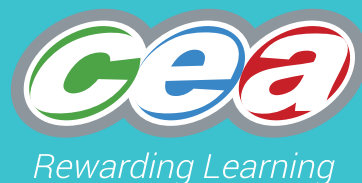


GCSE



CCEA GCSE Specification in Engineering and Manufacturing

Version 4: Updated 16 August 2021

For first teaching from September 2017
For first assessment in Summer 2018
For first award in Summer 2019
Subject Code: 0009



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1 Introduction

This specification sets out the content and assessment details for our GCSE course in Engineering and Manufacturing. We have designed this specification to meet the requirements of:

- Northern Ireland GCSE Design Principles; and
- Northern Ireland GCE and GCSE Qualifications Criteria.

First teaching is from September 2017. We will make the first award based on this specification in Summer 2019.

This specification is a unitised course. The guided learning hours, as for all our GCSEs, are 120 hours.

The specification supports the aim of the Northern Ireland Curriculum to empower young people to achieve their potential and to make informed and responsible decisions throughout their lives, as well as its objectives:

- to develop the young person as an individual;
- to develop the young person as a contributor to society; and
- to develop the young person as a contributor to the economy and environment.

If there are any major changes to this specification, we will notify centres in writing. The online version of the specification will always be the most up to date; to view and download this please go to www.ccea.org.uk

1.1 Aims

This specification aims to encourage students to:

- understand the contribution that engineering and manufacturing makes to society and the economy;
- develop an awareness and appreciation of commercial and industrial issues and emerging technologies in the context of engineering and manufacturing;
- develop and use a range of transferable skills when designing and making engineered and manufactured products, to enable them to become effective and independent learners;
- develop an awareness and understanding of environmental issues and sustainable development;
- develop applied engineering and manufacturing skills as a foundation for future learning and progression;
- apply their knowledge and understanding of engineering and manufacturing using problem-solving skills; and
- actively engage in engineering and manufacturing processes.

1.2 Key features

The following are important features of this specification.

- It offers opportunities to build on the skills and capabilities developed through the delivery of the Northern Ireland Curriculum at Key Stage 3.
- It allows students to develop transferable skills that will benefit them in vocational training and employment.
- It makes students aware of engineering and manufacturing industries.
- It is accompanied by planning frameworks and student guides to support teachers and students.
- It has broad cross-curricular links.
- It has only three units of assessment.
- It provides students with a broad background to, and core knowledge of, the engineering and manufacturing industries.
- It encourages students to develop design, computer-aided design (CAD) and technical skills, and knowledge and understanding of engineering and manufacturing industries.
- It encourages a student-centred approach to learning.
- It helps students to make informed choices regarding their career progression.
- It encourages students to develop and practise key transferable skills and adopt a positive attitude to sustainable engineering and manufacturing techniques.

1.3 Prior attainment

Students do not need to have reached a particular level of attainment before beginning to study this specification.

1.4 Classification codes and subject combinations

Every specification has a national classification code that indicates its subject area. The classification code for this qualification is 0009.

Please note that if a student takes two qualifications with the same classification code, schools, colleges and universities that they apply to may take the view that they have achieved only one of the two GCSEs. The same may occur with any two GCSE qualifications that have a significant overlap in content, even if the classification codes are different. Because of this, students who have any doubts about their subject combinations should check with the schools, colleges and universities that they would like to attend before beginning their studies.

2 Specification at a Glance

The table below summarises the structure of this GCSE course.

Content	Assessment	Weightings	Availability
Unit 1: Design	Controlled assessment Design portfolio Students complete one task in response to one design brief (from a choice of two). Teachers mark the task, and we moderate the results.	25%	Summer from 2018
Unit 2: Production	Externally assessed practical examination 3 hours Manufactured product Students complete one task in response to one assignment under examination conditions.	25%	Summer from 2019
Unit 3: Materials, Processes and Systems	External written examination 2 hours Students answer five questions in Section A. Students answer six questions in Section B. Section A is based on pre-release material.	50%	Summer from 2019

Students must take at least 40 percent of the assessment (based on unit weightings) at the end of the course as terminal assessment.

3 Subject Content

We have divided this course into three units. The content of each unit and the respective learning outcomes appear below.

Students studying this GCSE in Engineering and Manufacturing Specification should be familiar with the symbols specified in Appendix 3.

3.1 Unit 1: Design

This unit is worth **25 percent** of the full qualification. The controlled assessment task has a time guidance of approximately 20 hours. The aim of this unit is to give students an introduction to the planning, design and proposal of an engineered product to satisfy a design need.

Teachers should consider organising industrial visits to aid student understanding of industrial practice.

Students produce a portfolio with a maximum of **12** single-sided A3 pages or equivalent, outlining their analysis of the product with proposals for its design, development and production by an engineering and manufacturing company. All text must be font size 12. Headings should not exceed font size 16. Students may present the portfolio in an electronic format.

Students should understand that the design process is non-linear and creativity should be evident throughout the process.

We issue **two** design briefs in September of the first year of study. Centres select the design brief that is better suited to their needs.

Students are expected to:

- analyse a given design brief and research similar products;
- produce a detailed product specification;
- generate a range of concept sketches;
- evaluate and justify the design concept for development;
- develop a final solution to meet the requirements of the specification;
- produce engineering drawings of the final solution; and
- present a final solution with proposals for manufacture on an industrial scale.

See Appendix 2 for the assessment criteria for this unit.

Content	Learning Outcomes
3.1.1 Analyse the design brief 3.1.2 Research 3.1.3 Specification 3.1.4 Generation of design concepts 3.1.5 Development of chosen solution 3.1.6 Manufacturing proposal	Students should be able to: • identify and analyse the following key features of the design brief: – the specific requirements of the brief; – functional requirements of the product; and – performance criteria specified in the design brief; • research and analyse these key features of the design brief; • develop a detailed design specification; • generate a range of concept sketches; • evaluate the concept sketches; • justify their choice of design concept for development; • produce 2D and 3D concept solutions using freehand techniques, including annotated sketches, assembly and exploded views; • develop a solution to meet the requirements of the specification; • present the solution using 2D and 3D CAD, including exploded and working drawings with key dimensions (the 2D drawings should comply with British Standards); • use a range of calculations in the development of the solution, where appropriate; • present a manufacturing proposal; • propose suitable materials, components and production methods appropriate for the scale of production of the solution; and • produce an overall costing, taking into account materials, components and production methods.

