JOHN PORT SPENCER ACADEMY

Cam Nat Engineering Manufacture

Curriculum Overview

Key Stage – KS4

Joy Progress Success Act with care, kindness, respect and integrity

Our curriculum is carefully sequenced to ensure cumulative knowledge and progression. Each unit builds on the last, with clear concepts that students must grasp to progress. We define end points to illustrate what mastery looks like by year-end.

Location of resources:	
Curriculum intent and rationale:	***The engineering & technology curriculum develops students who are not just a generation of hobbyists but are work ready members of society who possess a comprehensive knowledge, understanding and skills set to resiliently tackle everyday design problems.*** ***They are able to create innovative and high-quality solutions that strive to make life better in an increasingly technological world.*** Students are taught in mixed ability groups, with a total of 3 lessons per week. Students follow the OCR Cambridge National Engineering Manufacture specification: Cambridge Nationals - Engineering Manufacture Level 1/Level 2 – J823 The rationale for teaching OCR Cambridge National in Engineering Manufacture is to provide students with hands-on experience in real-world manufacturing processes, tools, and materials. It develops practical skills in CNC machining, production planning, and quality control, while reinforcing maths, science, and computing knowledge. The course promotes problem-solving, teamwork, and independent thinking through applied learning. It supports progression to apprenticeships, vocational qualifications, or further study in engineering. Learners gain insight into industry practices and build employability skills such as resilience, communication, and responsibility. This qualification offers an accessible, engaging route into engineering, preparing students for future careers and helping them understand the impact of manufacturing on society.
National Curriculum Links:	**N/A at KS4**

What content needs to be covered? Key Knowledge and skills / misconceptions to address (with vocab in bold and spelling underlined)

By the end of the year students will know:

Yr 10 Half Term 1	Yr 10 Half Term 2	Yr 10 Half Term 3	Yr 10 Half Term 4	Yr 10 Half Term 5	Yr 10 Half Term 6
Students will learn key knowledge and skills about: CAD: Sketching, Extruding, Shelling, Lofting, file formats CAM: 3D printing parameters, design for manufacture, tolerance, Laser cutting, Writing a SOP, understanding SOP sequence and purpose. How to produce a Technical Specification. Purpose of a Technical Specification. **Challenge:** Complete the Lego man accessories. Complex design of Passive AMP. Production of detailed technical specification and associated orthographic drawings. **Misconceptions:** All plastics are 'plastic'	**Students will learn key knowledge and skills about:** Understanding the mechanical properties of materials, including: Strength, ductility, hardness, elasticity, plasticity, conductivity, toughness, machineability and cost Difference between pure metals and alloys Types of ferrous metal: cast iron, low carbon steel, high carbon steel and stainless steel Types of non-ferrous metal: aluminium and alloys, copper, brass and bronze Difference between thermoplastic and thermosetting polymers. Types of thermoplastic polymer: Acrylonitrile-Butadiene-Styrene (ABS), High Impact Polystyrene (HIPS), Polymethylmethacrylate (PMMA/Acrylic), Polycarbonate, Polylactic acid (PLA). **Types of thermosetting polymer**: urea formaldehyde, melamine formaldehyde, epoxy resin, polyester resin.	**Students will learn key knowledge and skills about:** Difference between metal alloys and composite materials. Types of composite material: glass reinforced polymer (GRP/fibreglass), carbon reinforced polymer (CRP). Definition of a smart material. **Types of smart material**: shape memory alloy (SMA), thermochromic pigment, photochromic pigment, Quantum Tunnelling Composite (QTC). Details of different manufacturing processes covering; **Wasting processes**: Sawing, Shearing, Drilling, Filing, Threading, Routing, Laser-cutting, Turning, Milling. Apply learning in HT1 to generate SOP for laser cutting & 3D printing. Production of NEA for RO16; SOP's	**Students will learn key knowledge and skills about:** Details of different manufacturing processes covering; **Shaping processes**: Sand casting, Die casting, Injection moulding, Powder metallurgy for ceramic product **Forming processes**; Forging, Press forming metal, Strip heating of polymers, Vacuum forming, Moulding of composite materials. **Additive manufacturing**; 3D Printing (fused deposition modelling). **Joining processes**; Brazing, MIG/MAG welding, Riveting, Mechanical fastening. Students will learn to sequence machining operations and determine the sequence of operations required for a manufactured part. Determine appropriate operating parameters for Computer Numerical Control (CNC) equipment. P	**Students will learn key knowledge and skills about:** **Summative assessment on topics including:** • **Materials properties** • **Manufacturing categories** • **Manufacturing methods** • **Polymers** • **Metals** • **Smart materials** • **Ceramics** Recap/Recall on the knowledge & Skills from HT2 covering: Understanding the mechanical properties of materials, including: Strength, ductility, hardness, elasticity, plasticity, conductivity, toughness, machineability and cost Students will prepare for the practical element or their RO15 coursework by producing an engineered part using subtractive manufacturing methods such as turning, drilling and threading.	**Students will learn key knowledge and skills about:** Interpreting an engineering drawing to identify information to facilitate manufacture including the following mechanical features: threads, holes, chamfers, countersinks and knurls. Interpreting an engineering drawing to identify information to facilitate manufacture including the following dimensional features: linear measurements, radius, diameter, tolerance and surface finish. How to select and safely use equipment for marking out including the following equipment: • Rules • Dividers • Scribers • Scribing blocks • Surface plates • Punches • Squares • Protractors

