

Next Generation Higher National Unit Specification

Principles of Mechanisation (SCQF level 7)

Unit code: J8G5 47
SCQF level: 7 (16 SCQF credit points)
Valid from: session 2024 to 2025

Prototype unit specification for use in pilot delivery only (version 1.0) September 2024

This unit specification provides detailed information about the unit to ensure consistent and transparent assessment year on year. It is for lecturers and assessors and contains all the mandatory information you need to deliver and assess the unit.

The information in this unit specification may be reproduced in support of SQA qualifications only on a non-commercial basis. If it is reproduced, SQA must be clearly acknowledged as the source. If it is to be reproduced for any other purpose, written permission must be obtained from permissions@sqa.org.uk.

This edition: September 2024 (version 1.0)

© Scottish Qualifications Authority 2024

Unit purpose

This unit focuses on the role of machinery in modern agricultural practices. It covers a broad range of topics, from the fundamentals of agricultural machinery, including engines and power systems, to the application of electricity in farming.

The unit content emphasises the importance of understanding the operation, selection and maintenance of various agricultural machines to improve the efficiency and sustainability of mechanisation in agriculture.

Entry to the unit is at your centre's discretion. Learners do not need any prior knowledge or experience to do this unit, though previous study of mathematics at SCQF level 5 would be helpful.

Unit outcomes

Learners who complete this unit can:

- 1 explain the principles of mechanisation
- 2 evaluate agricultural crop machinery
- 3 evaluate agricultural livestock machinery
- 4 describe the safe use of electricity in agriculture

Evidence requirements

To achieve these outcomes, learners must provide the following evidence:

Outcome 1

- ◆ Explain the basic operation of prime movers.
- ◆ Explain the relationships between power, torque, speed and fuel consumption, and the effect of gear selection.
- ◆ Identify suitable machinery for given tasks.

Outcome 2

- ◆ Describe and evaluate the use of equipment for tilling soil and establishing crops.
- ◆ Describe and evaluate the operation, performance, and management of equipment for distributing inorganic fertilisers.
- ◆ Describe and evaluate the operation, performance and management of equipment for protecting crops and cereal harvesting.

Outcome 3

- ◆ Describe the types of machinery utilised in livestock management, such as feed-processing equipment, milking machines and manure-management systems.
- ◆ Identify the specialised machinery used for the care and management of livestock.
- ◆ Describe the operational procedures and maintenance requirements of machinery used in livestock management.

Outcome 4

- ◆ Describe the role of electricity in agricultural operations, and its benefits.
- ◆ Explain electrical safety practices on farms.
- ◆ Describe the fundamentals of electrical circuits.
- ◆ Describe the use of electrically-powered equipment in agriculture.
- ◆ Describe the use of contemporary electric technologies, such as automated feeding systems and climate control in farm buildings, and their impact on agriculture.

You can assess learners' knowledge and their ability to apply these skills in agricultural contexts using a variety of formative and summative assessment methods. These could

NextGen: HN published prototype unit specification for use in pilot delivery only (version 1.0)
September 2024

include written assignments, oral presentations, group projects and practical demonstrations to assess learners' proficiency and their ability to apply these skills in agricultural technology contexts. They should involve the completion of an appropriate number of workshop and field exercises.

You should implement formative assessment strategies throughout the unit to gauge learners' understanding and progress. Provide feedback that is both timely and constructive, focusing on both the process and the outcome.

