

## Swindon Academy Engineering Curriculum Map 2021-22




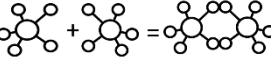






### Intent

The Engineering curriculum is designed to develop industry specific knowledge and skills in a practical learning environment. The course covers the development of key key engineering practical and technical skills, such as research, observation, measurement, making, using computer-aided design (CAD) and disassembly. Knowledge of key engineering sectors (mechanical, electrical/electronic and engineering design) and the interrelation of each in industry. A further understanding of the key stages involved in planning and implementing an engineering project and being able to respond to a single brief.

Students completing their BTEC Nationals in Engineering will be aiming to go on to employment. At the end of Key Stage 4 an engineering Swindon Academy student will have a solid understanding of basic engineering principles and will be awarded a Level 2 Engineering qualification. Engineering in Key Stage 5 is a popular subject for those students opting to go on to employment and further education.

There are enrichment opportunities for those in Sixth-Form for Engineering and there are lots of STEM opportunities for those in lower school to support their understanding of Engineering at Key Stage 4 and beyond. We have been fortunate enough over the years to organise visits to the Honda and Mini factory in Swindon for real life industry experience.

### Implementation – Rosenshine principles of instruction – *please write one or two sentences to describe the implementation for each of the Rosenshine principles below these must be subject specific and observable in lessons.*

Daily Review	New Material in Small Steps	Ask Questions	Provide Models	Guide Student Practice	Check Student Understanding	Obtain High Success Rate	Scaffolds for Difficult Tasks	Independent Practice	Weekly and Monthly Review
 Daily review is an important component of instruction. It helps strengthen the connections of the material learned. Automatic recall frees working memory for problem solving and creativity.	 Our working memory is small, only handling a few bits of information at once. Avoid its overload—present new material in small steps and proceed only when first steps are mastered.	 The most successful teachers spend more than half the class time lecturing, demonstrating and asking questions. Questions allow the teacher to determine how well the material is learned.	 Students need cognitive support to help them learn how to solve problems. Modelling, worked examples and teacher thinking out loud, help to clarify the specific steps involved.	 Students need additional time to rephrase, elaborate and summarise new material in order to store it in their long-term memory. More successful teachers build in more time for this.	 Less successful teachers merely ask "Are there any questions?" no questions are taken to mean no problems. False. By contrast, more successful teachers check on all students.	 A success rate of around 80% has been found to be optimal, showing students are learning and also being challenged. Better teachers taught in small steps followed by practice.	 Scaffolds are temporary supports to assist learning. They can include modelling, teacher thinking aloud, cue cards and checklists. Scaffolds are part of cognitive apprenticeship.	 Independent practice produces "overlearning" - a necessary process for new material to be recalled automatically. This ensures no overloading of students' working memory.	 The effort involved in recalling recently-learned material embeds it in long-term memory. And the more this happens, the easier it is to connect new material to such prior knowledge.
All students across the Key Stages will have a daily review. Students also have a daily numeracy check.	Staff to introduce new material through talk task.	Staff are expected to check understanding using Cold Call, Mini-Whiteboards and Turn & Talk	Staff are expected to model solutions clearly and where necessary use techniques such as NAME THE STEPS	Staff are expected to provide guided fluency tasks in order to students to grasp the underlying concept	Staff are expected to use a variety of AFL techniques and hunt for errors. Staff are expected to give clear and concise feedback	Staff are expected to be able to use a variety of techniques in order to assess student progress. Staff to use TLAC strategies such as cresting the wave	Staff are expected to differentiate and scaffold as appropriate for the students in their teaching group.	Staff are expected where required to set extended independent practice tasks.	Hot and Cold Tests are used in KS3 to assess progress and understanding, similar ideas will be introduced in Year 10