	Types of engineering ceramic: silicon carbide, tungsten carbide, silicate glass
	
	Apply learning in HT1 to produce annotated drawing of engineered part/s.
	
	Apply learning in HT1 on CAD/CAM to generate 3D parts and assemblies of engineered products to create files from CAM on 3D printer and laser cutter.
	
	Use provided CAD drawings to create working drawings suitable for the CNC manufacture of parts.
	
	Carry out on-screen simulation of CNC operations.
	
	Programme CNC machine operations covering the following parameters:
	• Setting datum points
	• Use of co-ordinates
	• Sequence of operations
	• Tool change-over
	• Setting tool offsets
	• Export information from CAD software to CNC machines
	
	Setting up of CNC equipment to include:
	• Tooling
	• Work holding
	• Setting datum points
	• Safety procedures
	
	Students will recap, retrieve and build on key knowledge and skills from half term 1:
	
	Challenge:
	Students are challenged to achieve the top of mark band 3 in all topic areas of R016
	Independence when accurately making and assembling 3D parts using CAD.
	Independence when accurately preparing files for 3D printing / laser cutting.
	
	To learn ALL the relative properties, typical forms of supply and common applications of the different materials.
		Students will recap, retrieve and build on key knowledge and skills from half term 2:
		
		Challenge:
		
		Students are challenged to achieve the top of mark band 3 in all topic areas of R016. Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose. Able to measure, mark out and cut out templates for the parts independently.
		
		The SOP produced includes all the information required to manufacture the product. All of the operations required are identified in a logical and workable sequence. All of the operating parameters for the CNC equipment are identified and appropriate and should provide a satisfactory outcome without adjustment. Understand ALL steps carried out to manufacture a product. To learn ALL the relative properties, typical forms of supply and common applications of the different materials.
		
		Misconceptions:
		
		Students often assume that all metals are magnetic.
		
		Students may think all plastics are soft or bendy.
		
		Students confuse hardness (resistance to scratching) with strength (resistance to force).
		
		Students may not understand why alloys are used instead of pure metals.
		
		Students often associate ceramics only with household items.
		
		Students may not consider how temperature, stress, or environment affects material properties.
		
		Students might think that if a material is recyclable, it's automatically sustainable.
			Produce standard operating procedures (SOPs) for the use of manufacturing processes.
			
			Students will recap, retrieve and build on key knowledge and skills from half term 2 & 3:
			
			Challenge:
			
			Students are challenged to achieve the top of mark band 3 in all topic areas of R016. Effectively applies understanding and skills to successfully produce the intended result in a way that would be fully fit-for-purpose. Able to set up and operate CNC equipment independently. Provided accurate and repeatable measurements of all of the features on the drawing using appropriate methods. Effectively applies understanding and skills to successfully produce the intended result in a way that would be fully fit-for-purpose.
			
			Misconceptions:
			
			Students may think any shaping process can be applied to any material.
			
			Students often confuse casting with moulding.
			
			Students may believe all machining processes are subtractive.
			
			Students may think additive manufacturing is only used for models or prototypes.
			
			Forging and stamping are interchangeable
			• Misconception: Students might not distinguish between these two.
			• Reality: Forging involves shaping metal using compressive forces, often at high temperatures. Stamping is a cold-forming process using dies.
			
			Students may think shaping only changes form, not function.
				Students will work independently to produce the part “fidget toy” to a higher degree of tolerance than is required in their RO15 coursework to set high expectations. They will analyse and interpret engineering information (again simulating requirements of RO15). Students will annotate engineering drawings and formulate logical manufacturing sequences for the given parts partly by building on prior learning and from new teaching input.
				
