NextGen: HN educator guide

HNC Engineering

Qualification code: GT64 47

Valid from: August 2026

This guide provides information about the Higher National Certificate (HNC) 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 HNC.

You must read it alongside the grading pack.

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Contents

Purpose of the qualification

Higher National Certificate (HNC) Engineering equips learners with the technical knowledge and skills, as well as the professional skills and personal behaviours (meta-skills), that employers expect from individuals entering into and working within the Scottish engineering and advanced manufacturing sector at HNC level.

HNC learners may already be in employment and attend centres on a day-release or other part-time basis. The HNC framework structure is flexible enough to allow centres to deliver the qualification in various ways, including two-year day release or evening attendance.

The options employed learners choose may reflect the branch of industry in which they are employed, or they may wish to gain knowledge of other areas of engineering to improve their career opportunities. Part-time learners may also use the HNC to gain entry to degree-level studies.

Full-time HNC learners may be school leavers who have not gained the required university entry qualifications and hope to use the qualification as an alternative way to access to a university education. Full-time learners may also be more mature persons who are seeking a change of employment.

The units have been designed to provide learners with opportunities to develop critical knowledge and understanding of theory and practical hands-on skills required by practising incorporated engineers.

While there is a degree of flexibility within the mandatory optional section of the award to suit local needs, there are still recognised traditional engineering discipline routes. The examples below show potential routes for Mechanical Engineering and Electrical Engineering.

Mechanical Engineering route

Mandatory units

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J7GK 46	Engineering Mathematics 1	1	8	6
J6CT 46	Engineering Principles	1	8	6
J6CS 47	Professional Practice in Engineering	4	32	7

Mandatory optional units

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6CX 47	Thermodynamics and Fluid Mechanics	3	24	7
J6D3 47	Engineering Mechanics and Materials	3	24	7

Optional unit

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6D9 47	Mechanical Engineering: Practical Skills	3	24	7

Electrical Engineering route

Mandatory units

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J7GK 46	Engineering Mathematics 1	1	8	6
J6CT 46	Engineering Principles	1	8	6
J6CS 47	Professional Practice in Engineering	4	32	7

Mandatory optional units

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6CW 47	Electrical Engineering Principles	3	24	7
J6D2 47	Electrical Power and Drive Systems	3	24	7

Optional unit

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6D6 47	Electrical Engineering: Practical Skills	3	24	7

Structure

Higher National Certificates (HNCs) are at SCQF level 7 and are made up of 120 SCQF credit points (15 Qualifications Scotland credits). HNCs must incorporate at least 80 credit points (10 Qualifications Scotland credits) at SCQF level 7.

Framework

The HNC is made up of mandatory, mandatory optional and optional units. Learners must complete all the mandatory units, 6 Qualifications Scotland credits from the mandatory optional units and 3 Qualifications Scotland credits from the optional units.

Mandatory units

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J7GK 46	Engineering Mathematics 1	1	8	6
J6CT 46	Engineering Principles	1	8	6
J6CS 47	Professional Practice in Engineering	4	32	7

Mandatory optional units (6 Qualifications Scotland credits required)

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6CW 47	Electrical Engineering Principles	3	24	7
J6D2 47	Electrical Power and Drive Systems	3	24	7

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J752 47	Digital Electronics: Theory and Applications	3	24	7
J751 47	Analogue Electronics: Theory and Applications	3	24	7
J89H 47	Engineering Systems: Validation and Verification	3	24	7
J6D4 47	Engineering Systems Principles	3	24	7
J6D0 47	Instrumentation and Control: Measurement Systems	3	24	7
J6D5 47	Instrumentation and Control: Control Systems	3	24	7
J6CV 47	Manufacturing Engineering: Materials and Processes	3	24	7
J6D1 47	Manufacturing Engineering: Simulation and Modelling	3	24	7
J6CX 47	Thermodynamics and Fluid Mechanics	3	24	7
J6D3 47	Engineering Mechanics and Materials	3	24	7

Optional units (3 Qualifications Scotland credits required)

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6D6 47	Electrical Engineering: Practical Skills	3	24	7

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6DA 47	Engineering Systems: Practical Skills	3	24	7
J6DB 47	Instrumentation and Control: Practical Skills	3	24	7
J6D9 47	Mechanical Engineering: Practical Skills	3	24	7
J750 47	Electronics in Practice: Skills and Techniques	3	24	7
J6CW 47	Electrical Engineering Principles	3	24	7
J6D2 47	Electrical Power and Drive Systems	3	24	7
J752 47	Digital Electronics: Theory and Applications	3	24	7
J751 47	Analogue Electronics: Theory and Applications	3	24	7
J89H 47	Engineering Systems: Validation and Verification	3	24	7
J6D4 47	Engineering Systems Principles	3	24	7
J6D0 47	Instrumentation and Control: Measurement Systems	3	24	7
J6D5 47	Instrumentation and Control: Control Systems	3	24	7
J6CV 47	Manufacturing Engineering: Materials and Processes	3	24	7
J6D1 47	Manufacturing Engineering: Simulation and Modelling	3	24	7

Unit code	Unit title	Qualifications Scotland credits	SCQF credit points	SCQF level
J6CX 47	Thermodynamics and Fluid Mechanics	3	24	7
J6D3 47	Engineering Mechanics and Materials	3	24	7
J7GL 47	Engineering Mathematics 2	1	8	7
J7L9 47	Engineering Mathematics 3	1	8	7
J7LA 48	Engineering Mathematics 4	1	8	8
J7LB 48	Engineering Mathematics 5	1	8	8
J7GP 47	Applications of Programmable Logic Controllers	1	8	7
J7GS 46	Engineering Practical Skills	2	16	6
J7N3 47	Work-based Learning	3	24	7

Aims of the qualification

General aims

1. Enhance employment prospects.
2. Develop meta-skills that complement technical and professional knowledge and skills.
3. Develop self-awareness and understanding to enable learners to use meta-skills to discuss, increase and enhance employability.
4. Support continuing professional development (CPD) and career development.
5. Enable progression within the Scottish Credit and Qualifications Framework (SCQF).
6. Develop the ability to apply analysis and synthesis skills to solve engineering problems.
7. Develop learning and transferable skills (including meta-skills).
8. Develop the ability to accurately apply a range of mathematical and other analytical techniques to solve engineering problems in the relevant engineering discipline.
9. Develop Learning for Sustainability skills, knowledge, understanding and values.

Specific aims

1. Enable learners to work as engineering technicians or incorporated engineers.
2. Meet the academic requirements for Engineering Technician (EngTech) status, with specific reference to the Engineering Council's five competences:

    - A. Knowledge and understanding
    - B. Design, development and solving engineering problems
    - C. Responsibility, management and leadership
    - D. Communication and interpersonal skills
    - E. Professional commitment

3. Enable progression to a Higher National Diploma (HND), or a degree in engineering or a related subject.

4. Transfer knowledge and skills gained to other areas of employment.
5. Enhance project management skills through a project-based approach to solving engineering problems.
6. Raise awareness of sustainability, environmental impact and other related areas in an engineering context.
7. Enhance the ability to develop safe systems of work.
8. Develop commitment to professional engineering values.
9. Carry out substantive project analysis and development of key engineering content through project assignments across units.
10. Allow learners to specialise in one or more of the following engineering disciplines:
    - electronics
    - electrical engineering
    - manufacturing engineering
    - mechanical engineering
    - instrumentation and control
    - engineering systems

Who is this qualification for?

