influence of constant and variable force and time-dependent acceleration. The relative motion of bodies and the effects of winds and currents are explored, with a vector approach being encouraged. The motion of projectiles in a vertical plane is explored. Newton's laws of motion are used to develop an understanding of equilibrium, friction and resulting motion, with particular emphasis on Newton's second law to consider one-dimensional motion on inclined planes.

Work, Power, Energy and Momentum (Advanced Higher)
This Unit introduces learners to solving problems involving motion in a horizontal circle with uniform angular velocity. In particular, banked tracks and skidding are considered, as is Newton's law of gravitation and its application to the circular orbit of satellites. The motion of the conical pendulum is also considered. Learners will look at simple harmonic motion and here consider force associated with elastic strings and springs and the application of Hooke's law. The principles of momentum and impulse and those of work, power and energy are developed. There is also consideration of motion in a vertical circle using the conservation of energy.

Further Mathematical Techniques in the Study of Mechanics (Advanced Higher)
This Unit covers development of skills in calculus, including modelling practical problems using differential equations. Integration using substitution and partial fractions and integration by parts are introduced to allow learners to find the centre of mass of a rigid body.

Conditions of award

To gain the award of the Course, the learner must pass all of the Units as well as the Course assessment. The required Units are shown in the Course outline section. Course assessment will provide the basis for grading attainment in the Course award.

Skills, knowledge and understanding

Further information on the assessment of skills, knowledge and understanding for the Course is given in the *Course Assessment Specification*. A broad overview of the mandatory subject skills, knowledge and understanding that will be assessed in the Course is given in this section.

This includes:

- knowledge and understanding of a range of straightforward and complex concepts in mechanics
- the ability to identify and use appropriate techniques in mechanics
- the ability to use mathematical reasoning and operational skills to extract and interpret information
- the ability to create and use multifaceted mathematical models
- the ability to communicate identified strategies of solution and provide justification for the resulting conclusions in a logical way
- the ability to comprehend both the problem as a whole and its integral parts
- the ability to select and use numerical skills

Skills, knowledge and understanding to be included in the Course will be appropriate to the SCQF level of the Course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level (www.sqa.org.uk/scqf).

Assessment

Information about assessment for the Course is included in the *Course Assessment Specification*, which provides 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.

Motion (Advanced Higher)
Learners who complete the Unit will be able to:

- use techniques in mechanics linked to motion

Work, Power, Energy and Momentum (Advanced Higher)
Learners who complete the Unit will be able to:

- use techniques in mechanics linked to work, power, energy and momentum

Further Mathematical Techniques in the Study of Mechanics (Advanced Higher)
Learners who complete the Unit will be able to:

- use further mathematical operational skills relevant to mechanics

Exemplification of possible approaches to assessment for these Units is provided in the *National Assessment Resource.*

Course assessment

Courses from National 4 to Advanced Higher include assessment of added value[1]. At National 5, Higher and Advanced Higher, the added value will be assessed in the Course assessment. The added value for the Course must 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 and application.

[1] Definitions can be found here: www.sqa.org.uk/sqa/47692.html

In the Advanced Higher Applied Mathematics (Mechanics) Course, added value will focus on:

- breadth
- challenge
- application

Learners will draw on, extend and apply the skills they have learned during the Course. This will be assessed within a question paper[2], requiring demonstration of the knowledge, skills and understanding acquired from across the Units and how they can be applied in unfamiliar contexts and/or integrated ways.

[2] Definitions can be found here: www.sqa.org.uk/sqa/47692.html

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

It is expected that learners will develop broad, generic skills through this Course. The skills that learners will be expected to improve on and develop through the 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
2.2 Money, time and measurement
2.3 Information handling

5 Thinking skills

5.3 Applying
5.4 Analysing and evaluating

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

Published: May 2012 (draft version 1.0)

Superclass: to be advised

History of changes to National Course Specification

Course details	Version	Description of change	Authorised by	Date

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