Knowledge and skills

Knowledge	Skills
<p>Outcome 1 Learners should understand:</p> <ul style="list-style-type: none"> ◆ engines, power, and torque and how this impacts machine selection ◆ the fundamental principles of prime mover operation, considering internal combustion engines using various fuels including hydrogen ◆ the role of fuel additives in reducing gaseous emissions ◆ electric motors as prime mover motive power ◆ how engines and motors generate power and torque ◆ how transmissions translate power and torque to useful work ◆ the fundamentals of hydraulic systems in a modern tractor ◆ how to select appropriate machinery 	<p>Outcome 1 Learners can:</p> <ul style="list-style-type: none"> ◆ explain the basic operation of prime movers, including how internal combustion engines use different fuels, such as hydrogen, to produce energy ◆ describe the role of fuel additives and selective catalytic reduction in reducing harmful gases being released into the atmosphere ◆ describe how electric motors function as a primary source of motive power ◆ discuss the process through which engines and motors create power and torque, and how transmissions translate that to useful work ◆ describe a simple hydraulic circuit ◆ determine the most suitable machinery for a particular task
<p>Outcome 2 Learners should understand:</p> <ul style="list-style-type: none"> ◆ a range of machinery, such as primary and secondary cultivation tools, seed drills, fertiliser spreaders and harvesters ◆ the function, operational techniques, and maintenance requirements of a range of machinery ◆ how to select suitable machinery for specific agricultural tasks 	<p>Outcome 2 Learners can:</p> <ul style="list-style-type: none"> ◆ identify and describe various types of agricultural machinery, including primary and secondary cultivation tools, seed drills, fertiliser spreaders and harvesters ◆ explain the purpose, operational methods, and upkeep needs of different agricultural machines ◆ use this understanding to choose equipment for particular farming activities

Knowledge	Skills
<p>Outcome 3 Learners should understand:</p> <ul style="list-style-type: none"> ◆ machinery used in livestock management, including feed-processing and bedding equipment, milking machines and manure-management systems ◆ the specialised machinery that supports the care and management of livestock ◆ the operational and maintenance aspects of livestock machinery 	<p>Outcome 3 Learners can:</p> <ul style="list-style-type: none"> ◆ summarise the types of machinery utilised in livestock management, such as feed-processing equipment, milking machines and manure-management systems ◆ identify the specialised machinery used to care for and manage livestock ◆ outline the operational procedures and maintenance requirements of machinery used in livestock management
<p>Outcome 4 Learners should understand:</p> <ul style="list-style-type: none"> ◆ the use of electricity in agricultural settings ◆ electrical safety on farms, basics of electrical circuits, and the application of electrically powered equipment ◆ modern electric technologies like automated feeding systems or climate control in farm buildings 	<p>Outcome 4 Learners can:</p> <ul style="list-style-type: none"> ◆ describe the role of electricity in agricultural operations and its benefits ◆ explain electrical safety practices on farms, understand the fundamentals of electrical circuits, and discuss the use of electrically powered equipment in agriculture ◆ investigate contemporary electric technologies, such as automated feeding systems and climate control in farm buildings, and their impact on agriculture

Meta-skills

You must give learners opportunities to develop their meta-skills throughout this unit. We have suggested how to incorporate the most relevant ones into the unit content, but you may find other opportunities.

Self-management

This includes focusing, integrity, adapting and initiative. The most relevant are:

- ◆ Focusing: collecting and assimilating accurate and meaningful data on which to base decisions, by filtering out non-essential material
- ◆ Adapting: developing a capacity to apply information from diverse technical fields (mechanical engineering and electrical systems) to make informed decisions regarding agricultural mechanisation

Social intelligence

This includes communicating, feeling, collaborating and leading. The most relevant are:

- ◆ Communicating: building communication skills, particularly an ability to listen, receive and give information for improved decision making
- ◆ Leading: committing to selecting agricultural machinery that leverages renewable energy and promotes long-term sustainability of resources

Innovation

This includes curiosity, creativity, sense-making and critical thinking. The most relevant are:

- ◆ Creativity: designing and recommending mechanisation strategies that enhance productivity while reducing environmental impact
- ◆ Sense-making: developing an ability to dissect and understand engineering concepts, and apply them to real-world agricultural machinery problems
- ◆ Critical thinking: assessing various machinery and technology options for their efficiency, suitability and sustainability, while considering both current and future agricultural needs

Literacies

This unit provides opportunities to develop the following literacies:

Numeracy

Learners have opportunities to develop numeracy knowledge, understanding and skills throughout the unit. In particular, they learn to apply mathematical methods to mechanisation in agriculture — for example to power, torque and speed analyses.