				Students will recap, retrieve and build on key knowledge and skills from half term 3&4:
				
				Challenge:
				
				Students are challenged to achieve the top of mark band 3 in all topic areas of R015. A comprehensive plan that includes all the information required to facilitate manufacture of the product. All materials needed are accurately identified. All processes, tools and equipment are appropriate and presented in a logical sequence. All health and safety issues have been considered. Appropriate quality control measures identified to support the manufacture of an effective outcome. All of the potential hazards of the process are identified and the risk of occurrence for each is estimated. Appropriate control measures identified for all of the hazards.
				
				Misconceptions:
				
				Students often confuse density with weight.
				
				Students assume good thermal conductors are also good electrical conductors.
				
				Students may think all plastics are poor conductors.
				
				Students confuse opacity with colour or darkness.
				
				Students may think expansion is a flaw.
				
				Strength and hardness are the same
					• Angle plates
					
					Measuring and marking out techniques to include:
					• Datum
					• Centre lines
					• Profiles:
					• square/rectangular
					• angular
					• radial
					• Circles
					• Hole positions
					
					How to select and use measuring instruments to include:
					• Rules
					• Digital Vernier callipers
					• external
					• internal
					• depth
					• Micrometres
					  ○ external
					  ○ internal
					• depth
					• Squares
					• Protractors
					• Height gauge
					• Dial Test Indicator (DTI)
					
					Manually controlled machining processes to include:
					• Drilling
					• Turning
					• Milling
					
					How to use tools and equipment to include:
					• Saws
					  ○ hacksaw
					  ○ junior hacksaw
					• Guillotine
					• Files
					• Tap and die
					• Press (sheet bending)
					
					Students will recap, retrieve and build on key knowledge and skills from half term 5:

	Misconceptions: Strength just means 'it's strong' Brittleness means 'its weak' All plastics are 'plastic' All metals are 'metal'		Students may assume manual methods like filing or hand forming are obsolete.	• Misconception: Students often use these terms interchangeably. Students think tough materials are hard. Students assume brittle materials are always weak. Elasticity and plasticity are opposites • Misconception: Students may think these are two ends of a spectrum. Ductility and malleability are the same • Misconception: Students often confuse these terms.	**Challenge:** **Students are challenged to achieve the top of mark band 3 in all topic areas of R015.** **All measuring equipment is selected and used appropriately. Select and safely use appropriate marking out equipment for all of the features. Able to measure and mark out independently.** **Misconceptions:** Students may think a single measurement is sufficient. Students often believe tidying up is only necessary after the product is complete. Students may assume tools are universal. Students might overlook how material properties influence shaping or joining. Students sometimes skip personal protective equipment (PPE) for "quick" or "easy" jobs. Students may think precision is only important in mass production. Students may rush into production without a clear plan.
Yr 11 Half Term 1	**Yr 11 Half Term 2**	**Yr 11 Half Term 3**	**Yr 11 Half Term 4**	**Yr 11 Half Term 5**	
Students will learn key knowledge and skills about: **Learn details of different manufacturing processes to include:** **Recall on:** **Wasting processes**: Sawing, Shearing, Drilling, Filing, Threading, Routing, Laser-cutting, Turning, Milling. To include: • Tools and equipment required • Steps carried out to manufacture a product	**Students will learn key knowledge and skills about:** **Students will learn to Interpreting orthographic third angle projection drawings to include the following:** Meaning of line types: • outlines • hidden detail • centreline • projection • dimension • leader line Standard conventions for dimensions • linear measurements	**Students will learn key knowledge and skills about:** **Student will learn about inventory management covering the following two industry techniques:** • JIT (Just in time) • MRP (Materials requirements planning) **Students will learn about lean manufacturing covering the following industry techniques:** The seven categories of waste: • transportation	**Students will learn key knowledge and skills about:** *Exam Preparation (R014)* Revisiting key theory topics: - Materials & their properties - Manufacturing methods - Engineering Drawings - Lean Manufacturing - Inventory Management Practice papers and mock exams: Use OCR sample assessments and mark schemes	***Exam is normally the first or second week back after half term*** **Students will learn key knowledge and skills about:** *Exam Preparation (R014)* Revisiting key theory topics: - Globalisation - Quality Practice papers and mock exams: Use OCR sample assessments and mark schemes Focus on command words and exam technique Targeted revision sessions:	