3.2 Unit 2: Production

This unit is worth **25 percent** of the full qualification. Assessment for this unit is three hours long and taken under examination conditions. This unit enables students to complete a manufacturing task and demonstrate engineering and manufacturing skills in the school workshop, using hand and manually controlled machine tools under examination conditions.

In January of the second year of study, we issue confidential instructions on the range of manufacturing processes, equipment and materials required to enable students to complete the practical examination task.

The manufacturing task takes place on a date determined by the examination timetable.

We collect and mark the examination task.

Students should be able to:

- read, interpret and use engineering drawings;
- use the appropriate materials, parts and components in making the task;
- use appropriate hand tools, manually controlled equipment and processes in the making of the task;
- apply health and safety procedures when using tools and equipment; and
- apply appropriate quality control techniques to ensure that individual parts are within the specified tolerances.

Content	Learning Outcomes
3.2.1 Read, interpret and use engineering drawings 3.2.2 Using materials, parts, components, tools, equipment and processes	Students should be able to: • apply knowledge and understanding of first and third angle projection techniques as used in engineering drawings; • read and interpret engineering drawings when completing the task; • identify the key dimensions and demonstrate understanding of the importance of working to dimensional tolerance when completing the task; • calculate the upper and lower tolerance limits for key dimensions when completing the task; • identify, discuss and justify health and safety: – in the workshop and industry; and – procedures associated with accidents; • be familiar with and recognise the following health and safety signs: – first aid; – eye protection; – ear protection; – dust masks; – fire alarm; – high visibility jacket; – emergency exit; – dangerous site; – no unauthorised access; – safety footwear; – wear safety harness; – lift correctly; and – isolating machines; • understand the need for the Health and Safety Executive (HSE); and • apply health and safety procedures when completing the task.

Content	Learning Outcomes
3.2.2 Using materials, parts, components, tools, equipment and processes (cont.)	Students should be able to: • identify, use and state the application of: – rules; – scribes; – pencils; – centre punches; – scribe blocks; – mallets; – odd-leg calipers; – spring dividers; – try and engineer's squares; – marking gauges; – screwdrivers; – sliding bevels; – wood chisels; – files; – hammers; – hand planes; – taps and dies; – hand saws; – adjustable spanners; – ring and open end spanners (metric only); – socket sets (metric only); – allen keys; – notchers; and – drills and drill bits; • apply knowledge and understanding of and use the following machines: – pillar drill; – lathes (wood and metal); – linisher; and – mill; and • apply knowledge and understanding of the following machines: – circular saw; and – hand router.

Content	Learning Outcomes
3.2.2 Using materials, parts, components, tools, equipment and processes (cont.)	Students should be able to: • apply knowledge and understanding of the following processes: – bending; – folding; – press forming; – vacuum forming; – injection moulding; – extrusion; – blow moulding; – composite layup; – punching; – stamping; – cutting; – turning; – drilling; – etching; – milling; – shaping; – heat treatment (normalising, annealing, hardening and tempering); – die casting or pressure die casting; – sand casting; and – jigs and fixtures; • demonstrate understanding and discuss the applications of the above processes and their use in specific products; and • use engineer's marking blue for marking out purposes.

Content	Learning Outcomes
3.2.2 Using materials, parts, components, tools, equipment and processes (cont.)	Students should be able to: • apply knowledge and understanding of the following permanent and semi-permanent joining methods: – nuts, bolts and machine screws (metric only); – wood screws and self-tapping screws; – pins and clips; – riveting; – soft and hard soldering (silver soldering); – welding; – brazing; – adhesives (PVA, tensol cement, liquid solvent and epoxy resin); – knock down fittings; – finger joint (comb); – dovetail joint; – mortise and tenon joint; – lap joint; – biscuit joint; – housing joint; and – mitre joint; • demonstrate understanding and discuss the applications of the above joining methods and their use in specific products; • mark out materials using appropriate tools; • use an appropriate range of hand tools and machines; • use appropriate joining and finishing processes; and • assemble an item using appropriate tools and equipment, where necessary.

Content	Learning Outcomes
3.2.3 Quality control	Students should be able to: • explain the difference between quality control and quality assurance; • demonstrate understanding of and apply tolerances in the manufacture of products using quality control techniques to measure, inspect and test products against a specification; • discuss the reasons for tolerances in the manufacture of products; • identify, explain and use: – inside and outside calipers; – vernier calipers; – micrometers; – go and no go gauges; and – depth gauges; • demonstrate understanding of the use of quality control (QC) charts and graphs and evaluate their use; • demonstrate understanding of the need for product safety regulations; • demonstrate awareness of the following standards, including their symbols: – British Standards Institution (BSI); – Conformité Européenne (CE); and – European Norm (EN); and • apply appropriate quality control techniques by inspecting, measuring and checking that parts are within tolerance.

3.3 Unit 3: Materials, Processes and Systems

This unit is worth **50 percent** of the full qualification. It is externally examined by one paper divided into two sections. Section A requires short and extended writing responses to pre-release material. Section B requires short and extended writing responses to unseen questions.

We provide the pre-release material in January of the year of the examination.

Teachers should consider organising industrial visits to aid student understanding of industrial practice.

This unit includes synoptic assessment building on the content of Unit 1 and Unit 2. This encourages students to demonstrate their ability to draw together areas of knowledge, skills and/or understanding from across a full range of study for this qualification. Therefore, we advise that students should take this unit at the end of the two year course. This encourages students to develop their understanding of the subject as a whole.

