Term This curriculum map offers a route through the GCSE Engineering (8852) specification.	**INTENT** **Substantive Knowledge** This is the specific, factual content for the topic, which should be connected into a careful sequence of learning.	**IMPLEMENTATION** **Disciplinary Knowledge (Skills)** This is the action taken within a particular topic in order to gain substantive knowledge.	**IMPACT** **Assessment opportunities** What assessments will be used to measure student progress? Evidence of how well students have learned the intended content.
Year 10 **Winter Term** Aim To introduce working with a systems approach using mechanical and electronic components/devices. and Technology lessons.	***Project 1: Working with metals.*** ***Aim*** To introduce understanding and working to formal engineering drawings. This a focus on technical drawing by hand or with cad. Learning to read technical drawings. ***Material removal 3.2.2 Shaping by forming and manipulation 3.2.3 Joining and assembly 3.2.5 Practical engineering skills 3.6.***	***Essential Skills*** To be able to read and understanding orthographic drawings, engineering conventions, dimensioning. To be able to use marking out methods using rule, square, dividers. To be able to use measurement with varying degrees of accuracy, using rule, callipers, micrometre and vernier callipers. To be able turn materials using manual or CNC lathe (or both if available), turning, facing, drilling. To be able to understand tool types and parts of the lathe; headstock, tail stock (if fitted), slides.	**HEALTH AND SAFETY -** machine sign off for the passport. Weekly homework Classwork Marked Peer and self-assessment Evaluation and mini moderation Seneca Learning (Chart assessment DATA) Termly Reporting Up to date tracking

	Project 2: Systems: Build a small robot. **Aim** To introduce working with a systems approach using mechanical and electronic components/devices. Cutting: using hacksaw, tinsnips. Drilling, using both Pillar drill, and lathe, twist drills, countersinking. Using a jig. Bending and forming, using the vice/folding bars, bending jigs or fixtures. Hot working/forging. Shaping and finishing, filing, possibly milling if available, use of abrasives. ***Mechanical systems 3.31*** ***Electrical systems 3.3.2*** ***Electronic systems 3.3.3.*** ***Pneumatic systems 3.3.5*** ***Practical engineering skills 3.6***	To be able to understand methods of producing tapers or radius. ***Essential Skills*** To be able to develop an understanding of how emerging technologies (in areas such as materials science, information technology (IT) and communications, energy, medicine and robotics) have changed and will continue to change the way in which engineered products are made and used. To develop skills, knowledge and understanding as a foundation for future learning and progression, in relation to engineering and other related disciplines To be able to engage in a range of intellectual and practical processes in order to solve problems through the production of engineered outcomes. To be able to analyse situations. To be able to work collaboratively to complete specific tasks.	

	Project 3: Understanding materials part 1. Aim Introduce materials testing as a design method of predicting performance under load. Tensile testing a variety of materials under load, e.g., nylon fishing line, cotton, hair, copper fuse wire, using a commercial tester or by improvised methods. Measuring extension under strain, total length v original length and comparing the thickness of end sections with middle to detect wasting. ***Modelling and calculating 3.4.1*** ***Testing 3.4.2*** ***Modelling and calculating 3.4.1*** ***Practical engineering skills 3.6.***	To be able to effectively prepare flowcharts. To be able to follow a provided production plan. To be aware of Health and Safety. The use of PPE and risk assessments. **Physical testing** To be able to understand the properties, both physical and mechanical, of groups of materials, including brittleness, ductility, malleability, hardness, strength/stiffness and toughness. To be able to use methods of testing and evaluating materials and structural behaviour under load, including determining tensile/compressive strength. To be able to use destructive and non-destructive testing. To be able to use testing control programs for programmable devices through modelling and enactment.	