• Safety measures • Shearing is restricted to manual use of a guillotine and tin snips • Threading is restricted to manually using a tap and die **Shaping processes**: Sand casting, Die casting, Injection moulding, Powder metallurgy for ceramic product To include: • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • Differences between sand and die casting, including the types of mould used **Forming processes**; Forging, Press forming metal, Strip heating of polymers, Vacuum forming, Moulding of composite materials. To include: • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • The characteristics of vacuum forming moulds **Additive manufacturing**; 3D Printing (fused deposition modelling). To include: • Tools and equipment required • Steps carried out to manufacture a product • Safety measures **Joining processes**; Brazing, MIG/MAG welding, Riveting, Mechanical fastening. To include: • Tools and equipment required • Steps carried out to manufacture a product • Safety measures • The relative characteristics of different methods of joining	• radius • diameter • tolerances • surface finish Abbreviations • across flats • centre line • diameter • drawing • material • square Representation of mechanical features • threads • holes • chamfers • countersinks • knurls Students will learn standard conventions in BS 8888 and how these are applied and how calculations of maximum and minimum acceptable dimensions from a stated tolerance are done. Students will learn what influences of the scale of manufacture on the production methods including: Scales of manufacture • one-off • batch • mass Advantages and limitations of jigs, fixtures, templates and moulds Level of automation manual control CAM processes fully automated robotic control Advantages and limitations of using CAM machines to manufacture parts Students will learn the reasons for implementing a quality system in engineering:	• inventory • movement • waiting • over-processing • over-production • defects How reducing each waste improves the performance of manufacturing. **Students will learn the meaning of globalisation in an engineering context, covering the following areas:** • Requirement for transportation • International standards • Influence on employment opportunities • Differences in employment conditions • Influence on product cost • Implications for sustainability • Consideration of economic, social, ethical and environmental implications **Students will complete a polymer thermoforming project covering theory and practical. They will recall learning from Yr10 HT1, HT2, HT3, HT4 & Year 11 HT1 covering the following topics:** • **CAD** • **CAM** • **CNC** • **Additive manufacturing (3d printing)** • **Subtractive manufacturing (laser cutting)** • **Shaping processes (injection moulding)** • **Forming processes (vacuum forming)** • **Materials Properties** • **Forms of supply** • **Scales of manufacture** **Challenge:** **Thermoforming challenge tasks:** **Design & Innovation Challenges** **1. Design for Disassembly**	Focus on command words and exam technique Targeted revision sessions: Based on mock exam feedback Use flashcards, quizzes, and group work *Topics tailored to individual class / student needs – **adaptive teaching*** *Personal learning checklists used to identify areas of weakness* **Students will recap, retrieve and build on key knowledge and skills learnt throughout the course:** **Challenge:** **Students will be challenged to engage with all revision activities both inside and outside of school, revision sessions will be offered and students encouraged to attend. Students should create a revision programme which details how, when and what they will revise outside of school.** **Misconceptions:** Students may feel that because they have completed the theory content of the course that they will succeed in the exam without having to revise.	Based on mock exam feedback Use flashcards, quizzes, and group work *Topics tailored to individual class / student needs – **adaptive teaching*** *Personal learning checklists used to identify areas of weakness* **Students will recap, retrieve and build on key knowledge and skills learnt throughout the course:** **Challenge:** **Challenge will focus around analysis of the command words and generation of answers that satisfy the marks available to each question – focus on gaining full marks for each answer.** **Analysis of past papers, to allow trends to be spotted.** **Generation of own exam style questions** **Misconceptions:** Vary depending on the group and mock QLA analysis	