This qualification is suitable for learners who want to work in industries within the Scottish engineering and advanced manufacturing sector, or progress to a degree in an engineering discipline.

Entry to this qualification is at your centre's discretion. However, we recommend that learners have one or more of the following:

- one Higher in Physics, Engineering Science, Mathematics, Computing Science or other related scientific or technology area that involves numeracy
- at least one other Higher pass in English, Modern Studies or another related area that involves communication
- a relevant National Certificate Group Award in Engineering or a related discipline, such as Construction or Computing
- a qualification comparable to those listed above from another awarding body

It is at your centre's discretion to accept applicants with a different experiential background who could benefit from taking the course or units within the course. This could include adult returners or those with relevant work experience.

Recognising prior learning

Qualifications Scotland recognises that learners gain knowledge and skills through formal, non-formal and informal learning contexts. Formal learning is learning certificated by a recognised awarding or professional body. Non-formal learning includes learning such as employers' in-house training courses. Informal learning is learning based on experience from a variety of environments that is not formally assessed.

It is unlikely that a learner would have the appropriate prior learning and experience to meet all the requirements of a full HNC.

We expect that the majority of part-time learners will be employed apprentices attending as part of their apprenticeship, under the supervision of a training officer.

During their apprenticeship, learners will have gained a valuable and varied range of practical skills.

This qualification contains an options list of 3-credit practical skills units. These are in the areas of:

- engineering systems
- mechanical
- electrical
- electronics
- instrumentation and control

There is also the more general 2-credit Engineering Practical Skills unit. We recommend that part-time learners receive credit for skills gained as part of their apprenticeship if they correspond with any of these practical skills units, or any other unit within the framework. This gives centres an additional opportunity to discuss apprentice learners' progress with training officers. This could reduce learners' time spent at college, with the final 3 credits consisting of recognised prior learning.

Centres should have a discussion on recognition of prior learning with apprentices and training officers at the start of the programme, to match their skills to one of the practical skills units. A complete match is not always possible. However, you can give partial credit and identify routes that give learners the opportunity to overcome any shortfalls.

A centre could have part-time learners coming from various employers, following different apprenticeships. For example, it is possible for some apprentices to receive prior recognition for electrical skills, while others receive prior recognition for mechanical skills. It is important that centres match the specific skills that an apprentice gains during employment to the skills and level required by the specific practical unit.

You can find more information and guidance about the recognition of prior learning on our website.

Articulation and progression

Learners who complete this qualification could go on to:

- other qualifications in engineering or related areas, such as HND Engineering or an HND in a related discipline
- further study, employment and/or training, such as a degree in engineering or a related discipline
- create a route towards meeting the academic requirements for the Engineering Council Engineering Technician (EngTech) status

Professional recognition

There is no automatic professional recognition on completing this qualification. However, it has been designed to provide a route towards meeting the academic requirements for recognition of Engineering Technician (EngTech) status by the Engineering Council.

Credit transfer arrangements

Centres can make decisions about transferring credit. They can transfer credit if the subject-related content of the units is broadly equivalent. Centres should consider the currency of a learner's achievement before transferring credit.

Recommended Core Skills entry profile

Learners should have the following Core Skills at the stated SCQF levels before starting this qualification. This information can help identify learners who may need additional support.

Core Skill	Recommended SCQF entry profile
Communication	SCQF level 6
Numeracy	SCQF level 6
Information and communication technology (ICT)	SCQF level 6
Problem solving	SCQF level 6
Working with others	SCQF level 6

How the qualification meets employer and higher education institution needs

This qualification is designed in collaboration with employers, higher education institutions (HEIs), practitioners and professional bodies to meet the sector need.

The following tables show how the qualification can benefit employers and HEIs by equipping learners with the necessary skill set:

- Table 1 shows how units map to the aims of the qualification.
- Table 2 shows how the units map to trade or professional body requirements.
- Table 3 shows the assessment strategy for the qualification.

Table 1: mapping qualification aims to units

General aims

All nine general aims are directly relevant to all units.

Specific aims

Key: aim is directly relevant to unit (X), aim is optional in this unit (O)

Unit code	Unit title	Aim 1	Aim 2	Aim 3	Aim 4	Aim 5	Aim 6	Aim 7	Aim 8	Aim 9	Aim 10
J7GK 46	Engineering Mathematics 1	X	X	X	X	X	O	O	O	X	X
J6CS 47	Professional Practice in Engineering	X	X	X	X	X	X	X	X	X	X
J6CT 46	Engineering Principles	X	X	X	X	X	O	X	O	X	X
J6CW 47	Electrical Engineering Principles	X	X	X	X	X	O	X	O	X	X
J6D2 47	Electrical Power and Drive Systems	X	X	X	X	X	O	X	O	X	X

Unit code	Unit title	Aim 1	Aim 2	Aim 3	Aim 4	Aim 5	Aim 6	Aim 7	Aim 8	Aim 9	Aim 10
J752 47	Digital Electronics: Theory and Applications	X	X	X	X	X	O	X	O	X	X
J751 47	Analogue Electronics: Theory and Applications	X	X	X	X	X	O	X	O	X	X
J89H 47	Engineering Systems: Validation and Verification	X	X	X	X	X	O	X	O	X	X
J6D4 47	Engineering Systems Principles	X	X	X	X	X	O	X	O	X	X
J6D0 47	Instrumentation and Control: Measurement Systems	X	X	X	X	X	O	X	O	X	X
J6D5 47	Instrumentation and Control: Control Systems	X	X	X	X	X	O	X	O	X	X
J6CV 47	Manufacturing Engineering: Materials and Processes	X	X	X	X	X	O	X	O	X	X
J6D1 47	Manufacturing Engineering: Simulation and Modelling	X	X	X	X	X	O	X	O	X	X
J6CX 47	Thermodynamics and Fluid Mechanics	X	X	X	X	X	O	X	O	X	X

Unit code	Unit title	Aim 1	Aim 2	Aim 3	Aim 4	Aim 5	Aim 6	Aim 7	Aim 8	Aim 9	Aim 10
J6D3 47	Engineering Mechanics and Materials	X	X	X	X	X	O	X	O	X	X
J6D6 47	Electrical Engineering: Practical Skills	X	X	X	X	X	O	X	O	X	X
J6DA 47	Engineering Systems: Practical Skills	X	X	X	X	X	O	X	O	X	X
J6DB 47	Instrumentation and Control: Practical Skills	X	X	X	X	X	O	X	O	X	X
J6D9 47	Mechanical Engineering: Practical Skills	X	X	X	X	X	O	X	O	X	X
J750 47	Electronics in Practice: Skills and Techniques	X	X	X	X	X	O	X	O	X	X
J7GL 47	Engineering Mathematics 2	X	X	X	X	X	O	X	O	X	X
J7L9 47	Engineering Mathematics 3	X	X	X	X	X	O	X	O	X	X
J7LA 48	Engineering Mathematics 4	X	X	X	X	X	O	X	O	X	X
J7LB 48	Engineering Mathematics 5	X	X	X	X	X	O	X	O	X	X
J7GP 47	Applications of Programmable Logic Controllers	X	X	X	X	X	O	X	O	X	X

Unit code	Unit title	Aim 1	Aim 2	Aim 3	Aim 4	Aim 5	Aim 6	Aim 7	Aim 8	Aim 9	Aim 10
J7GS 46	Engineering Practical Skills	X	X	X	X	X	O	X	O	X	X

Table 2: mapping trade or professional body requirements to units

This table indicates where opportunities to meet the Engineering Council's competences for the Engineering Technician (EngTech) standard may be found.