Term	1	2	3		3	4	5	6		6
Year 10	A1 Engineering sectors, engineered products and interconnections Learners will examine the interconnection between engineering sectors and engineered products. • Engineering definition in context: the safe application of technical and practical knowledge to transform ideas and materials (as part of a team) into products.  Students will also have the opportunity to create projects from various materials including wood, metal and plastic. Students will create a metal stream roller.	Engineered products from different sectors and combinations of sectors, e.g. aerospace (engines, wings, rotor blades, landing gear, fuselage, navigation systems), automotive (engines, suspension, braking system, fuel injection, engine management, cruise control), communications (satellite dish, smartphone, wireless router, transmission mast, set top box), electrical/electronic (drone, remote-controlled car/helicopter, television, games console, wireless speaker/headphones).		Assessment 1  Review and reteach		Engineering job roles, e.g. maintenance technician, machine operator, aircraft fitter, design engineer, manufacturing engineer, installation engineer, process engineer, telecommunications engineer. • Career progression opportunities, e.g. apprentice, operator, technician; technical, professional, management. • Role definitions: o unskilled o skilled o technical o managerial.	B1 The design process Through practical exercises, learners will produce solutions to problems using different combinations of engineering skills, including designing as part of the engineering design and make process. The engineering design and make process: define the problem, develop possible solutions, choose a solution, design and model the solution, evaluate outcome of project, work in a team. • Interpreting an engineering brief, e.g. physical requirements, aesthetics, size, function, performance requirements.		Assessment 2  Review and reteach	
	The need for people who are qualified in an engineering discipline and if possible are experts in more than one discipline (e.g. electrical/electronics engineer), and can use their skills to help solve real-world problems.	A2 Engineering organisations, functions, job roles and career progression Learners will examine organisations, functions and job roles, developing their understanding of how these contribute to career progression in engineering. • Examples of engineering organisations: o size, e.g.				Producing initial design proposals, e.g. researching existing products, producing design sketches in 2D and 3D, using	Computer-aided design (CAD) drawings using drawing, editing, modification and manipulation commands to generate engineering drawings and circuit diagrams on templates to the appropriate standard.			

		global/large, small to medium-sized enterprise (SME), small jobbing workshops o range of examples covering the sectors, e.g. research and development organisations, manufacturing organisations, service organisations. • Specialist organisations in sectors, e.g. manufacturer of aircraft wings,						
	Engineering sectors, e.g. aerospace, automotive, communications, electrical/electronic, mechanical, environmental, transport, rail, marine.	Functions in organisations, e.g. research, design, planning, making, quality, marketing, selling, customer service, installation.			Generating final design solution using 2D drawing techniques and 3D models, e.g. detailed drawings, circuit diagrams, 3D printing, physical modelling.	Making final design solution decisions, e.g. selection of materials, selection of making techniques, considering quality requirements. • How employees work in a team and peer review during the engineering design and make process with the customer as a focus, using generic skills, e.g. behaviours, attitudes, limitations, respect for others, professionalism, working relationships, collaborative skills.		