Students will prepare a production plan to manufacture a one-off product to include: • Materials required • Processes, tools and equipment required • Sequence of operations • Health and safety considerations • Quality control requirements **Students will learn to carry out risk assessments to include:** • Identify hazards (potential sources of harm) • Identify risks (the probability of a hazard occurring) • Identify control measures **Challenge:** **Students are challenged to achieve the top of mark band 3 in all topic areas of R015. Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose. Able to use machinery independently. Effectively applies understanding and skills to successfully produce the intended result in a way that would be fit-for-purpose. Able to use tools and equipment independently.** **Misconceptions:** Students may think that all processes (e.g., casting, moulding, machining) are interchangeable. Students often assume mass production is superior. Students may believe CNC machines run entirely on their own. Students might think, for example, that injection moulding works for metals as well as plastics.	• early intercept of problems in production • reducing waste and associated costs • consistency of finished products • conformity to industry standards and regulations • reduce issues at customer and returns Quality control as a reactive approach, measuring parts. Quality assurance as a preventative approach putting in place systems to reduce occurrence of defects. **Students will collate annotated images in the form of a practical diary as part of their evidence for NEA. They will recall learning from Yr10 HT1, HT2, HT3, HT4 & Year 11 HT1** **Students will recap, retrieve and build on key knowledge and skills from half term 1:** **Challenge:** **Students will be challenged to respond to marking and feedback given on coursework for RO15. They should reflect and develop the work they have produced to ensure that all RO15 task scores are in the top mark band.** **Misconceptions:** Orthographic and isometric drawings show the same thing • Misconception: Students may think both types of drawings are interchangeable. Students assume the front view must show the most features. Students often confuse the two or think the symbol is decorative. Students may omit hidden lines or think they're unimportant.	**Challenge students to design their game so that all parts can be easily taken apart for repair or recycling.** **2. Multi-Process Integration** **Require students to justify why each part is made using a specific process (e.g., why a handle is injection moulded vs. 3D printed).** **3. Customisation Feature** **Ask students to include a customisable element (e.g., interchangeable game pieces or modular components).** **Manufacturing Process Challenges** **4. Toolpath Optimisation** **Challenge students to reduce laser cutting time by optimising layout and nesting.** **5. Thermoforming Mould Design** **Ask students to design and make their own mould for a thermoformed part, considering draft angles and material shrinkage.** **6. Tolerance Testing** **Have students test and adjust tolerances between 3D printed and laser cut parts to ensure a perfect fit.** **Production & Inventory Challenges** **7. Just-in-Time Planning** **Students must plan their production so that no materials are wasted and parts are made only when needed.** **8. Inventory Simulation** **Give students a limited stock of materials and challenge them to manage it efficiently across all processes.** **Quality & Inspection Challenges** **9. Quality Control Checklist** **Students create and use a checklist to inspect their parts for defects (e.g., warping, poor surface finish, incorrect dimensions).** **10. Batch Consistency Test** **If making multiple parts (e.g., game tokens), students must ensure consistency across a small batch and explain how they achieved it.** **Sustainability & Globalisation Challenges** **11. Eco-Material Swap** **Challenge students to research and propose a more sustainable material for one of their parts.** **12. Global Supply Chain Scenario**			

Students may not see the link between process choice and product performance. Students might undervalue manual skills like filing, drilling, or hand assembly. Students may not appreciate the time differences between processes. Students often think the cost of a product is just the cost of the raw material.	Students think every drawing must include front, top, and side views. Students may treat freehand sketches as rough and imprecise. Students may place dimensions randomly or on hidden lines. Students often assume everything is mass-produced. Students may think one-off means amateur or unprofessional. Students may not understand the differences in setup, tooling, and flexibility. Students may confuse these two high-volume methods. Students may think mass or continuous production always leads to lower prices. Students may not realise that the **design** process is influenced by the scale of manufacture. Students may think the same number of workers is needed regardless of scale. Students may think a product must be flawless to be considered high quality. Students often believe quality checks happen only after production. Students may think quality only refers to the final item. Students may rely solely on visual inspection. Students might think quality control is expensive and unnecessary. Students may think quality is the responsibility of supervisors or inspectors. Students may ignore or misunderstand tolerances. Students may think quality is based on opinion or appearance.	**Present a scenario where a key material is delayed due to global supply issues—students must adapt their design or process.** **Misconceptions:** Students may think holding large amounts of inventory is safer. Students may overlook raw materials and components. Stock control is only about counting items • Misconception: Students may think it's just a physical task. Students may think JIT eliminates inventory completely. Students may think lean manufacturing is about reducing staff. Students may think small businesses can't use lean methods. Students may think lean is about speeding up production. Students may think waste is just scrap or offcuts. Students may think only multinational corporations are impacted. Students may think sourcing globally is always cheaper. Students may equate globalisation with moving jobs overseas. Students may overlook sustainability concerns.			
Previous learning that is particularly relevant:					

Practical Workshop Skills
Safe use of hand tools and basic machinery
Measuring, marking out, and cutting materials accurately
Understanding workshop safety and risk assessments
Materials and Their Properties
Identifying common materials (e.g. metals, plastics, woods)
Understanding basic properties like strength, flexibility, and durability
Making informed choices about material use in design tasks

Design and Planning
Creating design briefs and specifications
Developing and communicating ideas through sketches and models
Planning sequences of manufacture and evaluating outcomes
Quality Control and Evaluation
Checking accuracy and finish of products
Understanding tolerances and the importance of precision
Reflecting on what worked well and what could be improved

Introduction to Manufacturing Processes
Exposure to processes like drilling, filing, sanding, and joining
Awareness of batch and one-off production methods
Understanding the role of jigs, templates, and fixtures

Future Learning - How content prepares students for future units, Key Stage 4, or Key Stage 5?