Key: aim is directly relevant to unit (X), aim is optional in this unit (O)

Unit code	Unit title	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3	E4	E5
J7GK 46	Engineering Mathematics 1	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6CS 47	Professional Practice in Engineering	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J6CT 46	Engineering Principles	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6CW 47	Electrical Engineering Principles	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D2 47	Electrical Power and Drive Systems	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J752 47	Digital Electronics: Theory and Applications	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O

Unit code	Unit title	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3	E4	E5
J751 47	Analogue Electronics: Theory and Applications	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J89H 47	Engineering Systems: Validation and Verification	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D4 47	Engineering Systems Principles	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D0 47	Instrumentation and Control: Measurement Systems	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D5 47	Instrumentation and Control: Control Systems	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6CV 47	Manufacturing Engineering: Materials and Processes	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D1 47	Manufacturing Engineering: Simulation and Modelling	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6CX 47	Thermodynamics and Fluid Mechanics	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J6D3 47	Engineering Mechanics and Materials	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O

Unit code	Unit title	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3	E4	E5
J6D6 47	Electrical Engineering: Practical Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J6DA 47	Engineering Systems: Practical Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J6DB 47	Instrumentation and Control: Practical Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J6D9 47	Mechanical Engineering: Practical Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
J750 47	Electronics in Practice: Skills and Techniques	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J7GL 47	Engineering Mathematics 2	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J7L9 47	Engineering Mathematics 3	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J7LA 48	Engineering Mathematics 4	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J7LB 48	Engineering Mathematics 5	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O
J7GP 47	Applications of Programmable Logic Controllers	X	X	O	O	O	O	O	X	X	X	O	O	O	O	O

Unit code	Unit title	A1	A2	B1	B2	C1	C2	C3	D1	D2	D3	E1	E2	E3	E4	E5
J7GS 46	Engineering Practical Skills	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 3: assessment strategy for the qualification

Unit code	Unit title	Assessment method
J7GK 46	Engineering Mathematics 1	Closed-book
J6CS 47	Professional Practice in Engineering	Open-book, project-based
J6CT 46	Engineering Principles	Open-book, project-based
J6CW 47	Electrical Engineering Principles	Open-book, project-based
J6D2 47	Electrical Power and Drive Systems	Open-book, project-based
J752 47	Digital Electronics: Theory and Applications	Open-book, project-based
J751 47	Analogue Electronics: Theory and Applications	Open-book, project-based
J89H 47	Engineering Systems: Validation and Verification	Open-book, project-based

Unit code	Unit title	Assessment method
J6D4 47	Engineering Systems Principles	Open-book, project-based
J6D0 47	Instrumentation and Control: Measurement Systems	Open-book, project-based
J6D5 47	Instrumentation and Control: Control Systems	Open-book, project-based
J6CV 47	Manufacturing Engineering: Materials and Processes	Open-book, project-based
J6D1 47	Manufacturing Engineering: Simulation and Modelling	Open-book, project-based
J6CX 47	Thermodynamics and Fluid Mechanics	Open-book, project-based
J6D3 47	Engineering Mechanics and Materials	Open-book, project-based
J6D6 47	Electrical Engineering: Practical Skills	Open-book, project-based
J6DA 47	Engineering Systems: Practical Skills	Open-book, project-based

Unit code	Unit title	Assessment method
J6DB 47	Instrumentation and Control: Practical Skills	Open-book, project-based
J6D9 47	Mechanical Engineering: Practical Skills	Open-book, project-based
J750 47	Electronics in Practice: Skills and Techniques	Open-book, project-based
J7GL 47	Engineering Mathematics 2	Closed-book
J7L9 47	Engineering Mathematics 3	Closed-book
J7LA 48	Engineering Mathematics 4	Closed-book
J7LB 48	Engineering Mathematics 5	Closed-book
J7GP 47	Applications of Programmable Logic Controllers	Open-book, project-based
J7GS 46	Engineering Practical Skills	Open-book, project-based
J7N3 47	Work-based Learning	Open-book, project-based

Meta-skills

Every NextGen: HN Qualification gives learners the opportunity to develop meta-skills.

Meta-skills are transferable behaviours and abilities that help people to adapt and succeed in life, study and work. There are three categories of meta-skills: self-management, social intelligence and innovation. Each of these is made up of four meta-skills and a number of sub-skills.

- Self-management — focusing, integrity, adapting, initiative
- Social intelligence — communicating, feeling, collaborating, leading
- Innovation — curiosity, creativity, sense-making, critical thinking

From early in the qualification, we want learners to identify and understand the meta-skills they can develop, and to appreciate the personal and professional value of these skills. We want to support learners to continue to articulate, use and build on them long after they have achieved their qualification. In this way, we help learners to develop broad skills profiles, enabling them to thrive in a changing world.

Every NextGen: HN unit signposts opportunities for learners to develop meta-skills, and there is an assessed outcome in one of the mandatory units. When you make your whole-qualification grade decisions, you consider learners' commitment to engaging with meta-skills development.

You do not assess learners on their competence or progress in individual meta-skills. Instead, you assess them on evidence that they have engaged with a personal process of development. Meta-skills development is founded on a clear process of self-assessment, goal setting, action planning and reflective practice.

You can find meta-skills teaching, learning and assessment resources on our meta-skills web page.

Meta-skills in HNC Engineering

The mandatory unit Professional Practice in Engineering includes a specific outcome on meta-skills in which learners must show how they have developed their meta-skills.

Learners carry out projects, personal reflection and practical tasks throughout the course, which help them develop meta-skills.

Learning for Sustainability

Context

The United Nations (UN) 2030 Agenda for Sustainable Development, adopted by the UK in 2015, has shaped the development of Scottish, national and international sustainability policy. It sets out the UN Sustainable Development Goals (SDGs), which are central to the Scottish Government's National Performance Framework. Learning for Sustainability (LfS) is a commitment to embedding the SDGs in Scottish education.

LfS embraces global citizenship, sustainable development, social justice, human rights, climate change, biodiversity loss, equality and inclusion. Learners develop their capacity to deal with the unpredictable social, economic and environmental challenges facing our rapidly changing world.

