Long Term Curriculum Plan

Subject: **Design and Technology**

Our Subject Vision

Design and Technology is a subject which prepares pupils for work and life in the 21st century by allowing them to participate confidently and successfully in an increasingly technological world. Fast paced changes in the economy make predictions about future job market difficult. Giving students a range of transferable skills, up to date subject knowledge, and creative thinking will make them adaptable in the face of change.

Design and Technology can do this by empowering them to independently research, plan, implement and reflect and ensure they are equipped with the practical skills and technical knowledge to participate in modern society, giving them the option to pursue a career in STEM.

Design and technology programmes of study: key stage 3 National curriculum in England

Purpose of study

Design and technology are an inspiring, rigorous, and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants, and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing, and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising, and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth, and well-being of the nation.

Aims

The national curriculum for design and technology aims to ensure that all pupils:

- develop the creative, technical, and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world
- build and apply a repertoire of knowledge, understanding and skills to design and make high-quality prototypes and products for a wide range of users
- critique, evaluate and test their ideas and products and the work of others

Attainment targets

By the end of key stage 3, pupils are expected to know, apply, and understand the matters, skills and processes specified in the programme of study. Schools are not required by law to teach the example content in [square brackets].

Subject content Key stage 3

Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making. They should work in a range of domestic and local contexts [for example, the home, health, leisure, and culture], and industrial contexts [for example, engineering, manufacturing, construction, energy].

When designing and making, pupils should be taught to:

Design

- use research and exploration, such as the study of diverse cultures, to identify and understand user needs
- identify and solve their own design problems and understand how to reformulate problems given to them
- develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations
- use a variety of approaches [for example, biomimicry and user-centred design], to generate creative ideas and avoid stereotypical responses
- develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools

Make

- select from and use specialist tools, techniques, processes, equipment, and machinery precisely, including computer-aided manufacture
- select from and use a wider, more complex range of materials and components, taking into account their properties

Evaluate

- analyse the work of past and present professionals and others to develop and broaden their understanding
- investigate new and emerging technologies
- test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups
- understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers, and technologists

Technical knowledge

- understand and use the properties of materials and the performance of structural elements to achieve functioning solutions
- understand how more advanced mechanical systems used in their products enable changes in movement and force
- understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs]
- apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers]

End Points – GCSE DT

EP1.To innovate and take risks, to be resourceful, to be an enterprising and capable citizen.

EP2.To be a participant in advances in manufacturing, to be able utilise CAD (Computer Aided Design) CAM.

EP3.To be able to conduct primary and secondary research relating - aesthetic, technical, cultural, social, economic, industrial, and environmental issues. To understand and apply findings to inform design decisions.

EP4.To Design products that solve real world and relevant problems within a variety of contexts, considering their own and other's needs, wants and values

EP5.To combine practical and technological skills with creative thinking and problem solving to make products and systems to meet human needs

EP6.To have and apply an understanding of a wide range of materials, being able to choose and justify their use in relation to their aesthetic, technical, economic, cultural, and physical properties.

End Points – OCR National Engineering Design

R038: Principles of engineering design - EP1 - Designing processes, EP2 - Designing requirements, EP3 - Communicating design outcomes, EP4 - Evaluating design ideas

R039: Communicating designs - EP5 - Manual production of freehand sketches, EP6 - Manual production of engineering drawings, EP7 - Use of Computer Aided Design (CAD)

R040: Design, evaluation, and modelling - EP8 - Product evaluation, EP9 - Modelling design ideas

Subject Domains of Knowledge – GCSE DT

- D1. Industry and enterprise
- D2. Critical evaluation and disruptive technologies
- D3. Investigation with primary and secondary data
- D4. Prototype development
- D5. Specialist tools and equipment
- D6. Materials and their properties

Subject Domains of Knowledge – OCR National Engineering Design

R038: Principles of engineering design -

EP1 - Designing processes

- The stages involved in design strategies
- Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach

EP2 - Designing requirements

- Types of criteria included in an engineering design specification
- How manufacturing considerations affect design
- Influences on engineering product design

EP3 - communicating design outcomes

- Types of drawing used in engineering
- Working drawings

Subject Key Concepts GCSE DT

Industry and enterprise

- **C1. Organisation of the workplace**
- **C2. Business models**
- **C3. Automation**
- **C4. Scale of production**

Critical evaluation and disruptive technologies

- **C5. Global warming**
- **C6. Finite/non-finite**
- **C7. CAD/CAM**
- **C8. Planned obsolescence**
- **C9. Ethical considerations**