	Project 4: Make an electronic lock/alarm. Aim To introduce circuit design, use a CAD package for modelling circuit behaviour, test the outcomes of changing component values. Become aware of Ohms Law equations. Construct a working circuit. Compare the use of discrete integrated circuits with programmable devices.	To be able to modify a program to improve performance. The use of quality control methods to ensure successful outcomes through the application of tolerances. Identifying and applying checks during the production process. **Systems approach** To be familiar with the function of the system building blocks. To be able to describe the way in which parts of a system can be divided into sub-systems. To be able to look at circuit design in terms of, input, process, output. To be able understand the function of sensing devices e.g Light Dependant resistors, thermistors. To be able to understand how to match required function with available process devices:	

		o Timers e.g., 555NE. o Counters e.g., 4017B Decade Counter. o Comparators e.g., CA 3140. o Logic AND, OR, NOT 4001B, 4011B.	
Year 10 **Spring Term**	**Project 5: Build a bridge.** *Content and activity* To build a trussed structure from lightweight materials e.g., balsa, paper, thin card and destructively test. Calculate factor of safety, weight/load ratio. Build monocoque structures from card or form using vacuum moulding and test with dynamic and static loading, analyse failed structure for evidence of compression failures, distortion and buckling under load. Packaging a fragile object. Test a variety of materials for behaviour and failure modes in torsion and bending.	To be able to explore the concept of structural strength. To be able to create and test strong and stable structures. To be able Identify materials used for bridge construction and their properties. To be able to understand the forces acting on bridges or trussed structure. To be able to identify zero-force members in a structure. To be able to recognise planar and space (i.e., three-dimensional) trussed structures. To understanding why structures are often designed as trusses.	Weekly homework Classwork Marked Peer and self-assessment Evaluation and mini moderation Seneca Learning (Chart assessment DATA) Termly Reporting Mock Examination Up to date tracking

	Structural system 3.3.4 ***Practical engineering skills 3Structural system 3.3.4 Practical engineering skills 3.***	To learn how to identify trusses in bridge structures. To be able to describe different shapes that form trussed structures. To be able to record measurements of interior and exterior angles.	
	Project 6: CAD-CAM Using a 2D drawing package e.g. Tec soft 2D or Corel Draw alternatively a 3D package, working on a single plane to produce drawings that conform to standard. If facilities permit, drawings could be produced for export to laser/vinyl cutters. Using CAD to design 3D objects, working with a 3D package, using parametric constraints, and functions such as extrude, shell,	**Content and activity** To be able to know the advantages of using CAD in comparison with other methods. To be able to know about the software and hardware required to produce CAD drawings. To be able to produce and interpret CAD drawings. To be able to use CAD software to produce 3D drawings and views. To be able to describe the advantages, compared to other methods, of producing drawings electronically using a CAD package.	

	chamfering with methods of joining or locating components e.g. mating. Testing using CAD simulation, for stress or to articulate and test movements. Outputting 3D designs for CAM processes including rapid prototyping, CNC milling, routing. ***Practical engineering skills 3.6***	To be able to maintain design specifications and requirements by constraining the geometry within a drawing. To be able to apply multiple geometric constraints to objects instantly. To include formulas and equations within dimensional constraints. To be able to make design changes quickly by changing the value of a variable. To understand to process of assembly, joining and combining materials in order to produce a 3D rendered product.	

	Project 7: Producing engineering drawings. Orthographic drawings – third angle Placement of views, plan and elevations. Dimensioning. Conventions - Centre lines, screw threads, holes. Sectional views Cross hatching. Conventions and rules. Isometric projection including isometric circles. Assembly drawing using a disassembled product.	**Content and activity** To be able to describe how drawing and communication are important to the engineering design process. To be able to explain the need for engineering drawings in manufacturing and construction disciplines. To be able to communicate a simple engineering design through the use of a drawing with detailed instructions. To accurately measure and cut materials as specified in a design drawing. To be able to explain the concept of orthographic projection and why it is useful in engineering. To be able to draw the three principle orthographic views of an object. To be able to accurately draw cubes, cuboids, and other 3D compound shapes using isometric paper. To understand isometric drawings, axes, and planes. To be able to draw isometric circles in different isoplanes.	