LfS combines:

- education for sustainable development (ESD)
- global citizenship
- outdoor learning

ESD is the internationally used term for sustainability education. Although LfS has a broader remit, the terms are largely interchangeable. Colleges and universities tend to use ESD, while schools usually use LfS. Both focus on a broad range of social, economic and environmental themes and approaches across all levels of education. Qualifications Scotland uses LfS as an umbrella term.

Learning for Sustainability in NextGen: HN Qualifications

Sustainability is a core component in this qualification.

Learners who complete this qualification should have:

- a general understanding of social, economic and environmental sustainability
- a general understanding of the 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

Sustainability is embedded in outcome 1 of the mandatory Professional Practice in Engineering unit.

Learners who complete this outcome can:

- assess their own knowledge and understanding of sustainability and the SDGs
- review unit content against the SDGs to identify a sustainability-related issue
- apply knowledge and understanding of sustainability and the SDGs to propose improvements

The Engineering Council has embedded sustainability in the key aims of all levels of professional engineer. Engineers must ‘demonstrate appropriate consideration of the principles of sustainability’ to gain professional recognition. There are six principles to guide and motivate professional engineers in their Guidance on Sustainability.

One of the specific aims of HNC Engineering is to ‘raise awareness of sustainability, environmental impact and other related areas in an engineering context’. Specifically, in outcome 1 of Professional Practice in Engineering, learners must demonstrate that they have ‘examined and summarised the sustainability and environmental impacts of the solutions to the problem’ for a given task. Sustainability is also considered in other units in this qualification.

Find out more about Qualifications Scotland’s approach on the NextGen: HN Learning for Sustainability web page. There is an LfS reflective template available in the resources section. You may find it helpful as a starting point for considering how the SDGs are, or could be, embedded in a qualification, unit or assessment.

Grading

Please see the grading pack for this qualification for more information on making grade judgements.

Grading in NextGen: HN Qualifications produces a valid and reliable record of a learner’s level of achievement across the breadth of the qualification content.

As well as grading the whole qualification, you assess individual units on a pass or fail basis. Each unit has evidence requirements that learners must achieve before you can consider them for whole-qualification grading.

Whole-qualification grade outcomes

Learners who pass NextGen: HN Qualifications receive one of the following grade outcomes for the qualification as a whole:

- Achieved with Distinction
- Achieved with Merit
- Achieved

To determine a learner’s whole-qualification grade, you use the grading matrix provided in the grading pack to assess and judge their performance across the key aspects of the HNC. You must align your judgements with the following whole-qualification grade descriptors.

Whole-qualification grade descriptors

Achieved with Distinction

The learner has achieved an excellent standard across the course content, going significantly beyond meeting the qualification requirements. They showed a comprehensive knowledge and understanding of course concepts and principles, and consistently used them to apply skills to complete high-quality work. They engaged significantly with the process of developing their meta-skills in the context of their HN Qualification.

Achieved with Merit

The learner has achieved a very good standard across the course content, going beyond meeting the qualification requirements. They showed a very good knowledge and understanding of course concepts and principles, and consistently used them to apply skills to complete work of a standard above that expected for an Achieved grade. They actively engaged with the process of developing their meta-skills in the context of their HN Qualification.

Achieved

The learner has achieved a good standard across the course content, credibly meeting the qualification requirements. They showed a good knowledge and understanding of course concepts and principles, and used them to apply skills to complete work of the required standard. They engaged with the process of developing their meta-skills in the context of their HN Qualification.

Approaches to delivery and assessment

Centres should sequence and integrate assessment across units to reflect the needs of their learners and the resources available. A typical sequence of units for delivery could concentrate on practical skills and core principles initially, followed by the more demanding knowledge and skills required to complete the HNC.

Sequencing or integrating units

Delivery of Engineering Systems, Mechanical and Electrical pathways

Engineering Systems

Semester 1 (18 weeks)	Semester 2 (18 weeks)
• Engineering Mathematics 1 (1 credit) — 2 hours per week • Engineering Principles (1 credit) — 2 hours per week • Engineering Systems Principles (3 credits) — 6 hours per week • Engineering Systems: Practical Skills (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week	• Professional Practice in Engineering (4 credits) — 8 hours per week • Engineering Systems: Validation and Verification (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week
Total per week: 17 hours	Total per week: 15 hours

Mechanical

Semester 1 (18 weeks)	Semester 2 (18 weeks)
• Engineering Mathematics 1 (1 credit) — 2 hours per week • Engineering Principles (1 credit) — 2 hours per week • Engineering Mechanics and Materials (3 credits) — 6 hours per week • Mechanical Engineering: Practical Skills (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week	• Professional Practice in Engineering (4 credits) — 8 hours per week • Thermodynamics and Fluid Mechanics (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week
Total per week: 17 hours	Total per week: 15 hours

Electrical

Semester 1 (18 weeks)	Semester 2 (18 weeks)
• Engineering Mathematics 1 (1 credit) — 2 hours per week • Engineering Principles (1 credit) — 2 hours per week • Electrical Engineering Principles (3 credits) — 6 hours per week • Electrical Engineering: Practical Skills (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week	• Professional Practice in Engineering (4 credits) — 8 hours per week • Electrical Power and Drive Systems (3 credits) — 6 hours per week • Grading and meta-skills support — 1 hour per week
Total per week: 17 hours	Total per week: 15 hours

Outcome delivery

Engineering Systems — semester 1 (18 weeks)

Engineering Mathematics 1 (1 credit, 2 hours per week)

1. solve problems involving functions and trigonometric equations
2. solve problems involving exponential and logarithmic equations
3. apply mathematical techniques involving vectors and complex numbers

Engineering Principles (1 credit, 2 hours per week)

1. describe mechanical engineering quantities used in engineering systems
2. describe electrical engineering quantities used in engineering systems
3. compare mechanical and electrical quantities
4. investigate the properties of materials used in engineering systems

Engineering Systems Principles (3 credits, 6 hours per week)

1. apply electrical principles to solve problems encountered in engineering systems
2. apply mechanical principles to solve problems encountered in engineering systems
3. apply fluids and heat transfer principles to solve problems encountered in engineering systems
4. apply instrumentation principles to solve problems encountered in engineering systems

Engineering Systems: Practical Skills (3 credits, 6 hours per week)

1. work safely and efficiently in a workshop environment
2. use engineering software to solve a pre-defined problem
3. assemble and test an electrical or electronic circuit
4. assemble and test a mechanical artefact

Total per week: 16 hours

Engineering Systems — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

1. use engineering and digital skills to solve a real-world engineering problem
2. demonstrate team working skills
3. use project management concepts
4. use communication skills to communicate progress and solutions
5. develop own meta-skills in a vocational context

Engineering Systems: Validation and Verification (3 credits, 6 hours per week)

1. apply key concepts of system integration
2. use verification and validation techniques in system modelling
3. identify methods of assuring quality in engineering systems
4. explain the importance of reliability to engineering design

Total per week: 14 hours

Mechanical — semester 1 (18 weeks)

Engineering Mathematics 1 (1 credit, 2 hours per week)

1. solve problems involving functions and trigonometric equations
2. solve problems involving exponential and logarithmic equations
3. apply mathematical techniques involving vectors and complex numbers