Investigation with primary and secondary data

- **C10. Primary and secondary data**
- **C11. Representation of data**
- **C12. Responding to data**
- **C.13 The work of others**

Prototype development

- **C.14 Design strategies**
- **C.15 Exploring design ideas**
- **C.16 Communicating design ideas**

Specialist tools and equipment

- **C.17 Marking out**

Subject Key Concepts OCR National Engineering Design

R038: Principles of engineering design

EP1 - Designing processes

Linear design, Iterative design, Inclusive design, User-centred design, Sustainable design, Ergonomic design, Analysis of the design brief, Methods of researching the product requirements, Production of an engineering design specification, Generation of design ideas by sketching and modelling, The reasons for the use of modelling, Virtual modelling of the design idea, Physical modelling of the design idea, Manufacture, or modification of the prototype

EP2 - Designing requirements

Needs and wants, Quantitative and qualitative criteria, Reasons for the product criteria included in the design specification (ACCESS FM), Scale of manufacture, Material availability and form, Types of manufacturing processes, Production costs, Market pull and technology push, British and International Standards, Legislation, Planned obsolescence, Sustainable design (6Rs), Design for the circular economy

EP3 - Communicating design outcomes

Freehand sketching, Isometric, Oblique, Orthographic drawings, Exploded views, [OBJ] Assembly drawings, Block diagrams, Flowcharts, Circuit diagrams, Wiring diagrams

- Using CAD drawing software

EP4 - Evaluating design ideas

- Methods of evaluating design ideas
- Modelling methods
- Methods of evaluating a design outcome

R039: Communicating designs -

EP5 - Manual production of freehand sketches

- Sketches for a design idea

EP6 - Manual production of engineering drawings

- Drawings for a design idea

EP7 - Use of computer aided design (CAD)

- Produce a 3D CAD model of a design proposal to include compound 3D shapes

R040: Design, evaluation, and modelling -

EP8 - Product evaluation

- Product analysis
- Carry out product disassembly

EP9 - Modelling design ideas

- Methods of modelling

- **C.18 Addition process**
- **C19.Wasting processes**
- **C.20.Deforming processes**
- **C.21.Finishing processes**
- **C.22Commercial processes**

Materials and their properties

- **C.23 Sources and origin of plastic**
- **C.24 Thermoforming plastic**
- **C.25 Thermosetting plastic**
- **C.26 Density**
- **C.27 Conductivity**
- **C.28 Strength**
- **C.29 Hardness**
- **C.30 Toughness**
- **C.31 Malleability**
- **C.32 Elasticity**
- **C.33 Stock forms**
- **C.34 Reinforcing**

2D engineering drawings using third angle orthographic projection, Standard conventions, Meaning of line types, Abbreviations, Representations of mechanical features, Advantages, and limitations of using CAD drawing software compared to manual drawing techniques

EP4 - Evaluating design ideas

Production of models, Qualitative comparison with the design brief and specification, Ranking matrices, Quality Function Deployment (QFD), Virtual (3D CAD), Card, Block, Breadboarding, 3D printing, Methods of measuring the dimensions and functionality of the product, Quantitative comparison with the design brief and specification, User testing, Reasons for identifying potential modifications and improvements to the design,

R039: Communicating designs

EP5 - Manual production of freehand sketches

2D/3D sketches, Thick/thin lines, Texture, Tone Shading, Annotation, and labelling techniques, Produce an isometric sketch for a design proposal,

EP6 - Manual production of engineering drawings

Produce a 3rd angle orthographic projection drawing of a design proposal using standard conventions, Produce an assembly drawing for a design proposal.

EP7 - Use of computer aided design (CAD)

Produce a 3D CAD model of a design proposal to include compound 3D shapes, Produce 3D CAD assemblies of components

R040: Design, evaluation, and modelling

EP8 - Product evaluation

Carry out product analysis using ACCESS FM, compare products using Ranking matrices, Quality Function Deployment (QFD), Use of manufacturers manuals or other published sources, use appropriate tools and instruments, Analyse the disassembled product