Content	Learning Outcomes
3.3.1 Materials	Students should be able to: • apply knowledge and understanding of the mechanical properties of materials: – brittleness; – ductility; – malleability; – hardness; – strength (tensile, compressive, bending, shear and torsion); – stiffness; – toughness; – plasticity; – elasticity; and – conduction (heat and electricity); and • interpret stress/strain graphs and perform calculations using Young's modulus (SI units) using: $\text{stress} = \frac{\text{force}}{\text{cross-sectional area}}$ $\text{strain} = \frac{\text{change in length}}{\text{original length}}$ $\text{Young's modulus} = \frac{\text{stress}}{\text{strain}}$

Content	Learning Outcomes
3.3.1 Materials (cont.)	Students should be able to: • interpret load/extension graphs and stress/strain graphs; • explain and interpret the elastic limit; • explain what is meant by the term Factor of Safety and discuss issues associated with the Factor of Safety; • demonstrate knowledge and understanding of the following materials and their applications: – ferrous metals and alloys (cast iron, stainless steel and low, medium and high carbon steel); – non-ferrous metals and alloys (copper, aluminium, brass, bronze and aluminium alloy); – thermosetting polymers (melamine formaldehyde and epoxy resins); – thermoplastic polymers (polythene, polypropylene, polyvinyl chloride (PVC), acrylic, nylon and polyester); – hardwood (balsa, beech, mahogany and oak); – softwood (pine, redwood and cedar); – manufactured board (plywood, blockboard, chipboard, medium density fibreboard (MDF) and hardboard); and – composite materials (glass reinforced plastic (GRP) and carbon composites); • apply knowledge and understanding of the following smart materials and their applications: – shape-memory alloys (SMAs); – polymorph; – reactive glass; and – thermochromic materials; • discuss the benefits of smart materials; • apply knowledge and understanding of how the properties of materials can be changed by: – alloying; and – cold working; and • discuss the reasons for changing the properties of materials.

Content	Learning Outcomes
3.3.1 Materials (cont.)	Students should be able to: • apply knowledge and understanding of the following finishing techniques and methods: – painting; – dip coating; – powder coating; – lacquering; – electroplating; – galvanising; and – polishing; • apply knowledge and understanding of the following aspects of materials: – cost; – form; – size; – shape; – density; and – availability; • perform calculations relating to these aspects to inform the development of an engineered product; • use the formulae below to perform calculations in relation to metals (sheet, tubular and round bar), wood and plastic (sheet, tubular and rod): area of a cuboid = length × width ($A = L \times W$) volume of a cuboid = length × width × height ($V = L \times W \times H$) area of a circle = $\pi \times \text{radius}^2$ ($A = \pi r^2$) circumference of a circle = $\pi \times \text{diameter}$ (πD) volume of a cylinder = area × length ($V = A \times L$) area of a triangle = $\frac{1}{2} \text{ base} \times \text{height}$ ($A = \frac{1}{2} (B \times H)$) density = mass/volume ($\rho = \frac{m}{v}$) percentage = ratio × 100% • translate information between numeric and graphical form and interpret data presented in graphical form.

Content	Learning Outcomes
3.3.1 Materials (cont.) 3.3.2 Engineering and manufacturing production methods 3.3.3 Engineering and manufacturing costs 3.3.4 Technology used in engineering and manufacturing	Students should be able to: • consider waste produced as a cost when manufacturing a product; • discuss the issues around the disposal and recycling of waste materials; • apply knowledge and understanding of the following production methods: – assembly line; – batch; – mass; and – just-in-time (JIT); • apply knowledge and understanding and be able to perform calculations relating to: – direct costs in the production process: human, material and service resources identified within the production stage; – indirect costs: management, administration, marketing and expenses; and – total cost of manufacturing a product: direct costs plus indirect costs; • apply knowledge and understanding of the following: – computer-aided design (CAD); – computer-integrated manufacturing (CIM); – computer-aided manufacturing (CAM); and – computer-aided engineering (CAE); • demonstrate knowledge and understanding of, and use, the following CNC machines: – routers; – milling machines; – lathes; – laser cutters; and – 3D printers; and • apply knowledge and understanding of the use of robotics in industry.

Content	Learning Outcomes
3.3.5 Systems in engineering and manufacturing	Students should be able to: • explain the term mechatronics and discuss the use of mechatronics in industry; • demonstrate knowledge and understanding of pick and place machines in engineering; • identify the following electronic components by their circuit symbol and physical appearance and demonstrate awareness of their basic function: – resistors; – capacitors; – LEDs and bulbs; – batteries; – motors; – buzzers; – variable resistors; – seven-segment displays; and – switches (pressure and microswitch); • identify the following mechanical components by their symbol and physical appearance and demonstrate awareness of the function and use of these components in a product: – linkages; – levers (first, second and third class); – gear systems (simple and compound); – chains and sprockets; – pulleys and belts; and – cams and followers; • explain the applications of these mechanical components in products and industry; and • perform calculations using the Principle of Moments: moment of a force = force × distance ($M = f \times d$).

Content	Learning Outcomes
3.3.5 Systems in engineering and manufacturing (cont.)	Students should be able to: • identify the following pneumatic components by their symbol and physical appearance and demonstrate awareness of their basic function: – three and five port valves; – valve actuators (roller, push button, plunger and lever); – flow control valves; – cylinders (double-acting cylinder and single-acting cylinder); – reservoirs; and – shuttle valves; • explain the applications of these pneumatic components in products and industry;
3.3.6 New and emerging technologies	• discuss the impact of new and emerging technologies in relation to: – the workforce; – the efficiency of production methods; – the environment; – health and safety; and – sustainability; and • discuss the impact of new and emerging technologies on the design and manufacture of products in relation to: – materials and components; – recycling; – environmental costs; – reduced energy costs; and – maintenance and repair.

4 Scheme of Assessment

4.1 Assessment opportunities

For the availability of examinations and controlled assessment, see Section 2.