Engineering Principles (1 credit, 2 hours per week)

1. describe mechanical engineering quantities used in engineering systems
2. describe electrical engineering quantities used in engineering systems
3. compare mechanical and electrical quantities
4. investigate the properties of materials used in engineering systems

Engineering Mechanics and Materials (3 credits, 6 hours per week)

1. understand the relationship between the structure and properties of materials in relation to mechanical engineering problems
2. apply the principles and laws that relate to engineering dynamics to resolve mechanical engineering problems
3. apply the principles and laws that relate to static equilibrium and strength of materials to resolve mechanical engineering problems

Mechanical Engineering: Practical Skills (3 credits, 6 hours per week)

1. apply the concepts of dimensional control and measurement to determine the accuracy of manufactured mechanical components
2. produce components using hand fitting techniques
3. apply turning operations and techniques to manufacture mechanical components
4. apply milling operations and techniques to manufacture mechanical components

Total per week: 16 hours

Mechanical — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

1. use engineering and digital skills to solve a real-world engineering problem
2. demonstrate team working skills
3. use project management concepts
4. use communication skills to communicate progress and solutions
5. develop own meta-skills in a vocational context

Thermodynamics and Fluid Mechanics (3 credits, 6 hours per week)

1. apply the concepts of temperature and heat to resolve engineering problems
2. apply aspects of the first law of thermodynamics to resolve engineering problems
3. define the various properties and energy transfers for vapours relating to engineering problems
4. apply the principles of heat transfer to resolve engineering problems
5. analyse problems relating to hydrostatic pressures on vertical submerged plane surfaces
6. solve problems involving the application of the mass continuity and Bernoulli's equation to incompressible flow in pipes
7. apply fluid principles in the design, construction and testing of pneumatic and hydraulic systems related to engineering problems

Total per week: 14 hours

Electrical — semester 1 (18 weeks)

Engineering Mathematics 1 (1 credit, 2 hours per week)

1. solve problems involving functions and trigonometric equations
2. solve problems involving exponential and logarithmic equations
3. apply mathematical techniques involving vectors and complex numbers

Engineering Principles (1 credit, 2 hours per week)

1. describe mechanical engineering quantities used in engineering systems
2. describe electrical engineering quantities used in engineering systems
3. compare mechanical and electrical quantities
4. investigate the properties of materials used in engineering systems

Electrical Engineering Principles (3 credits, 6 hours per week)

1. demonstrate knowledge and understanding of DC principles
2. demonstrate knowledge and understanding of single-phase AC principles
3. demonstrate knowledge and understanding of three-phase principles
4. demonstrate knowledge and understanding of electrostatics and electromagnetics

Electrical Engineering: Practical Skills (3 credits, 6 hours per week)

1. work safely and efficiently in electrical work environments
2. understand safe isolation procedures
3. use test instruments to measure electronic circuits
4. install and test low voltage electrical circuits

Total per week: 16 hours

Electrical — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

1. use engineering and digital skills to solve a real-world engineering problem
2. demonstrate team working skills
3. use project management concepts
4. use communication skills to communicate progress and solutions
5. develop own meta-skills in a vocational context

Electrical Power and Drive Systems (3 credits, 6 hours per week)

1. explain the structure and operation of electrical power systems
2. describe the construction, operation and characteristics of a range of electrical motors
3. explain protection, starting and control methods for a range of electrical motors
4. analyse the performance of electrical machines under a range of load conditions
5. apply electrical engineering principles to provide a solution for a given real-world engineering problem

Total per week: 14 hours

Additional guidance on integrated or holistic assessment

Holistic or integrated assessment focuses on assessing a number of outcomes in a unit together, or in some cases, assessing the unit as a whole, rather than by outcome. When assessing a unit of competence holistically, the assessment activities integrate a number of aspects of the competence. Holistic or integrated assessment can reduce the time spent on assessment and can promote greater equity in the assessment process.

When developing or revising a NextGen: HN Qualification, Qualifications Scotland works with a development team to devise an appropriate assessment strategy that accommodates holistic or integrated assessment. However, the practice of integrating units for the purposes of learning and teaching is a centre-led activity.

Units are designed to facilitate holistic or integrated assessment approaches that prevent large, unwieldy assessments.

Sometimes more than one piece of evidence is needed for a unit. For example, if a unit is about building a wall, a learner would need to produce evidence of performance (following the correct procedures and processes when building the wall) and product (a completed wall).

Evidence requirements must do what they say: specify requirements for evidence of learner competence in the unit. The evidence must be of sufficient quality for an assessor or verifier to judge that the learner has achieved the unit.

Centres should consult Qualifications Scotland's Guide to Assessment when developing assessments.

This qualification uses a project-based approach to gathering evidence, both within and across units. This is aided by centres developing engineering-specific case studies to enable learners to submit project-based evidence. In your approach to developing assessments, you should consider the grading profile that learners are working towards and the meta-skills they must develop. Certain units lend themselves to including Learning for Sustainability topics, and we encourage centres to include these in assessments.

Centres should develop comprehensive assessment plans built on this project approach to assessment across units. They should clearly show how the assessment plans contribute to grading and meta-skills development. Centres also must consider the roles and responsibilities of all staff associated with the delivery of the qualification and how information is conveyed to learners at appropriate points in course delivery. When developing comprehensive assessment plans, you should consider the sections of this document covering meta-skills and grading, as well as referring to the grading pack.

We have provided two examples of case studies in Appendix 1.

Task matrix

Below, we provide task matrix templates for the three pathways of engineering systems, mechanical engineering and electrical engineering, across two semesters. You can use a task matrix when you develop case studies to ensure you deliver outcomes in a cohesive, task-orientated way. This allows learners to develop knowledge and skills, including meta-skills and Learning for Sustainability. The number of tasks can vary depending on the resources available at your centre.

You should complete the task matrix by marking boxes with ‘X’ to show which tasks an outcome is integrated with. You can use the completed task matrix for quality assurance, detailing where outcomes are covered and identified in specific tasks.

We have not included Engineering Mathematics 1 in the task matrix, but you may wish to include it in your tasks.

Engineering Systems — semester 1 (18 weeks)

Engineering Principles (1 credit, 2 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Describe mechanical engineering quantities used in engineering systems.								
2. Describe electrical engineering quantities used in engineering systems.								
3. Compare mechanical and electrical quantities.								
4. Investigate the properties of materials used in engineering systems.								

Engineering Systems Principles (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Apply electrical principles to solve problems encountered in engineering systems.								
2. Apply mechanical principles to solve problems encountered in engineering systems.								
3. Apply fluids and heat-transfer principles to solve problems encountered in engineering systems.								
4. Apply instrumentation principles to solve problems encountered in engineering systems.								

Engineering Systems: Practical Skills (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Work safely and efficiently in a workshop environment.								
2. Use engineering software to solve a pre-defined problem.								
3. Assemble and test an electrical or electronic circuit.								
4. Assemble and test a mechanical artefact.								

Engineering Systems — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Use engineering and digital skills to solve a real-world engineering problem.								
2. Demonstrate team working skills.								
3. Use project management concepts.								
4. Use communication skills to communicate progress and solutions.								
5. Develop own meta-skills in a vocational context.								