		To understand Dimensions are a numerical value expressed in appropriate units of measurement and used to define the size, location, orientation, form or other geometric characteristics of a part. To be able to use dimensioning when drawing isometric objects (Parallel, combined, repeated etc.)	
Year 10 **Summer Term**	***Project 8: Make a casting/molding.*** Using a prepared pattern, demonstrate sand casting including all relevant terminology, cope, drag, pourer, riser. Explain contraction and the need for venting. Make and use simple cut outs as molds to cast pewter. Make and use simple cut outs as moulds to cast pewter.	To be able to demonstrate and discuss the sand casting process. To be able to identify the limitations of the sand casting process. To be able to understand how sand cast materials can have defects and small voids that are not visible on the surface. To demonstrate their ability to apply knowledge of casting concepts to the manufacture of a casting.	Weekly homework Classwork Marked Peer and self-assessment Evaluation and mini moderation Seneca Learning (Chart assessment DATA) Termly Reporting

	Practical engineering skills 3.6 ***Casting and moulding 3.2.4***	To design and then fabricate an appropriate mold for the intended casting. To be able to cast a usable part and evaluate its quality. **Content and activity**	Up to date tracking

	Project 9: Make it go faster? Introduce the aerodynamic concepts of thrust, drag and lift. Look at applications including F1 in schools, paper dart launchers and commercial applications such as, for example, golf clubs. Thermoforming. Thermosetting. Working with thermoforming polymers. Applications of polymers. Composites and reinforcements · GRP, Carbon fibre, Kevlar. · Reinforcements e.g. steel in concrete.	To be able to understand aerodynamics is the study of forces and the resulting motion of objects through the air. To be able to describe how four key forces (lift, weight, thrust, drag) act on airplanes during flight. To be able to explain Bernoulli's principle. To able to use Bernoulli's principle to explain what lift means with respect to airplanes. To be able to understand thermoforming is a manufacturing process where a plastic sheet is heated to a pliable forming temperature, formed to a specific shape in a mould, and trimmed to create a usable product. To be able understand a thermosetting plastic is a polymer that is irreversibly hardened with heat. To be able to describe how polymers are synthesized by combining two types of monomers with heat for a sufficient period of time. To be able to know how a cross-linker will cause a change in the physical properties of a polymer system and how molecular arrangements influence these materials properties.	

	Project 10: Understanding materials part 2. *Timber* Structural grade timber, selection and testing, uses. Ceramics - Properties and uses, advantages and disadvantages. Heat treatment of metals – Annealing, hardening and tempering, case hardening. Avoiding corrosion and finishes Plating, galvanising, anodising, painting *Problem solving* *Planning for the NEA*	To be able to describe examples how polymers are used in everyday life. To be able to understand that composites are made by embedding a material known as the reinforcement (fibres or fragments) into the matrix (material that surrounds the reinforcement, acting as a binder) **Content and activity**	

	NEA start **Section 1: Problem solving** **(15 Marks)** Written description of the task, clearly defining the problem to be solved. Communicated ideas including a brief specification. A completed prototype produced to test the idea(s). ***Problem analysis*** - Students need to analyse the context, in doing this, mind maps or multi-causal diagrams as well as written text can be used. ***Problem solving/solution development*** -This analysis should progress to developing several outline proposals, each capable of further detailed development, although to save time either one, or elements of several ideas combined should then developed into a single proposal which can be modelled.	***Opportunity should be taken to link and supplement the processes used, with previous learning.*** NEA activities including; research, problem solving, drawing and planning, using engineering skills, applying systems technology and testing and evaluating. To be able to engage in a range of intellectual and practical processes in order to solve problems through the production of engineered outcomes. To develop knowledge and understanding of materials, components and resources relating to engineering	

	Modelling - Modelling will form an important part of this development, this may take various forms, including the use of mechanisms kits and electronic breadboarding, drawing and sketching, building models from easily manipulated materials such as card and balsa, calculating and using various computer based applications to refine their ideas. ***Communicating*** - Across the entire project it is important that the student communicates with the reader in a clear and concise way. Any decisions they make should be referenced to help the reader understand their thought processes and why they followed a particular course of action e.g why one material was selected rather than another, why a microcontroller is used rather than discrete components. These can be justified by relating them to technical demand, including speed of operation, current consumption or simply due to availability or cost. ***Production of a prototype*** - Once the prototype is completed and evaluated then conclusions can be drawn regarding its quality. That is	To develop knowledge and understanding of engineering processes and be able to apply these where appropriate in order to produce a manufactured outcome. To be able draw on knowledge, skills and understanding of materials, processes and techniques in order to engineer products which provide a functioning solution in response to a given brief. To develop an understanding of how emerging technologies (in areas such as materials science, information technology (IT) and communications, energy, medicine and robotics) have changed and will continue to change the way in which engineered products are made and used. To be able to develop an understanding of health and safety procedures and be able to carry out practical activities in a safe way. To be able to develop an awareness and understanding of the impact of engineering on the environment and sustainable development. To develop skills, knowledge and understanding as a foundation for future learning and progression, in relation to engineering and other related disciplines	