This is a unitised specification; candidates must complete at least 40 percent of the overall assessment requirements at the end of the course, in the examination series in which they request a final subject grade. This is the terminal rule.

Candidates may resit individual assessment units once before cash-in. The better of the two results will count towards their final GCSE grade unless a unit is required to meet the 40 percent terminal rule. If it is, the more recent mark will count (whether or not it is the better result). Results for individual assessment units remain available to count towards a GCSE qualification until we withdraw the specification.

4.2 Assessment objectives

There are **three** assessment objectives for this specification. Candidates must:

- A01** recall, select and communicate their knowledge and understanding of engineering and manufacturing in a range of contexts;
- A02** apply skills, knowledge and understanding, including quality standards, in a variety of design contexts, and plan and carry out investigations and making tasks involving an appropriate range of tools, equipment, materials and processes; and
- A03** analyse and evaluate evidence, design proposals and outcomes, make reasoned judgements and present conclusions and recommendations.

4.3 Assessment objective weightings

The table below sets out the assessment objective weightings for each assessment component and the overall GCSE qualification.

Assessment Objective	Unit Weighting (%)			Overall Weighting (%)
	Controlled Assessment	External Assessment		
		Unit 1	Unit 2	
AO1	5	5	20	30
AO2	10	10	20	40
AO3	10	10	10	30
Total Weighting	25	25	50	100

4.4 Quality of written communication

In GCSE Engineering and Manufacturing, candidates must demonstrate their quality of written communication. They need to:

- ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
- select and use a form and style of writing that suit their purpose and complex subject matter; and
- organise information clearly and coherently, using specialist vocabulary where appropriate.

Quality of written communication is assessed in responses to questions and tasks that require extended writing.

4.5 Reporting and grading

We report the results of individual assessment units on a uniform mark scale that reflects the assessment weighting of each unit. We determine the grades awarded by aggregating the uniform marks that candidates obtain in individual assessment units.

We award GCSE qualifications on a grade scale from A* to G, with A* being the highest. The nine grades available are as follows:

Grade	A*	A	B	C*	C	D	E	F	G
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If candidates fail to attain a grade G or above, we report their result as unclassified (U).

5 Grade Descriptions

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded depends in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performances in others.

Grade	Description
A	Candidates recall, select and communicate detailed knowledge and thorough understanding of engineering and manufacturing, including their wider effects. They apply relevant knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks effectively. They test their solutions, working safely and with a high degree of precision. They analyse and evaluate the evidence available, reviewing and adapting their methods when necessary. They present information clearly and accurately, making reasoned judgements and presenting substantiated conclusions.
C	Candidates recall, select and communicate sound knowledge and understanding of engineering and manufacturing, including their wider effects. They apply knowledge, understanding and skills in a range of situations to plan and carry out investigations and tasks. They test their solutions, working safely and with precision. They review the evidence available, analysing and evaluating some information clearly and with some accuracy. They make judgements and draw appropriate conclusions.

Grade	Description
F	Candidates recall, select and communicate knowledge and understanding of basic aspects of engineering and manufacturing, including their wider effects. They apply limited knowledge, understanding and skills to plan and carry out simple investigations and tasks, with an awareness of the need for safety and precision. They modify some aspects of their approach in the light of progress. They review their evidence and draw basic conclusions.

6 Guidance on Controlled Assessment

6.1 Controlled assessment review

We will replace our controlled assessment task every year to ensure that it continues to set an appropriate challenge and remains valid, reliable and stimulating.

6.2 Skills assessed by controlled assessment

Teachers must assess the following skills through controlled assessment:

- independent learning;
- communication evidenced in the design portfolio;
- creative engineering and manufacturing solutions;
- engineering and manufacturing capability; and
- analytical and evaluative capability associated with engineering and manufacturing processes and outcomes.

6.3 Level of control

Rules for controlled assessment in GCSE Engineering and Manufacturing are defined for the three stages of the assessment:

- task setting;
- task taking; and
- task marking.

6.4 Task setting

The level of control for task setting is **high**. This means that we set the task.

We issue **two** tasks for Unit 1 in September each year for submission the following May. Centres must choose **one** of the two tasks. Each task is only available for a single assessment opportunity. It is centres' responsibility to ensure that their candidates complete a task valid for the year when they will submit for moderation.

Centres have the opportunity to contextualise the controlled assessment task to suit their specific circumstances.

We will provide centres with guidance on how to complete and submit the task.

6.5 Task taking

The level of control for task taking is **medium**.

Candidates have approximately 20 hours to complete the controlled assessment task.

Areas of Control	Detail of Control
Authenticity	• Candidates may carry out research outside of the classroom. • Candidates may complete their portfolio within and outside of the classroom environment, but teachers must be able to authenticate this work. • Teachers must ensure that candidates acknowledge and reference any ideas and sources used.
Feedback	• Teachers must guide and supervise candidates on the following: – monitoring progress; – preventing plagiarism; – ensuring compliance with health and safety requirements; – ensuring work is completed in accordance with the specification requirements; and – ensuring work can be assessed in accordance with the procedures and marking criteria. • Candidates should reach their own conclusions. • Teachers must record any support or guidance given to candidates on the Candidate Record Sheet and mark their work appropriately.
Page Limit	• Candidates must produce a design portfolio. • The portfolio should be a maximum of 12 single-sided A3 pages or equivalent). All text must be font size 12. Headings should not exceed font size 16. • Candidates may present the portfolio in an electronic format. • Candidates must submit their completed work by May.
Collaboration	• Candidates must submit their own individual responses; however, this work may be informed by discussion and/or working with others.

Areas of Control	Detail of Control
Resources	• Candidates should be able to access and use the necessary resources available to the centre. • Centres with limited resources or with candidates who need to use special equipment must contact us for advice on how to proceed before offering this course to their candidates. • Candidates must reference all resources that they access and use. • Candidates' freehand design proposals for Unit 1 must be their own original work drawn solely from first principles.