Engineering Systems: Validation and Verification (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Apply key concepts of system integration.								
2. Use verification and validation techniques in system modelling.								
3. Identify methods of assuring quality in engineering systems.								
4. Explain the importance of reliability to engineering design.								

Mechanical — semester 1 (18 weeks)

Engineering Principles (1 credit, 2 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Describe mechanical engineering quantities used in engineering systems.								
2. Describe electrical engineering quantities used in engineering systems.								
3. Compare mechanical and electrical quantities.								
4. Investigate the properties of materials used in engineering systems.								

Engineering Mechanics and Materials (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Understand the relationship between the structure and properties of materials in relation to mechanical engineering problems.								
2. Apply the principles and laws that relate to engineering dynamics to resolve mechanical engineering problems.								
3. Apply the principles and laws that relate to static equilibrium and strength of materials to resolve mechanical engineering problems.								

Mechanical Engineering: Practical Skills (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Apply the concepts of dimensional control and measurement to determine the accuracy of manufactured mechanical components.								
2. Produce components using hand fitting techniques.								
3. Apply turning operations and techniques to manufacture mechanical components.								
4. Apply milling operations and techniques to manufacture mechanical components.								

Mechanical — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Use engineering and digital skills to solve a real-world engineering problem.								
2. Demonstrate team working skills.								
3. Use project management concepts.								
4. Use communication skills to communicate progress and solutions.								
5. Develop own meta-skills in a vocational context.								

Thermodynamics and Fluid Mechanics (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Apply the concepts of temperature and heat to resolve engineering problems.								
2. Apply aspects of the first law of thermodynamics to resolve engineering problems.								
3. Define the various properties and energy transfers for vapours relating to engineering problems.								
4. Apply the principles of heat transfer to resolve engineering problems.								
5. Analyse problems relating to hydrostatic pressures on vertical submerged plane surfaces.								
6. Solve problems involving the application of the mass continuity and Bernoulli's equation to incompressible flow in pipes.								

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
7. Apply fluid principles in the design, construction and testing of pneumatic and hydraulic systems related to engineering problems.								

Electrical — semester 1 (18 weeks)

Engineering Principles (1 credit, 2 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Describe mechanical engineering quantities used in engineering systems.								
2. Describe electrical engineering quantities used in engineering systems.								
3. Compare mechanical and electrical quantities.								
4. Investigate the properties of materials used in engineering systems.								

Electrical Engineering Principles (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Demonstrate knowledge and understanding of DC principles.								
2. Demonstrate knowledge and understanding of single-phase AC principles.								
3. Demonstrate knowledge and understanding of three-phase principles.								
4. Demonstrate knowledge and understanding of electrostatics and electromagnetics.								

Electrical Engineering: Practical Skills (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Work safely and efficiently in electrical work environments.								
2. Understand safe isolation procedures.								
3. Use test instruments to measure electronic circuits.								
4. Install and test low voltage electrical circuits.								

Electrical — semester 2 (18 weeks)

Professional Practice in Engineering (4 credits, 8 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Use engineering and digital skills to solve a real-world engineering problem.								
2. Demonstrate team working skills.								
3. Use project management concepts.								
4. Use communication skills to communicate progress and solutions.								
5. Develop own meta-skills in a vocational context.								

Electrical Power and Drive Systems (3 credits, 6 hours per week)

Outcome	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
1. Explain the structure and operation of electrical power systems.								
2. Describe the construction, operation and characteristics of a range of electrical motors.								
3. Explain protection, starting and control methods for a range of electrical motors.								
4. Analyse the performance of electrical machines under a range of load conditions.								
5. Apply electrical engineering principles to provide a solution for a given real-world engineering problem.								

Assessing project units

All learners carry out a group or individual project as part of the Professional Practice in Engineering unit, which also includes a meta-skills outcome. The project used for this unit can be formed from the mini projects used for other units, as shown above.

Opportunities for e-assessment

Assessment that is supported by information and communication technology (ICT), such as e-testing or the use of e-portfolios or social software, may be appropriate for some assessments in this qualification.

If you want to use e-assessment, you must ensure that you apply the national standard to all evidence and that the conditions of assessment (as specified in the evidence requirements) are met, regardless of the mode of gathering evidence.

You could also use open, distance and/or e-learning techniques to deliver part or all of the qualification. These could include:

- identifying and sharing useful learning support materials through the internet
- learners using the internet to carry out more in-depth investigations
- developing or purchasing paper-based and/or electronic learning support and assessment materials for individual units
- developing online assessment materials
- using e-mentoring arrangements to support distance learners
- removing any existing barriers to using software

Remediation and re-assessment in NextGen: HN Qualifications

Remediation

Remediation allows an assessor to clarify learners' responses, either by requiring a written amendment or by oral questioning, where there is a minor shortfall or omission in evidence requirements. In either case, the assessor must formally note such instances, in writing or as a recording, and make them available to the internal and external verifier.

Remediation is not permitted for closed-book assessments.

The size and structure of the larger NextGen: HN units should mean that the assessor or lecturer is close enough to ongoing assessment activity in project-based units to identify the requirement for remediation as it occurs.

Re-assessment

We must give learners who fail the unit a re-assessment opportunity or, in exceptional circumstances, two re-assessment opportunities. Where we have introduced larger units to the framework, we expect instances of re-assessment to be minimal, due to the approach to assessment and remediation. Where re-assessment is required in a project-based unit, a substantially different project must be used.

Resource requirements

Centres must offer at least one subject-specific engineering discipline and be equipped to deliver the specific engineering content. Centres already offering HNC Engineering have suitable resources to deliver this qualification.

Information for centres

Equality and inclusion

The units in this HNC are designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

You should 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.

Internal and external verification

You must make sure all assessment methods you use in this qualification are internally verified according to your centre's policies and Qualifications Scotland's guidelines. Information on how to request prior verification for your assessment from Qualifications Scotland is available on our prior verification web page.

Qualifications Scotland carries out external verification to ensure that internal assessment meets the national guidelines for this qualification.

More information on internal and external verification is available in our Guide to Assessment and in NextGen: HN Quality Assurance — Guidance for Centres.

Glossary

Qualifications Scotland credits: 1 Qualifications Scotland credit equals 8 SCQF credit points.

Qualifications Scotland credit value indicates the contribution the unit makes to a Qualifications Scotland qualification. A Qualifications Scotland credit value of 1 represents approximately 40 hours of learning, teaching and assessment.

SCQF: the Scottish Credit and Qualifications Framework (SCQF) is Scotland's national framework for describing qualifications. We use SCQF terminology in this guide to refer to credits and levels. For more information on the SCQF, visit the SCQF website.

SCQF credit points indicate the amount of learning required to complete a qualification. NextGen HNCs and HNDs are worth 120 SCQF credit points.

SCQF levels indicate how hard the qualification is to achieve. The SCQF covers 12 levels of learning. NextGen HNCs are at SCQF level 7 and NextGen HNDs are at SCQF level 8.