		EP9 - Modelling design ideas Virtual CAD 3D, Physical modelling,

Year 10: OCR National Engineering Design

Units / Term **Adapt according to subject**	**Unit 1 R038 Principles of Engineering Design (exam)**	**Unit 2 R039 Communicating Designs (NEA)**
Unit Overview	In this unit you will learn about the different design strategies and where they are used, as well as the stages that are involved in iterative design, which is currently one of the most widely used design strategies. You will learn about the type of information needed to develop a design brief and specification, and the manufacturing and other considerations that can influence a design. You will develop knowledge of the types of drawing used in engineering to communicate designs, as well as the techniques used to evaluate design ideas and outcomes, including modelling methods.	In this unit you will learn how to develop your techniques in sketching and gain industrial skills in engineering drawing using standard conventions that include dimensioning, line types, abbreviations, and representation of mechanical features. You will enhance your confidence and capabilities by using computer aided design (CAD), 2D and 3D software, to produce accurate and detailed drawings and models that visually communicate your designs.
Key Concepts taught in this Unit	***EP1 - Designing processes*** Linear design, Iterative design, Inclusive design, User-centred design, Sustainable design, Ergonomic design, Analysis of the design brief, Methods of researching the product requirements, Production of an engineering design specification, Generation of design ideas by sketching and modelling, The reasons for the use of	***EP5 - Manual production of freehand sketches*** 2D/3D sketches, Thick/thin lines, Texture, Tone Shading, Annotation, and labelling techniques, Produce an isometric sketch for a design proposal, ***EP6 - Manual production of engineering drawings*** Produce a 3rd angle orthographic projection drawing of a design proposal using standard conventions, Produce an assembly drawing for a design proposal.

	modelling, Virtual modelling of the design idea, Physical modelling of the design idea, Manufacture, or modification of the prototype ***EP2 - Designing requirements*** Needs and wants, Quantitative and qualitative criteria, Reasons for the product criteria included in the design specification (ACCESS FM), Scale of manufacture, Material availability and form, Types of manufacturing processes, Production costs, Market pull and technology push, British and International Standards, Legislation, Planned obsolescence, Sustainable design (6Rs), Design for the circular economy ***EP3 - Communicating design outcomes*** Freehand sketching, Isometric, Oblique, Orthographic drawings, Exploded views, Assembly drawings, Block diagrams, Flowcharts, Circuit diagrams, Wiring diagrams 2D engineering drawings using third angle orthographic projection, Standard conventions, Meaning of line types, Abbreviations, Representations of mechanical features, Advantages, and limitations of using CAD drawing software compared to manual drawing techniques ***EP4 - Evaluating design ideas*** Production of models, Qualitative comparison with the design brief and specification, Ranking matrices, Quality Function Deployment (QFD), Virtual (3D CAD), Card, Block, Breadboarding, 3D printing, Methods of measuring the dimensions and functionality of the product, Quantitative comparison with the design brief and specification, User testing, Reasons for identifying potential modifications and improvements to the design,	***EP7 - Use of computer aided design (CAD)*** Produce a 3D CAD model of a design proposal to include compound 3D shapes, Produce 3D CAD assemblies of components
Key domains taught in this Unit	EP1 - Designing processes • The stages involved in design strategies • Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach EP2 - Designing requirements • Types of criteria included in an engineering design specification • How manufacturing considerations affect design • Influences on engineering product design EP3 - communicating design outcomes	EP5 - Manual production of freehand sketches • Sketches for a design idea EP6 - Manual production of engineering drawings • Drawings for a design idea EP7 - Use of computer aided design (CAD) • Produce a 3D CAD model of a design proposal to include compound 3D shapes

	• Types of drawing used in engineering • Working drawings • Using CAD drawing software EP4 - Evaluating design ideas • Methods of evaluating design ideas • Modelling methods • Methods of evaluating a design outcome	
KS4 End Points	R038: Principles of engineering design - EP1 - Designing processes, EP2 - Designing requirements, EP3 - Communicating design outcomes, EP4 - Evaluating design ideas	R039: Communicating designs - EP5 - Manual production of freehand sketches, EP6 - Manual production of engineering drawings, EP7 - Use of Computer Aided Design (CAD)
Declarative Knowledge (Students should know)	1.1• Students may be required to recommend a design strategy for a particular product and justify their choice. 1.2.1• Students will need to be able to identify the key stages of the iterative design process and describe the stages involved in carrying out each process. 1.2.2 - 1.2.3• Students will need to know how to analyse existing products using ACCESS FM. • Students will need to understand how the stages of the iterative design process allow the development of the design based on a cyclic process of designing, making, evaluating, and refining of the prototype. 2.1.1 – 2.1.3• Students will need to know how to use ACCESS FM to produce an engineering design specification and knowledge of the scale of manufacture. • Students should know at least one example of a product produced by each scale of manufacture. • Students will need to know how designs are made sustainable through the consideration of the 6Rs, and should know at least one example of how a product is made sustainable by one of the 6Rs.• Students will need to be able to describe the influences on engineering product design. 3.1.1• Students will need to know each of the engineering drawing techniques and may be expected to identify each of the conventions or representations stated. • Students may also be expected to add dimensions using the conventions to provided drawings.	Task 1• Students must be able to produce freehand sketches of a design idea or design proposal using rendering techniques: thick/thin lines; texture; shading and annotation to demonstrate the design. It would be highly unusual to see the same output from students in a cohort.• Ensure that students produce a range of design ideas and proposals that respond to the specification provided, using both 2D and 3D techniques and utilise graphical communication methods to enhance their ideas. Task 2• Students are required to develop one design proposal further using rendering techniques to present both 2D and 3D sketches. • Detailed annotation and labelling should be used to help describe the function, features, material choices, assembly methods etc. • Students should explain how their design meets the design specification provided. Task 3• Students must be able to produce a 3rd angle orthographic drawing and an assembly drawing for a design proposal. They must use the correct standards and conventions. • Manual production of drawings refers to either the use of drawing boards or 2D CAD software, so access to either drawing boards and drawing instruments, or access to a 2D CAD software, is required. • You should ensure that students produce a range of engineering drawings following standard conventions (BS 8888). • To demonstrate their design proposal, students should utilise a range of assembly drawing techniques. Task 4• You should ensure that students use CAD software to produce formal presentation design proposals. • Students must demonstrate skill in using 2D and 3D CAD modelling.