6.6 Task marking

The level of control for task marking is **medium**.

Teachers mark the controlled assessment task using assessment criteria that we provide. They should use professional judgement to select and apply the criteria in each successive mark band appropriately and fairly to candidates' work. They should not use half marks. They should follow a 'best fit' approach when selecting a candidate's mark, making allowance for balancing strengths and weaknesses in each response.

Teachers must ensure that the work they mark is the candidate's own. For up-to-date advice on plagiarism, or any kind of candidate malpractice, see *Suspected Malpractice in Examinations and Assessments: Policies and Procedures* on the Joint Council for Qualifications website at www.jcq.org.uk

6.7 Internal standardisation

Centres with more than one teaching group must carry out internal standardisation of controlled assessment tasks before submitting their marks to us. This is to ensure, as far as possible, that each teacher has applied the assessment criteria consistently when marking assessments. Centres may need to adjust an individual teacher's marking:

- to bring assessments into line with those of other teachers in the centre; and
- to match the standards established at the agreement trial.

If marks do change, centres must amend the total/final mark on their Candidate Record Sheet.

6.8 Moderation

Centres must submit their marks and samples to us by May in any year. We may adjust centres' marking to bring the assessment of the candidates' work into line with our agreed standards.

We issue full instructions each year on:

- our moderation procedures;
- which samples we require; and
- the deadlines for submitting marks and samples to us.

Teachers and centre staff may contact us at any stage if they require advice, assistance or support relating to any aspect of controlled assessment.

6.9 Drafting/Redrafting

Teachers must not correct candidates' work in detail and return it to them to write up a fair copy. Responsibility for drafting a piece of work towards completion lies entirely with the candidate. Once a candidate has submitted the controlled assessment and it has been awarded a mark, that mark is final. The candidate may not carry out further work.

See Appendix 2 for a glossary of controlled assessment terms. For more details, see the Joint Council for Qualifications document *Instructions for Conducting Controlled Assessments*, available at www.jcq.org.uk

7 Curriculum Objectives

This specification builds on the learning experiences from Key Stage 3 as required for the statutory Northern Ireland Curriculum. It also offers opportunities for students to contribute to the aim and objectives of the Curriculum at Key Stage 4, and to continue to develop the Cross-Curricular Skills and the Thinking Skills and Personal Capabilities. The extent of the development of these skills and capabilities will be dependent on the teaching and learning methodology used.

7.1 Cross-Curricular Skills at Key Stage 4

Communication
Students should be able to: - communicate meaning, feelings and viewpoints in a logical and coherent manner, <i>for example compare and contrast the chosen workshop practice and suggested industrial alternatives and discuss the impact of new and emerging technologies;</i> - make oral and written summaries, reports and presentations, taking account of audience and purpose, <i>for example present a manufacturing proposal and propose suitable materials, components and production methods appropriate for the scale of production of a solution;</i> - interpret, analyse and present information in oral, written and ICT formats, <i>for example interpret load/extension graphs and stress/strain graphs;</i> and - explore and respond, both imaginatively and critically, to a variety of texts, <i>for example research and analyse key features that relate to the design brief.</i>
Using Mathematics
Students should be able to: - use mathematical language and notation with confidence, <i>for example identify the key dimensions of all product parts;</i> - use mental computation to calculate, estimate and make predictions in a range of simulated and real-life contexts, <i>for example perform calculations using Young's Modulus (SI units), and consider waste produced as a cost when manufacturing a product;</i> - select and apply mathematical concepts and problem-solving strategies in a range of simulated and real-life contexts, <i>for example perform calculations relating to direct and indirect costs and total manufacturing costs;</i> - interpret and analyse a wide range of mathematical data, <i>for example understand the use of QC charts and graphs;</i> - assess probability and risk in a range of simulated and real-life contexts, <i>for example identify health and safety issues in school workshops and industry;</i> and - present mathematical data in a variety of formats which take account of audience and purpose, <i>for example produce an overall costing, taking into account materials, components and production methods.</i>

Using ICT

Students should be able to make effective use of information and communications technology in a wide range of contexts to access, manage, select and present information, including mathematical information, *for example present a proposed industrial manufacturing process in a logical and sequential order using flowcharts, block diagrams, grids and graphs.*

7.2 Thinking Skills and Personal Capabilities at Key Stage 4**Self-Management**

Students should be able to:

- plan work, *for example present a final solution with proposals for manufacture and produce and use a production plan;*
- set personal learning goals and targets to meet deadlines, *for example produce a work schedule;*
- monitor, review and evaluate their progress and improve their learning, *for example evaluate the manufacturing process and consider key aspects;* and
- effectively manage their time, *for example produce a work schedule for making the individual product parts and overall assembly.*

Working with Others

Students should be able to:

- learn with and from others through co-operation, *for example applying knowledge and understanding of CAD and engaging with others through setting up and using CNC machinery;* and
- listen actively to others and influence group thinking and decision-making, taking account of others' opinions, *for example when interpreting load/extension graphs and stress/strain graphs.*

Problem Solving

Students should be able to:

- identify and analyse relationships and patterns, *for example research and analyse key features that relate to the design brief;*
- propose justified explanations, *for example justify the choice of the design concept for development;*
- reason, form opinions and justify their views, *for example present a manufacturing proposal;*
- analyse critically and assess evidence to understand how information or evidence can be used to serve different purposes or agendas, *for example identify and analyse appropriate key design features;*
- analyse and evaluate multiple perspectives, *for example generate a range of concept sketches;*
- explore unfamiliar views without prejudice, *for example present a manufacturing proposal;*
- weigh up options and justify decisions, *for example develop the solution to meet the requirements of the specification;* and
- apply and evaluate a range of approaches to solve problems in familiar and novel contexts, *for example research and analyse key features of the design brief and generate a range of concept sketches.*

Although not referred to separately as a statutory requirement at Key Stage 4 in the Northern Ireland Curriculum, **Managing Information** and **Being Creative** may also remain relevant to learning.