Information for learners

HNC Engineering

This information explains:

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

Qualification information

Higher National Certificate (HNC) Engineering equips you with the technical knowledge and skills, as well as the professional skills and personal behaviours (meta-skills), that employers expect from individuals entering into and working within the Scottish engineering and advanced manufacturing sector at HNC level.

You complete 6 credits common to all engineering disciplines and 9 credits reflecting a specific engineering discipline. The content mirrors the Engineering Council's five competences that you need to become an Engineering Technician (EngTech).

Although there is no set entry route to this qualification, we recommend that you have achieved one or more of the following:

- one Higher in Physics, Engineering Science, Mathematics, Computer Science or another related scientific or technology area that involves numeracy
- at least one other Higher pass in English, Modern Studies or another related area that involves communication
- a relevant National Certificate Group Award in Engineering or a related discipline, such as Construction or Computing
- a qualification comparable to those listed above from another awarding body

HNC Engineering is project-based. You must provide evidence that meets the requirements of each unit you take by completing projects and tasks that reflect the knowledge, skills and technology of your chosen specific engineering discipline. Your lecturer will give you engineering-specific case studies to base your projects on. The number of projects or tasks you need to complete depends on the resources available at your centre.

When you complete the qualification, you will receive a grade of Achieved, Achieved with Merit, or Achieved with Distinction. This is based on the evidence you generate in the units. The mandatory and mandatory optional units count towards your overall grade. The three optional credits do not contribute to your overall grade, but you still must achieve them to complete the qualification.

Your centre makes judgements about projects using a detailed criteria matrix based on key competences covering:

- academic knowledge
- sector-specific knowledge
- skills
- professional behaviours

You develop meta-skills throughout the qualification. In the project units, evidence of your meta-skills development contributes to your grade.

HNC Engineering enables you to progress to:

- employment in the engineering industry at an appropriate engineering technician level
- study for a degree or Higher National Diploma (HND) in a related discipline

Appendix 1: example case studies

Wind turbine case study

As we become more aware of the adverse environmental effects of burning fossil fuels, there is an increasing trend towards developing less harmful methods of power generation. This trend is also driven by the realisation that the resources of coal and oil that we have become dependent on are finite, and eventually will no longer be available to meet our demands.

As an alternative means of generating power, renewable sources of energy are being utilised to produce power to meet our increasing demands. Renewable energy originates from sunlight, wind, tidal, geothermal, and other natural sources, and is classed as 'renewable' since it may be either naturally replenished or sustained by actions such as replanting trees.

The development and installation of renewable power-generating systems may depend on a number of factors, such as the amount of power required, the geographical location or the local weather conditions. Scotland's coastline is 7332 miles long, which creates the opportunity for tidal and wave power generation. Coastline, inshore waters, and hilly or mountain regions are also inherently windy, making many areas of Scotland suitable for siting wind turbines.

Wind turbines are becoming a familiar sight and can be found in cities, offshore and in rural areas. They may be installed as single units or in large numbers to form a wind farm, depending on the user's power requirements.

Turbines come in a wide variety of designs and power-generating capacity for use as supplementary domestic power sources; for small-scale power generation for farms, factories and community projects; and for large-scale commercial supply to the National Grid.

A wind turbine is an engineering system comprising mechanical, electrical and electromechanical sub-systems. The concepts of these systems relate to those introduced in the core units of HNC Engineering, and involve applying the basic concepts and techniques to the branch of engineering you are studying. Specifically:

<Insert units or outcomes covered by this case study>

You need to access the internet to help you prepare. The main sources of information for this case study will be websites providing information on a range of topics as suggested below.

<Insert specific elements covered by this case study, such as:>

- system elements — amplifiers, rectifiers, generators, control devices
- transducers — applications, principles of operation, standard output signals and their uses
- actuators — applications, principles of operation
- properties of materials used in the specification and design of wind turbines
- calculations and description of basic engineering quantities — velocity, acceleration, force, energy, power, power consumption
- system power sources — hydraulic, electrical, wind
- sub-systems related specifically to power generation systems
- control principles
- block diagrams and sketching of engineering systems and components
- open-loop, closed-loop, use of controllers
- control system response
- underdamping, overdamping and critical damping
- effects of three-term system control

Questions to help direct your studies

Below is a guide to topics, which may help to direct your research. It poses some questions and is intended to guide you towards relevant areas of information relating to the wind turbine case study.

As you carry out your research, the following questions will help point you in the right direction:

- What are the principles of operation of a wind-powered generation system, and what are the engineering quantities relating to such a system, along with the units of those quantities?
- Transducers convert a non-electrical quantity into an electrical signal. List the transducers described in the core units of this HNC. What are typical applications of each in relation to wind turbines?
- Before constructing a system, a great deal of thought must go into deciding which materials to use. For example, are the materials rigid, flexible, heavy, light, ductile, good conductors, good insulators, good in compression, or good in tension? The characteristics of materials in manufacturing processes and during their service life are also major factors in choice of materials. Produce a list of materials, identifying their properties and characteristics that would be relevant to wind turbine component construction.
- What is meant by ‘open-loop control’ and ‘closed-loop control’? How can the response of a system be modified to compensate for a change of input?

Hydroelectric power case study

The generation of electrical power from hydro sources is an indirect source of solar power. Solar radiation evaporates water from the seas and land. This heated water vapour rises, and as it rises, it cools and expands, eventually condensing to form clouds. When the resulting rain from the clouds falls on higher ground, it has gained potential energy as a result of the sun's input. Hydroelectric power is created as a result of extracting some of this energy as the water flows back to the sea.

The resource of electricity is measured in kilowatt hours (kWh) for usage at a local level. Globally, it is expressed in terawatt hours (TWh) per year.

Around 25% of the 1.5 billion TWh of solar energy that hits Earth is consumed in the evaporation of water. Therefore, the water vapour in our atmosphere gives a very large store of renewable energy. However, most of this energy is not available to us, because as the water vapour condenses, most of the energy is released as heat in the atmosphere and radiates back into space. A very small percentage (0.06%) is retained by the precipitation that falls on mountains and hills.

The worldwide available resource of energy as water flows toward the sea has been estimated at 40 000 TWh per year. This is approximately 15 times the output of hydropower globally. The technical potential of hydropower that could be captured globally has been estimated at 15 000 TWh.

To harness some of this power, hydroelectric schemes must have two essential properties:

- an effective head (the height, H, through which the water falls)
- the flow rate (the number of cubic metres of water per second, Q)

The power carried by the water is roughly 10 times the product of these two quantities:

$$P(kWh) = 10 \times Q \times H$$

The electric power output is, of course, much less than this input.

Stored potential energy

When water is held at height it represents a stored energy, and can be considered as gravitational potential energy. Roughly 9.81 joules of energy input are needed to lift one kilogram vertically through one metre against the gravitational pull of the Earth. If M kilograms are raised through H metres, the stored potential energy in joules is represented as:

Potential energy = MgH (equation 1)

g is the acceleration due to gravity, and is given a value of 9.81 ms².

The above equation allows engineers to calculate the energy store represented by water held at a given height, providing they know the stored mass and the height (the available head).