The OCR Cambridge National in Engineering Manufacture prepares students for future learning by building a solid foundation in both practical and theoretical engineering concepts. Here's how:
Academic & Technical Foundations

- Introduces core principles of manufacturing, materials science, and production planning.
- Reinforces maths and science through measurements, tolerances, and understanding material properties.
- Develops digital literacy via CAD/CAM and CNC programming.

Practical Experience

- Hands-on tasks simulate real-world engineering challenges.
- Learners gain confidence using tools, machinery, and quality control techniques.

Progression Pathways

- Supports transition to Level 3 qualifications, apprenticeships, or A Levels in engineering and technology.
- Builds problem-solving, teamwork, and independent learning—essential for higher education and industry.

Outcomes:
By the end of the year pupils will be able to solve/create/produce/write:

- Solve engineering problems by applying knowledge of manufacturing processes, materials, and production planning to meet specific design requirements.
- Create accurate and safe engineering components using a range of tools, equipment, and techniques, including both manual and computer-aided methods.
- Produce detailed planning and production documentation, such as job cards, quality control records, and risk assessments, aligned with industry standards.
- Write clear and structured evaluations, justifying material and process choices, and reflecting on the quality and accuracy of manufactured products.

Assessment Strategy How we know our students are knowing and remembering more –
Data from hunting not fishing, formative and summative assessment/s is used to adapt teaching and provide targeted challenge and intervention, supporting SEND and disadvantaged pupils.

Formative:
- Guiding Practical Skills Development
Observe and give feedback as students learn to use tools, machinery, and processes safely and accurately.
Skills are built progressively, with feedback helping students refine techniques before final assessment.
- Supporting Planning and Documentation
Students receive feedback on their production plans, standard operating procedures, and quality control documentation.
This helps them improve clarity, accuracy, and alignment with industry standards.
- Encouraging Reflection and Improvement
Pupils are encouraged to reflect on their work and make improvements before final submission.
We can give general guidance (not specific solutions) to help students identify areas for development.
- Tracking Progress Against Assessment Objectives
We use checklists and observation records to monitor how well students are meeting the criteria.
This helps inform teaching and ensures students are on track for success.
- Peer and Self-Assessment
Students may assess each other's work or reflect on their own, promoting deeper understanding and ownership of learning.
- **In Theory Lessons (R014)**

Quizzes, concept checks, and mini-projects are used to assess understanding of key concepts, production methods and materials and their properties.

Others include:

Summative (& cumulative)
R014: Principles of Engineering Manufacture (Exam)
A written paper assessing theoretical knowledge of materials, processes, tools, and health and safety.
Worth 40% of the final grade.
Taken at the end of the course (terminal assessment rule applies).

R015: Manufacturing a One-Off Product (NEA)
Students plan and manufacture a single product using hand tools and equipment.
Assesses planning, making, and evaluating skills.
Worth 30% of the final grade.

R016: Manufacturing in Quantity (NEA)
Focuses on batch production using jigs, templates, and quality control.
Assesses teamwork, accuracy, and production efficiency.
Worth 30% of the final grade.

Cumulative assessment is embedded in the course structure by:
- Building knowledge and skills progressively across units. For example, skills learned in R015 (one-off production) are applied and extended in R016 (batch production).

Opportunities to revisit past learning:
Cross-Unit Skill Reinforcement
Knowledge from R014: Principles of Engineering Manufacture (exam unit) is applied in both R015 and R016 (NEA units).
For example, understanding of materials, tools, and safety procedures is revisited when students plan and carry out manufacturing tasks.
Practical Application of Theory
Theoretical concepts such as manufacturing processes, tolerances, and quality control are reinforced through hands-on tasks in R015 and R016.
This helps students internalize and apply knowledge in real-world contexts.
Iterative Project Work
In NEA units, students are encouraged to review and refine their work based on feedback and testing.
This process naturally involves revisiting earlier decisions, plans, and techniques.
Mock Exams and Practice Assignments

- **Verbal feedback during lessons**
- **Written comments on digital portfolios**
- **Checklists and rubrics aligned with assessment objectives**
- **1:1 progress reviews to set targets and next steps**
- **Marking of mock examinations & use of mock feedback lessons**
- **Use of personal learning checklists**

- Tracking student progress over time through practical tasks, planning documents, and evaluations.
- Preparing students for the final exam (R014) by revisiting and applying theory throughout the course.
- Encouraging reflection and improvement through teacher feedback and self-assessment during NEA development.
- Mock exams and milestone reviews: Used to track understanding and readiness for final assessments.