	not its physical appearance, but simply how well it meets the objectives identified by the student at the commencement of the NEA.	To be able apply their knowledge and understanding of mathematical concepts in an engineering related context.	
Year 11 **Term 1**	**Nea** **Section 2: Drawings and convention** **(Worth 15 Marks)** It is important that students learn how to present information in graphical form. This can take various forms including: • isometric drawing • orthographic drawing • exploded drawing • assembly drawings. They can be produced using any suitable CAD package or drawn by hand. Students should follow the sector specific conventions of technical drawings which may include a Title Block giving: Name of the drawing, scale, date and projection method.	To be able to understand and apply conventions for technical drawings, including orthographic projections, isometric views, and pictorial representations. To be able to develop an understanding of how products are manufactured to different scales of production, including one-offs, batch, mass, continuous, just-in-time. To be able to understand and apply conventions for technical drawings, including orthographic projections, isometric views, and pictorial representations. To be able to have a sound knowledge of the basic concepts of manufacturing engineering. To be able to interpret drawings and technical information, select and demonstrate safe practical production processes and communicate using oral, written and graphical modes.	Weekly homework Classwork Marked Peer and self-assessment Evaluation and mini moderation Seneca Learning (Chart assessment DATA) Termly Reporting Mock Examination Up to date tracking

	All drawings must be supported with detailed annotation explaining the parts of the prototype development. **Section 3: Production planning (Worth 15 Marks)** Students can be given the freedom to choose their own layout for this section. They may choose to use flowcharts, paragraphs or a table format to evidence detailed planning and sequencing of the product to be made Students should produce (as appropriate): • a detailed production plan • an explanation of each of the stages of production • an explanation of the quality control techniques used to produce the product. **Section 4: Manufacturing and engineering skills (Worth 15 Marks)**	***Using a logical and systematic approach they should be able to:*** Produce flowcharts and systems block diagrams to describe operations and procedures. Establish/describe systems boundaries and components. Describe sub-systems within systems. Map problems. ***Analyse and evaluate existing solutions to problems they should be able to:*** Look at similar devices that perform the same function including disassembly. Examine different ways of doing things. Make judgements about the effectiveness of existing solutions. ***Using data and evaluating the should able to :*** Use data gathering methods. Use statistical analysis. Draw conclusion.	

	Students should use a range of processes and materials when manufacturing the product. Both hand and CAM machines can be used in the completion of the project. There must be a balance between the two where possible. This section can be presented with clear photographs annotated with detailed descriptions using correct technical terms for tools and machines. **Section 5: Applying systems technology** **(Worth 10 Marks)** Students should show the working of the systems using system block diagrams in the Input – Process – Output format, with feedback present where needed. The same representation to be used for all systems. For example, pneumatic, mechanical and electronic/electrical systems. **Section 6: Testing and evaluation** In this section students will test the product against the specification		

	produced in Section 1. Students are encouraged to be honest and critical with their testing and recording the results. Objective testing is important. Testing of the final completed prototype against pre-set objectives gives better feedback for improvement. Evaluation should be based on all the systems used. Students should then provide their suggested improvements. If time permits, modifications can be taken further by proposing a better version through further research and/or CAD modelling. A detailed account of the functioning of the product both with reference to mechanisms and electronics, or other systems if used, with photographic evidence should be included. NEA Finish		

Year 11 **Term 2 and 3** **Exam**	Revision and exam preparation starts. GCSE mathematical understanding and equations in engineering worth 15% To be covered – area, volume etc Past papers, maths question and targeted lesson. Topic 1: What influences design? Topic 2: Impact of modern technologies ***Factors influencing design of solutions.*** ***3.1.3 Material costs and supply 3.1.2*** ***Impact of modern technologies 3.***	NEA marks to be submitted to AQA by due date To be able to understand the impact of engineering on society, including safety procedures and sustainable practices. To be able to familiarize yourself with materials, components, and their properties relevant to engineering applications in preparation for an exam.	Weekly homework Classwork Marked Peer and self-assessment Seneca Learning (Chart assessment DATA) Termly Reporting Up to date tracking