Communication

Learners have the opportunity to develop their written, graphical and verbal communication skills throughout the unit in classroom- and workshop-based practice tasks and discussions.

Digital

Learners can develop and enhance their digital literacies, as they use word processing, spreadsheet and presentation software in all their learning outcomes.

Learning for Sustainability

Throughout this unit, you should encourage learners to develop their skills, knowledge and understanding of sustainability.

This includes:

- ◆ a general understanding of social, economic and environmental sustainability
- ◆ a general understanding of the United Nations Sustainable Development Goals (SDGs)
- ◆ a deeper understanding of subject-specific sustainability
- ◆ the confidence to apply the skills, knowledge, understanding and values they develop in the next stage of their life

The unit covers the underlying principles learners need to apply scientific theory and practice to the efficient use of energy and operation of machinery, thereby reducing the environmental impact of using machinery for agricultural purposes.

The evolution of agriculture into a mechanisation-driven industry should make the sector more efficient, both financially and in terms of production volumes. It should also significantly help to meet local and global sustainability goals.

Delivery of unit

The unit involves covering both theory and practice in classroom-, farm- and workshop-based tasks. As you deliver the unit, you should arrange visits to a range of livestock farms, as well as teaching the theoretical knowledge.

The notional time for delivery and assessment is 80 hours. The amount of time you allocate to each outcome is flexible, but you should treat each outcome as presenting equal demand.

This is an optional unit in HNC Agriculture. You can deliver it as a stand-alone unit, or partially integrate it with elements of the Principles of Livestock Production, Principles of Crop Production or Professional Practice and Skills units.

There are opportunities to combine or integrate assessments with those for the Principles of Crop Production or Principles of Livestock Management units.

Additional guidance

The guidance in this section is not mandatory.

Approaches to delivery

The unit offers a degree of flexibility in how you deliver the different outcomes. We recommend that you take a scaffold learning approach and that you personalise learning opportunities.

The following information may help shape how you deliver the unit as a whole. Any visits or speakers you arrange can also offer learning opportunities for other units that are part of HNC Agriculture.

- ◆ Provide contextualised examples and exercises.
- ◆ Promote reflective practice — encourage learners to reflect on their learning experiences, and ensure they have regular opportunities for self-assessment, self-reflection, and self-directed learning.
- ◆ Foster a growth mindset by providing constructive feedback and encouraging learners to persist and learn from their mistakes.
- ◆ Invite guest speakers from the agricultural industry — ask farmers and agricultural machinery dealers to share their experiences and perspectives on the use of data in agriculture.
- ◆ Collaborate with industry partners to provide learners with real-world projects, internships or work placements where they can apply their skills in agricultural mechanisation.
- ◆ Recognise and accommodate learners' diverse learning styles and preferences.
- ◆ Provide differentiated instruction, allowing learners to work at their own pace and access resources tailored to their individual needs.
- ◆ Offer opportunities for learners to pursue independent or group projects that align with their specific interests within the field of agricultural mechanisation.

Approaches to assessment

You can assess this unit in a variety of different ways. The following approach to assessment is a suggestion; other approaches to assessment are also valid.

1 Quizzes and/or written work (30% of total grade)

You could focus on the fundamental principles of agricultural machinery, including engines, power systems, and the basics of electricity in agriculture. This could cover outcomes 1 and 4, testing learners on their theoretical knowledge and their ability to apply the principles of prime mover operation, electric motors, and the basics of electrical safety and circuits in agriculture.