8 Links and Support

8.1 Support

The following resources are available to support this specification:

- our Engineering and Manufacturing microsite at www.ccea.org.uk and
- specimen assessment materials.

We also intend to provide:

- past papers;
- mark schemes;
- Chief Examiner's reports;
- Principal Moderator's reports;
- guidance on progression from Key Stage 3;
- planning frameworks;
- centre support visits;
- support days for teachers;
- agreement trials;
- controlled assessment guidance for teachers;
- controlled assessment guidance for candidates;
- a resource list; and
- exemplification of examination performance.

8.2 Examination entries

Entry codes for this subject and details on how to make entries are available on our Qualifications Administration Handbook microsite, which you can access at www.ccea.org.uk

Alternatively, you can telephone our Examination Entries, Results and Certification team using the contact details provided.

8.3 Equality and inclusion

We have considered the requirements of equality legislation in developing this specification and designed it to be as free as possible from ethnic, gender, religious, political and other forms of bias.

GCSE qualifications often require the assessment of a broad range of competences. This is because they are general qualifications that prepare students for a wide range of occupations and higher level courses.

During the development process, an external equality panel reviewed the specification to identify any potential barriers to equality and inclusion. Where appropriate, we have considered measures to support access and mitigate barriers.

We can make reasonable adjustments for students with disabilities to reduce barriers to accessing assessments. For this reason, very few students will have a complete barrier to any part of the assessment.

It is important to note that where access arrangements are permitted, they must not be used in any way that undermines the integrity of the assessment. You can find information on reasonable adjustments in the Joint Council for Qualifications document *Access Arrangements and Reasonable Adjustments*, available at www.jcq.org.uk

8.4 Contact details

If you have any queries about this specification, please contact the relevant CCEA staff member or department:

- Specification Support Officer: Nuala Tierney
(email: ntierney@ccea.org.uk)
- Education Manager: Judith Ryan
(email: jryan@ccea.org.uk)
- For a full list of contacts within CCEA visit our website at www.ccea.org.uk/examiner-centre-support/examinations-support/key-contacts

Appendix 1

Glossary of Terms for Controlled Assessment Regulations

Term	Definition
Component	A discrete, assessable element within a controlled assessment/qualification that is not itself formally reported and for which the awarding organisation records the marks May contain one or more tasks
Controlled assessment	A form of internal assessment where the control levels are set for each stage of the assessment process: task setting, task taking, and task marking
External assessment	A form of independent assessment in which question papers, assignments and tasks are set by the awarding organisation, taken under specified conditions (including detailed supervision and duration) and marked by the awarding organisation
Formal supervision (High level of control)	The candidate must be in direct sight of the supervisor at all times. Use of resources and interaction with other candidates is tightly prescribed.
Informal supervision (Medium level of control)	Questions/Tasks are outlined, the use of resources is not tightly prescribed and assessable outcomes may be informed by group work. Supervision is confined to: - ensuring that the contributions of individual candidates are recorded accurately; and - ensuring that plagiarism does not take place. The supervisor may provide limited guidance to candidates.
Limited supervision (Limited level of control)	Requirements are clearly specified, but some work may be completed without direct supervision and will not contribute directly to assessable outcomes.

Term	Definition
Mark scheme	A scheme detailing how credit is to be awarded in relation to a particular unit, component or task Normally characterises acceptable answers or levels of response to questions/tasks or parts of questions/tasks and identifies the amount of credit each attracts May also include information about unacceptable answers
Task	A discrete element of external or controlled assessment that may include examinations, assignments, practical activities and projects
Task marking	Specifies the way in which credit is awarded for candidates' outcomes Involves the use of mark schemes and/or marking criteria produced by the awarding organisation
Task setting	The specification of the assessment requirements Tasks may be set by awarding organisations and/or teachers. Teacher-set tasks must be developed in line with awarding organisation specified requirements.
Task taking	The conditions for candidate support and supervision, and the authentication of candidates' work Task taking may involve different parameters from those used in traditional written examinations. For example, candidates may be allowed supervised access to sources such as the internet.
Unit	The smallest part of a qualification that is formally reported May comprise separately assessed components

Appendix 2

Assessment Criteria and Mark Bands for Unit 1: Design

Analyse the design brief and research								
Assessment Objectives	Mark Band 1: Basic	Mark Range	Mark Band 2: Satisfactory	Mark Range	Mark Band 3: Good	Mark Range	Mark Band 4: Excellent	Mark Range
	Relevant material is poorly organised and presented with a lack of clarity and coherence.		Relevant material is sufficiently organised and presented with some clarity and coherence.		Relevant material is well organised and presented with a good degree of clarity and coherence.		Relevant material is succinct, well organised and presented with a high degree of clarity and coherence.	
AO1 AO2 AO3 Total: 16	Candidates work with considerable guidance to: - produce a basic analysis that may incorporate the key features listed in the task; - produce basic research related to the task; and - use spelling, punctuation and grammar with limited accuracy and demonstrate a limited selection and use of an appropriate form and style of writing and specialist terminology.	1–4	Candidates work with some guidance to: - produce a satisfactory analysis that incorporates the key features listed in the task; - produce satisfactory research related to the task; and - use spelling, punctuation and grammar with satisfactory accuracy and demonstrate a satisfactory selection and use of an appropriate form and style of writing and specialist terminology.	5–8	Candidates work with little guidance to: - produce a good analysis that incorporates the key features listed in the task; - produce good research and analysis related to the task; and - use spelling, punctuation and grammar with good accuracy and demonstrate a good selection and use of an appropriate form and style of writing and specialist terminology.	9–12	Candidates work independently to: - produce an excellent analysis that incorporates the key features listed in the task; - produce excellent research and analysis related to the task; and - use spelling, punctuation and grammar with excellent accuracy and demonstrate an excellent selection and use of an appropriate form and style of writing and specialist terminology.	13–16
Award zero marks for work not worthy of credit.								