We use mock exams and practice tasks to help students recall and apply earlier learning, especially in preparation for the R014 exam.
These activities also highlight areas where further review is needed.

Teacher-Led Reviews and Recaps
Regular lesson starters, quizzes, low-stakes testing and review sessions are used to revisit key concepts and terminology.

Feedback and Reflection
Regular formative feedback encourages students to reflect on their progress and revisit earlier work to improve it—especially in the NEA.

Subject specific Revision Programme
Produced for December onwards (Yr 11), it gives pupils a week-by-week guide on which topics to cover / re-cap and when. This is supported by page links to the revision guide and links to exam style questions.

Opportunities for homework (including apps):
Completion of set assignments linked to the NEA
Watching of YouTube clips related to manufacturing processes

How is the curriculum adapted to meet the needs of SEND and disadvantaged pupils, while maintaining high expectations?

- Practical applications make learning more meaningful and accessible
- Repetition and retrieval practice from formative and summative assessments
- DT Contribution paid for Pupil Premium – support materials used in school
- PP and SEND students take priority seating within our classrooms
- Scaffolding e.g. modelling, showing exemplar work
- Teaching Materials – clear font, coloured backgrounds, videos / step-by-step images projected on the board to show key processes
- Written Feedback for identified assessments
- Dedicated time in lessons to address misconceptions
- We maintain ambitious goals for SEND and disadvantaged pupils
- Variety of teaching styles used to support individual needs
- Access to SEND information e.g. passports
- We use formative assessment to identify barriers and adapt teaching in real time
- Feedback is specific, actionable, and encouraging, helping pupils understand how to improve
- Purchasing of revision guides for Pupil Premium students

Wider Curriculum and Enrichment – cultural capital and real world application -

Enriching experiences:
The OCR Cambridge National in Engineering Manufacture supports enriching experiences by combining hands-on learning with real-world relevance. Students use CNC machinery, CAD/CAM software, and industry-standard tools to create tangible products, building pride and confidence. Learners develop resilience, independence, and problem-solving through iterative design and reflection. Collaboration and communication are fostered through peer feedback. These experiences inspire curiosity, boost motivation, and prepare students for future study, careers, and lifelong learning in engineering and beyond.

Literacy, Oracy and disciplinary language:

Literacy

- Students read and interpret **technical specifications**, engineering drawings, and process documentation.
- They produce **structured written work**—including planning documents, evaluations, and annotated designs.
- The course builds vocabulary around **manufacturing processes**, materials, and quality control, encouraging precise and purposeful writing.

Oracy

Cross-Curricular opportunities / Opportunities to develop 'character':

- **Mathematics**: Students apply geometry, algebra, and data analysis in tasks like measuring tolerances, calculating production costs, and interpreting technical drawings.
- **Science (Physics & Chemistry)**: Supports understanding of forces, energy transfer, material properties, and chemical processes in manufacturing.

Our curriculum supports the school value of:

Joy	*Foster enthusiasm and engagement by offering hands-on, practical learning that connects directly to real-world engineering. Students use tools, machinery, and CAD/CAM software to create tangible products, building confidence and pride. Tasks are based on industry scenarios, encouraging creativity, problem-solving, and innovation. The course suits different learning styles through a mix of theory and applied activities, keeping learners motivated. Collaboration and reflection boost participation, while clear links to careers and progression pathways help students see the value of their work. This dynamic approach inspires curiosity and empowers learners to explore engineering with purpose and excitement.*
Progress	*We monitor and support progress through a combination of formative and summative assessment strategies. Teachers track student progress through regular practical tasks and written assessments aligned with the assessment objectives of R015 and R016.* *Feedback is provided through peer critiques, teacher marking, and one-to-one discussions, helping students reflect and improve. Progress in the Non-Exam Assessment (NEA) is monitored through milestone check-ins and portfolio reviews. Differentiated support, including scaffolding, modelling, and targeted intervention, ensures all learners can succeed. Digital tools like CAD software and online portfolios also help track development and showcase learning over time.*
Success	*We celebrate success by giving verbal praise, positive phone calls, reward points and showcasing exceptional performance – such as practical work, NEA content or written pieces.*
Act with care, kindness, respect, and integrity	*We build meaningful connections with our students starting with hands-on learning that empowers students to create real products. Teachers celebrate individual progress, offer personalised feedback, and tailor instruction to different learning styles. Linking projects to real-world industries and careers helps students see relevance and value.* *Regular check-ins and reflection foster confidence and resilience. By creating a supportive, inclusive environment where every contribution matters, we help students feel seen, heard, and motivated—*