2 Practical assessments (20% of total grade)

You could use a range of practical assessments to cover the operational aspects of outcomes 2 and 3, which could include competency in the following examples:

- ◆ tractor driving and servicing
- ◆ operating livestock machinery (at least one)
- ◆ operating arable machinery (at least one)
- ◆ taking a basic electric wiring test, in which learners show they can trace a wiring system and identify constituent parts

3 Project (40% of total grade)

Learners could apply their knowledge to a real or simulated agricultural setting, selecting appropriate range machinery for an appropriate mechanised operation on a farm, and thereby covering outcomes 2 (20%) and 3 (20%).

Examples of mechanised operations could be:

- ◆ making silage
- ◆ crop establishment
- ◆ crop harvesting
- ◆ slurry application

You could combine or integrate these assessments with those for the Principles of Crop Production or Principles of Livestock Management units.

4 Coursework assignments (10% of total grade)

Learners could produce a technical report in the form of a written assignment in which they investigate a recent innovation in an agricultural mechanisation application in farming.

This assessment approach would help ensure a balanced evaluation of learners' theoretical knowledge and practical skills.

Equality and inclusion

This unit is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

You must consider the needs of individual learners when planning learning experiences, selecting assessment methods or considering alternative evidence.

Guidance on assessment arrangements for disabled learners and those with additional support needs is available on the [assessment arrangements web page](#).

Information for learners

Principles of Mechanisation (SCQF level 7)

This information explains:

- ◆ what the unit is about
- ◆ what you should know or be able to do before you start
- ◆ what you need to do during the unit
- ◆ opportunities for further learning and employment

Unit information

This unit gives you the knowledge and skills to objectively evaluate mechanical plant and equipment for optimum business efficiency. During the unit, you consider topics related to the principles of mechanisation in agriculture.

You do not need any prior knowledge or experience to do this unit, but you would find it helpful to have studied mathematics at SCQF level 5.

You have the opportunity to develop theoretical and practical knowledge and skills in class and workshop settings. Farm visits can help you understand these in a real-world context.

You are assessed using a variety of formative and summative assessment methods, including the completion of an appropriate number of workshop and field exercises.

You are encouraged to keep a log of your reflections as you develop meta-skills, digital literacies, industry knowledge and wider employability skills throughout the teaching and assessment processes.

When you have completed this unit, you can:

- 1 explain the principles of mechanisation
- 2 evaluate agricultural crop machinery
- 3 evaluate agricultural livestock machinery
- 4 describe the safe use of electricity in agriculture

Meta-skills

This unit will enable you to enhance your meta-skills including in the following ways.

- ◆ **Self-management:** focusing on collecting and assimilating accurate and meaningful data on which to base decisions, by filtering out non-essential material; developing a capacity to apply information from diverse technical fields (mechanical engineering and electrical systems) to make informed decisions regarding agricultural mechanisation
- ◆ **Social intelligence:** building communication skills, particularly an ability to listen, receive and give information for improved decision making; committing to selecting agricultural machinery that leverages renewable energy and promotes long-term sustainability of resources

NextGen: HN published prototype unit specification for use in pilot delivery only (version 1.0)
September 2024

- ◆ Innovation: designing and recommending mechanisation strategies that enhance productivity while reducing environmental impact; developing an ability to dissect and understand engineering concepts and apply them to real-world agricultural machinery problems; assessing various machinery and technology options for their efficiency, suitability and sustainability, while considering both current and future agricultural needs

Sustainability

The unit gives you the underlying principles required to apply scientific theory and practice to sustainable food production, land use, water resource management and energy supply.

This unit is part of the HNC Agriculture. It gives you the knowledge and skills to select and work with agricultural machinery on a farm. On completion of the HNC you may be able go on to study the HND Agriculture, or go directly into employment.

Administrative information

Published: September 2024 (version 1.0)

Superclass: SK

History of changes

Version	Description of change	Date

Please check [SQA's website](#) to ensure you are using the most up-to-date version of this document.