Specification								
Assessment Objectives	Mark Band 1: Basic	Mark Range	Mark Band 2: Satisfactory	Mark Range	Mark Band 3: Good	Mark Range	Mark Band 4: Excellent	Mark Range
	Relevant material is poorly organised and presented with a lack of clarity and coherence.		Relevant material is sufficiently organised and presented with some clarity and coherence.		Relevant material is well organised and presented with a good degree of clarity and coherence.		Relevant material is succinct, well organised and presented with a high degree of clarity and coherence.	
AO1 AO2 AO3 Total: 14	Candidates work with considerable guidance to: - produce a basic design specification that makes basic reference to the criteria listed in the controlled assessment task; and - use spelling, punctuation and grammar with limited accuracy and demonstrate a limited selection and use of an appropriate form and style of writing and specialist terminology.	1–3	Candidates work with some guidance to: - produce a satisfactory design specification that makes satisfactory reference to the criteria listed in the controlled assessment task; and - use spelling, punctuation and grammar with satisfactory accuracy and demonstrate a satisfactory selection and use of an appropriate form and style of writing and specialist terminology.	4–7	Candidates work with little guidance to: - produce a good design specification that makes good reference to the criteria listed in the controlled assessment task; and - use spelling, punctuation and grammar with good accuracy and demonstrate a good selection and use of an appropriate form and style of writing and specialist terminology.	8–11	Candidates work independently to: - produce an excellent design specification that makes detailed reference to the criteria listed in the controlled assessment task; and - use spelling, punctuation and grammar with excellent accuracy and demonstrate an excellent selection and use of an appropriate form and style of writing and specialist terminology.	12–14
Award zero marks for work not worthy of credit.								

Generation of design concepts								
Assessment Objectives	Mark Band 1: Basic Relevant material is poorly organised and presented with a lack of clarity and coherence.	Mark Range	Mark Band 2: Satisfactory Relevant material is sufficiently organised and presented with some clarity and coherence.	Mark Range	Mark Band 3: Good Relevant material is well organised and presented with a good degree of clarity and coherence.	Mark Range	Mark Band 4: Excellent Relevant material is succinct, well organised and presented with a high degree of clarity and coherence.	Mark Range
AO1 AO2 AO3 Total: 26	Candidates work with considerable guidance to: - produce limited 2D/3D concept sketches using freehand techniques, including basic annotation, assembly and exploded views; - produce a basic evaluation of concepts and justification of the design concept for development; and - use spelling, punctuation and grammar with limited accuracy and demonstrate a limited selection and use of an appropriate form and style of writing and specialist terminology.	1–6	Candidates work with some guidance to: - produce satisfactory 2D/3D concept sketches using freehand techniques, including satisfactory annotation, assembly and exploded views; - produce a satisfactory evaluation of concepts and justification of the design concept for development; and - use spelling, punctuation and grammar with satisfactory accuracy and demonstrate a satisfactory selection and use of an appropriate form and style of writing and specialist terminology.	7–13	Candidates work with little guidance to: - produce good 2D/3D concept sketches using freehand techniques, including good annotation, assembly and exploded views; - produce a good evaluation of concepts and justification of the design concept for development; and - use spelling, punctuation and grammar with good accuracy and demonstrate a good selection and use of an appropriate form and style of writing and specialist terminology.	14–20	Candidates work independently to: - generate excellent 2D/3D concept sketches using freehand techniques, including detailed annotated sketches, assembly and exploded diagrams of important aspects; - produce an excellent evaluation of concepts and justification of the design concept for development; and - use spelling, punctuation and grammar with excellent accuracy and demonstrate an excellent selection and use of an appropriate form and style of writing and specialist terminology.	21–26
Award zero marks for work not worthy of credit.								

Development of chosen solution								
Assessment Objectives	Mark Band 1: Basic	Mark Range	Mark Band 2: Satisfactory	Mark Range	Mark Band 3: Good	Mark Range	Mark Band 4: Excellent	Mark Range
	Relevant material is poorly organised and presented with a lack of clarity and coherence.		Relevant material is sufficiently organised and presented with some clarity and coherence.		Relevant material is well organised and presented with a good degree of clarity and coherence.		Relevant material is succinct, well organised and presented with a high degree of clarity and coherence.	
AO1 AO2 AO3 Total: 28	Candidates work with considerable guidance to: - develop a basic solution using 2D and 3D CAD that shows exploded and working drawings with key dimensions to meet the requirements of the specification; and - use, where appropriate, a limited range of calculations in the development of the final solution to meet the requirements of the specification.	1–7	Candidates work with some guidance to: - develop a satisfactory solution using 2D and 3D CAD that shows exploded and working drawings with key dimensions to meet the requirements of the specification; and - use, where appropriate, a satisfactory range of calculations in the development of the final solution to meet the requirements of the specification.	8–14	Candidates work with little guidance to: - develop a good solution using 2D and 3D CAD that shows exploded and working drawings with most key dimensions to meet the requirements of the specification; and - use, where appropriate, a good range of calculations in the development of the final solution to meet the requirements of the specification.	15–21	Candidates work independently to: - develop an excellent solution using 2D and 3D CAD that shows exploded and working drawings with all key dimensions to meet the requirements of the specification; and - use, where appropriate, an excellent range of calculations in the development of the final solution to meet the requirements of the specification.	22–28
Award zero marks for work not worthy of credit.								