- Learners present ideas, explain procedures, and justify decisions during practical tasks and peer discussions.
- Group work fosters **collaborative dialogue**, active listening, and constructive feedback.
- Oracy is developed through **real-world scenarios**, mirroring workplace communication.

Disciplinary Language

- Students learn to use **engineering terminology** confidently—terms like CNC, tolerances, jigs, fixtures, and lean manufacturing.
- They engage in **subject-specific discourse**, applying language to solve problems and communicate technical intent.
- Exposure to authentic industry contexts helps learners "talk like engineers," preparing them for future study and employment.

- **Computing & ICT**: Integrates CAD/CAM software, CNC programming, and digital workflow systems.
- **Design & Technology**: Reinforces design principles, prototyping, and iterative development.
- **Business Studies**: Explores production planning, quality control, lean manufacturing, and market viability.
- **Geography & Environmental Science**: Links to sustainability, ethical sourcing, and lifecycle analysis of materials.
- **English**: Enhances literacy through technical documentation, evaluations, and persuasive communication.

Our curriculum supports personal development by:

Independence & Responsibility

- Students manage their own projects, make design decisions, and follow safety protocols—building accountability and self-motivation.
- Planning and completing tasks develops time management and organisational skills.

Resilience & Problem Solving

- Learners face real engineering challenges, learning to adapt, troubleshoot, and improve through iterative design.
- Mistakes become learning opportunities, fostering perseverance and confidence.

Collaboration & Communication

- Team-based tasks and peer feedback build interpersonal skills, empathy, and respect.
- Students learn to express ideas clearly—verbally and in writing—mirroring workplace communication.

Career Readiness & Self-Belief

- Exposure to industry practices and tools like CNC and CAD/CAM boosts ambition and self-efficacy.
- Success in practical tasks reinforces pride and a sense of achievement.

making engineering not just a subject, but a personal journey of growth and discovery.		**Careers / Employability skills:** **How does the curriculum link to the following employability skills:** **Technical & Industry Skills** • **CNC machining and CAD/CAM software operation** • **Production planning, quality control, and materials selection** • **Understanding of manufacturing processes and engineering specifications** **Core Employability Skills** • **Problem-Solving:** Students tackle real-world design and production challenges, learning to analyse issues and develop effective solutions. • **Communication:** Learners document processes, present ideas, and collaborate—building confidence in both technical and verbal expression. • **Teamwork:** Group tasks and peer feedback foster cooperation, adaptability, and interpersonal skills. • **Time Management:** Managing NEA projects teaches planning, prioritisation, and meeting deadlines. • **Resilience & Initiative:** Hands-on tasks encourage persistence, independent learning, and self-motivation. • **Digital Literacy**: Students use CAD/CAM software and CNC equipment, gaining fluency in industry-standard technologies. • **Attention to Detail:** Precision in measuring, marking out, and quality control builds accuracy and accountability. • **Speaking:** Developing confidence and professionalism essential for workplace collaboration and client interaction. **Employment Sectors discussed include:** **Engineering & Manufacturing** • Mechanical, electrical, and civil engineering • Aerospace and automotive industries

- Robotics, automation, and process control
- CNC machining and precision manufacturing

Digital & Technology
- CAD/CAM design and digital prototyping
- Programmable systems and smart manufacturing
- Industrial software and systems integration

Design & Product Development
- Industrial and product design
- Packaging and materials innovation
- Ergonomics and user-centered design

Science & Research
- Materials science and testing
- Environmental engineering and sustainability
- Research and development in manufacturing technologies

Business & Operations
- Production planning and logistics
- Quality assurance and lean manufacturing
- Technical consultancy and project management

Curriculum impact is evaluated through pupil study, work scrutiny, and progress data. Findings inform regular curriculum review to ensure continuous improvement.

When was this curriculum last reviewed? Include date	What changes were made and why?	How is ongoing improvement ensured?
July 25		Work scrutiny, QA monitoring, Learning Walks, CPD sessions
		Faculty meetings, examination reports, recall of exam scripts
		NEA and Mock moderation