Power, head and flow rate

To estimate the resource, the power available at any time is vitally important. The power, P, is the rate at which the energy is delivered (the number of joules per second). This depends on the flow rate of the falling water (the number of cubic metres per second, Q). The mass of a cubic metre of fresh water is 1000 kg, so the mass falling per second will be $1000 \times Q$. It then follows from equation 1 that:

$$P = 1000 \times Q \times g \times H$$

When estimating hydroelectric resources, engineers must take into account energy losses. In a real-life hydroelectric system, the water will lose some energy due to friction. Therefore, the effective head is less than the actual head. Sometimes, the effective head is no more than 75% of the actual height difference. Sometimes, it is as much as 95%.

There are also energy losses in the operating plant itself. At optimum conditions, a hydroelectric turbo-generator is a very efficient machine. It converts 95% to 97% of the input power into electrical output. However, the efficiency — the ratio of output power to input power — is always less than 100%.

Types of hydroelectric plant

Hydroelectric plants can range in capacity from 500 watts up to 10 000 megawatts. They can be classified in different ways, including:

- the effective head of water
- the rated power output
- the type of turbine used
- the location and type of dam or reservoir

These factors are not independent of each other. The available head and output determine the type of plant.

Low, medium and high heads

A high head is usually recognised as an effective head of more than 100 metres, and a low head less than 10 metres.

The low head dam, or barrage, maintains the head of water and also houses the plant. It sometimes has a lock for ships or a ladder run for salmon. These usually have low storage capacity and are dependent on the flow rate at the time of the year, or the prevailing weather. The large volume flow means the plant and associated civil engineering is large, leading to high construction costs.

The medium head is usually associated with large hydroelectric installations with a dam at a narrow point in the river valley. The large reservoir behind the dam is capable of supplying power, except in very prolonged dry conditions. The civil engineering costs are very high.

The high head reservoir lies well above the outflow level and the penstock carrying the water may cut through a mountain to reach the turbine. With a high head, the flow needed for a given power is much smaller than for a low-headed plant, so the turbines and generators are more compact. However, the long penstock adds to the cost, and the structure must be able to withstand the high pressures below the large depth of water.

The rated power output is dependent on flow rates and their variability. When calculating power, the local rainfall of the catchment area is taken into account. However, allowances must be made for evaporation, take-up by vegetation and leakage into the ground. Sometimes these factors can account for 75% of the original total. The preferred technique for estimating the power involves establishing the relationships between flow rate and either water depth or water speed at chosen points along the route.

As previously stated, the transfer of energy carried by the water into electrical energy is carried out by the turbo-generator. A turbo-generator is a rotating turbine driven by the water and is connected by a common shaft to the rotor of a generator.

Turbines come in many shapes and forms, and vary in size, with blades ranging from under 1 metre to 20 metres.

Francis turbines are the most common type used in medium-scale to large-scale plants. They can be used where the head is as low as 2 metres to as high as 300 metres. Francis turbines are radial flow turbines. The water flow is inwards towards the centre. The turbine is submerged and can run with its axis horizontal or vertical. In medium-headed or high-headed turbines, the water flow is channelled through a scroll case. This is a curved tube that reduces in size like a snail shell. Guide vanes inside the scroll direct the water in towards the runner. The shape of the guide vanes is important in producing the smooth flow that leads to high efficiency. Francis turbines run most efficiently when the blade speed is only slightly less than the speed of the water on the blades.

Maintaining the correct speed and direction of the incoming water relative to the runner blades is important too, and this can sometimes lead to problems. If demand falls, the output power can be reduced by reducing the water flow. In a Francis turbine, this is done by turning the guide vanes. This requires a large torque force, which changes the angle at which the water hits the blades and reduces the efficiency.

The Francis turbine does have its limits. If the head is low, a large volume flow is needed for a given power. However, a low head also means low water speed, and these two factors mean a larger input area is required. This led to engineers looking at and developing propeller-type turbines such as the Kaplan turbine. In the propeller turbine, the area in which the water enters is as large as possible. It covers the entire area swept by the blades. They are therefore suitable for very large volume flows and are used where the head is only a few metres. The advantage over radial-type turbines is that it is easier to improve its efficiency by varying the angle of the blades when the power demand changes. An important feature is that the optimum blade speed is greater than the water speed. This allows a rapid rate of rotation even with low water speeds.

For sites with heads above 250 metres, the Pelton wheel is the preferred turbine. It is essentially a wheel with a set of buckets around the rim. A high-speed jet of water, formed because of the high head hitting the edge between the buckets in turn and under optimum conditions, gives up almost all its kinetic energy. The power is varied by adjusting the jet size or deflecting the jet away from the wheel.

The Turgo or crossflow turbine is a variation on the Pelton wheel. The double cups of the Pelton wheel are replaced by shallower ones, with the water entering on one side and leaving on the other. Its ability to handle a larger volume of water than a Pelton wheel of similar diameter gives it an advantage for generation at medium heads.

Control systems and instrumentation

It is vitally important in modern generating stations to be able to control not just the large head of water, but also the generating equipment. Speeds, temperature, vibration and pressures within the turbine and generating sets must be constantly monitored by various sensors. Maintenance and calibration procedures of this equipment are rigorously controlled.

Because of the large water pressures, the sluice gates are operated hydraulically. The main hydraulic pressure and the open or closed positions of the gate are monitored by electrical pressure switches.

In modern generating stations, the use of these transducers has made the practice of running pressure lines over long distances to the control room unnecessary. It is extremely important to measure the water level. Differential pressure transducers can be sited locally, and by using a 4-20 mA control loop, the level can be monitored and controlled accurately. Some equipment, however, still uses voltage sensors, and these signals have to be signal-conditioned between the sensor and the control room.

As the turbine and generator run at high speeds, two of the most important control systems in a hydroelectric station are the speed of the generator, and the vibration and temperature analysis of the generator bearings. Removing either the turbine or generator to replace the bearings or rework the bearing housings is a large, time-consuming job that has an effect on the National Grid’s capability and security. Other work done at this time would involve checking the integrity of the materials that the generator and the turbine are constructed from, and the various seals that protect the equipment from water entry.

To reduce downtime and prevent equipment failure, the speed of the generator is governed by a controller that takes into account the speed and torque from the head of water to proportionally control the electrical output.

The bearings are monitored constantly for vibration, adequate lubrication and, more importantly, temperature by sensors located in the bearing housings.

Administrative information

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History of changes

Version	Description of change	Date
1.0	'Valid from' date on front cover updated to 'August 2026' and 'Prototype educator guide for use in pilot delivery only' line deleted. On 1 February 2026, Qualifications Scotland replaced SQA as the new national awarding body. We have updated the logo and 'SQA' throughout the document to reflect this. **What you need to do differently** There is no change to learning, teaching and assessment.	April 2026

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If a unit is revised:

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- centres should only enter learners for the previous version of the unit if they can complete it before its finish date

For more information on NextGen: HN Qualifications please email nextgen@qualifications.gov.scot.

Thank you to everyone who helped us develop this qualification. Your expertise, time and thoughtful input was invaluable.