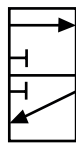
Manufacturing proposal								
Assessment Objectives	Mark Band 1: Basic	Mark Range	Mark Band 2: Satisfactory	Mark Range	Mark Band 3: Good	Mark Range	Mark Band 4: Excellent	Mark Range
	Relevant material is poorly organised and presented with a lack of clarity and coherence.		Relevant material is sufficiently organised and presented with some clarity and coherence.		Relevant material is well organised and presented with a good degree of clarity and coherence.		Relevant material is succinct, well organised and presented with a high degree of clarity and coherence.	
AO1 AO2 AO3 Total: 16	Candidates work with considerable guidance to: - produce a basic manufacturing proposal that makes limited reference to materials, components and production methods; - produce a basic overall costing of the proposal; and - use spelling, punctuation and grammar with limited accuracy and demonstrate a limited selection and use of an appropriate form and style of writing and specialist terminology.	1–4	Candidates work with some guidance to: - produce a satisfactory manufacturing proposal that makes some reference to materials, components and production methods; - produce a satisfactory overall costing of the proposal; and - use spelling, punctuation and grammar with satisfactory accuracy and demonstrate a satisfactory selection and use of an appropriate form and style of writing and specialist terminology.	5–8	Candidates work with little guidance to: - produce a good manufacturing proposal that makes clear reference to materials, components and production methods; - produce a good overall costing of the proposal; and - use spelling, punctuation and grammar with good accuracy and demonstrate a good selection and use of an appropriate form and style of writing and specialist terminology.	9–12	Candidates work independently to: - produce an excellent manufacturing proposal that makes detailed reference to materials, components and production methods; - produce an excellent overall costing of the proposal; and - use spelling, punctuation and grammar with excellent accuracy and demonstrate an excellent selection and use of an appropriate form and style of writing and specialist terminology.	13–16
Award zero marks for work not worthy of credit.								

Appendix 3

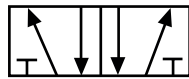
Symbols and Safety Signs GCSE Engineering and Manufacturing Symbols

Students studying this GCSE Engineering and Manufacturing Specification should be familiar with the symbols and safety signs below.

3.3.5: Pneumatic:



3/2 Valve



5/2 Valve



Exhaust



Pressure source



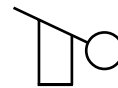
Plunger



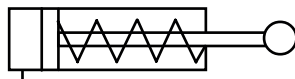
Roller trip



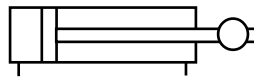
Push button



Lever



Single acting cylinder (SAC)



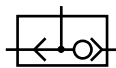
Double acting cylinder (DAC)



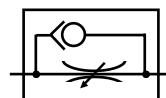
Spring return



Reservoir



Shuttle valve



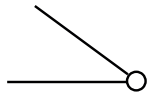
Unidirectional flow restrictor



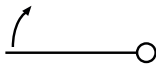
Bidirectional flow restrictor

GCSE Engineering and Manufacturing Symbols

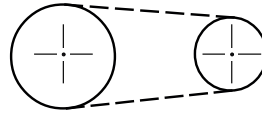
3.3.5: Mechanical



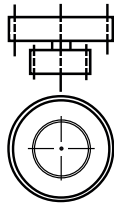
Linkage



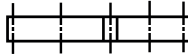
Lever



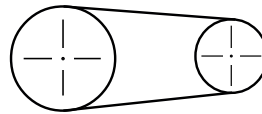
Sprocket and chain



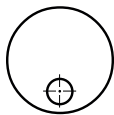
Compound Gear



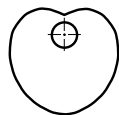
Meshed gear
(simple)



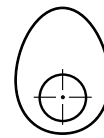
Belt and Pulley



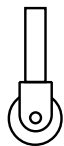
Eccentric cam



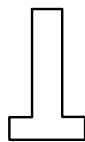
Heart-shaped
cam



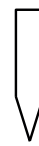
Pear-shaped
cam



Roller follower



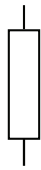
Flat follower



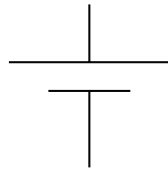
Knife follower

GCSE Engineering and Manufacturing Symbols

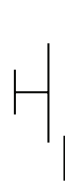
3.3.5: Electronics



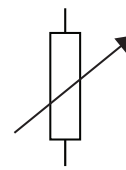
Resistor



Battery



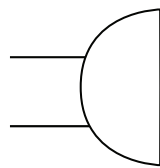
Push-to-make
switch



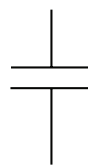
Variable
resistor



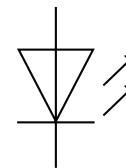
SPST switch



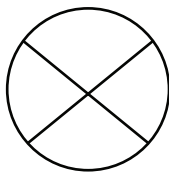
Buzzer



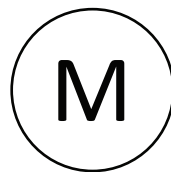
Capacitor



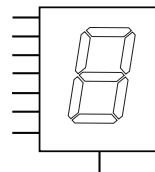
Light-emitting
diode



Bulb



Motor



Seven Segment display

GCSE Engineering and Manufacturing Symbols

3.2.3: Health & Safety Signs

Standard Symbols



British Standards



Conformité Européene

EN 7010

European Norm



Wear ear protection



Wear eye protection



Wear dust mask



Wear high visibility jacket



First Aid



Emergency exit



Dangerous site



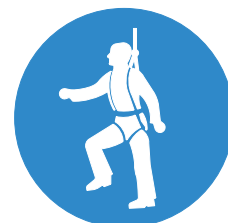
Fire alarm



Lift correctly



Wear safety footwear



Wear safety harness

GCSE Engineering and Manufacturing Symbols

3.2.3: Health & Safety Signs

Standard Symbols



No unauthorised
access



Isolate machine

Summary of Changes since First Issue

(Most recent changes are indicated in red on the latest version)

Revision History Number	Date of Change	Page Number	Change Made
Version 1	N/A	N/A	First issue
Version 2	29 October 2019	Content page	Appendix 3 listed
Version 2	29 October 2019	7	Reference to Appendix 3 inserted
Version 2	29 October 2019	41	Appendix 3 added
Version 3	15 December 2020	15	Amendments & additional text added
Version 4	16 August 2021	41	New Appendix 3 added



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IN PEOPLE