	3.1.2• Students will need to describe at least one modelling method in the creation of a product prototype and give one example of a product produced using one of the modelling methods.	
Procedural Knowledge (Students should be able to do)	***R038: Principles of engineering design -*** EP1 - Designing processes • The stages involved in design strategies • Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach EP2 - Designing requirements • Types of criteria included in an engineering design specification • How manufacturing considerations affect design • Influences on engineering product design EP3 - communicating design outcomes • Types of drawing used in engineering • Working drawings • Using CAD drawing software EP4 - Evaluating design ideas • Methods of evaluating design ideas • Modelling methods • Methods of evaluating a design outcome	***R039: Communicating designs -*** EP5 - Manual production of freehand sketches • Sketches for a design idea EP6 - Manual production of engineering drawings • Drawings for a design idea EP7 - Use of computer aided design (CAD) • Produce a 3D CAD model of a design proposal to include compound 3D shapes
Developing T3 Literacy and Numeracy	Linear Iterative Inclusive User-centred Sustainable Ergonomic design, Analysis primary research secondary research market research existing products interviews focus groups anthropometric data ACCESS FM (Aesthetics, Cost, Customer, Environment, Size, Safety, Function, Materials and Manufacturing) disassembly , one-off batch mass availability and form wasting shaping forming joining finishing assembly Market pull and technology push British and International Standards Legislation Planned obsolescence (6Rs) Rethink Reuse Recycle Repair Reduce Refuse Design for the circular economy,	2D/3D sketches Thick/thin lines Texture Tone Shading Annotation and labelling techniques: Centre line Parts list to include up to 4 parts lines arcs polygons extrude revolves sizing dimensioning shelling holes CAD reference geometry: work planes CAD rendering, CAD assembly: multiple components mate tools mate constraint tools animation
Assessment (Summative and Formative)	The externally assessed unit is made up of a number of topic areas. Each topic area has related teaching content that must be taught. A direct question may be asked about any content in the teaching content column. The breadth and depth column helps to clarify the breadth and depth of teaching needed, and indicates the range of	The NEA units are made up of a number of topic areas with associated teaching content which details what must be taught as part of each topic area. The NEA units also have an exemplification column that provides more information about, and examples relating to, the teaching content. This

	knowledge and understanding that may be assessed in the exam. This column also confirms any aspects that you do not need to teach in relation to the content as 'does not include' statements.	helps to exemplify the teaching expected so that students are equipped to successfully complete their assignments.
Links to Prior Learning	This unit builds upon all the KS3 units. Taking them into greater depth and application, specific to the course.	
Next steps in learning	R038 continues into Year 11, R039 is submitted in Year 10, any pupils not achieving required grades can resubmit but would need to redo the whole unit.	
Common Barriers to learning in this unit	Lack of prior knowledge – misconceptions of key concepts and lack of opportunity for practical experience and handling of tools and equipment in use of forming and shaping materials. I cannot draw attitude – especially when it is technical (current Year 10) Misconceptions of key concepts and lack of opportunity for practical experience (if attendance was impacted in year 7 and 8 due to COVID-19) Inability to recognise cross curricular links, eg. Art, Science, Maths skills and knowledge.	