Term	1		2		3	4	5
Year 11	Learning aim A: Understand materials, components and processes for a given engineered product. Learners will investigate the materials, components and processes used in the production of engineered products.  A1 Materials: Engineering material categories: o ferrous, e.g. mild steel, wrought iron, stainless steel o non-ferrous, e.g. aluminium, titanium, copper, silver, zinc o thermosetting polymers, e.g. phenol-formaldehyde, polyimides, polyurethane o thermoforming polymers, e.g. polyethylene, polypropylene, acrylic.	Mock 1	Learners will investigate engineered products by using practical engineering skills and techniques, such as disassembly and assembly, observation and measurement.  B1 Practical engineering skills: Observing and recording skills, such as an examination of: visual features, surface features, mass, colour, degradation, identification marks. Measurement skills, such as: measuring diameter, measuring linear dimensions, use of comparative techniques, knowledge of component values, e.g. resistors. Appraisal/interpretation skills, such as justifications and reasoning.	Mock 2	Learners will produce solutions to problems using different combinations of practical engineering skills, including making as part of the engineering design and make process.  C1 Engineering making process: defining the problem, developing possible solutions, choosing a solution. Making using engineering processes. Inspecting and testing chosen solution. Evaluating outcome of project.	Mock 3	Revision and past paper practice to embed knowledge and apply skills
	Properties of engineering materials: strength, hardness, toughness Characteristics of engineering materials, such as: machinability, workability, durability.		B2 Disassembly techniques Safe use of disassembly techniques, to include removal of semi-permanent fixings, parts removal and layout, replacement of non-reusable consumables or fixings. Safe use of tools and equipment – disassembly/reassembly tools with settings.		C2 Develop a production plan: Developing a production plan, to include: health and safety, operations/processes, inspection, testing and quality standards, equipment/tools, materials and components, quantity, e.g. one-off, batch, mass production.		
	A2 Components: Types of components, such as: proprietary, e.g. rivet, nut and bolt, screw, key, mechanical fixings, electronic components, such as resistors, capacitors, fuses, diodes, product specific, e.g. bush, flange, printed circuit board (PCB). Characteristics of components, e.g. permanent/semi-permanent, sizes/dimensions, surface roughness, values, fixing methods.  A3 Processes Types of engineering processes: cutting, e.g. drilling, sawing, filing, shearing, shaping, e.g. turning, milling; forming, e.g. forging, casting, extruding, moulding, folding, bending; joining, e.g. fastening, bonding, soldering, brazing.		B3 Product design specification (PDS) Requirements in terms of: size and mass, product life and reliability, performance/function/service requirements, economic and making considerations, implications of standards and legislation.		Awareness of risks and hazards for making processes. Safe preparation, good housekeeping and close down of the work area. Making skills associated with the product to be produced, e.g. choosing suitable tools, appropriate set up of the work area/machine, adaptation according to inspected outcomes. Skills in observing and recording techniques, e.g. in process measurement and comparison.		

Year 12	<p>You are working as a final year apprentice in a small engineering company. You have been using some engineering processes to [manufacture small components/repair small products*] as part of your team; your manager is pleased with your work and has decided that you should be given some more responsibility. He wants you to look at whether the company is using the most appropriate engineering processes when [manufacturing small components/repairing small products*].</p> <p>Your manager has asked you to examine a [component they produce/service they deliver*] and to report back on the engineering processes that can be used to [make/deliver*] it, including health and safety factors, and how human factors could affect the performance of these processes. The report will impact upon company investment decisions in the future.</p>	Review and reteach	<p>You are an apprentice in a small design office, where drawings have traditionally been created using sketching and drawing board techniques, with limited use of CAD software. New CAD drawings are being created from artefacts and your manager has asked you to generate two of these new drawings from a given engineered component and a given electrical circuit. The drawings you prepare will be used to produce the engineered component and electrical circuit, so your manager will be checking that they meet international standards.</p>	Review and reteach	<p>You are working as a final year apprentice in a medium-sized engineering company. Your manager is pleased with your work and has decided that you should be given some more responsibility. He wants you to become part of a small team that will [manufacture a batch of an engineered product/deliver a batch of an engineering service*] using a different approach to that normally employed by the company.</p> <p>Your manager wants you to work with colleagues to organise the team and set targets.</p>	Review and reteach	<p>You are working as a final year apprentice in a small engineering company. Your supervisor is pleased with the investigations you completed into ways that your company could gain a competitive advantage.</p> <p>Your supervisor has now asked you to investigate reasons why an engineering organisation would wish to control costs, so they can be considered in your organisation.</p> <p>To do this, your supervisor wants you to find out about the different types of costs that an engineering organisation will encounter, and ways in which these costs could be controlled.</p>	Review and reteach	<p>You are working as a final year apprentice in a small engineering company. Your supervisor is pleased with the work that you have done so far to investigate the ways in which your company could gain a competitive advantage over other organisations, and your application of activity-based costing.</p> <p>Your supervisor has now asked you to investigate quality management systems and how these can be used to give your engineering organisation a competitive advantage over your rivals. Once you have done this, your supervisor would like you to carry out a value analysis exercise for a product or service so that you can identify areas where the value of the outputs could be increased.</p>	Review and reteach
	<p>You are going to evaluate the effectiveness of engineering processes and how human factors affect them.</p> <p>To do this: Your tutor will provide you with a [product that needs to be produced/service that needs to be delivered*] using a range of engineering processes. You need to:</p> <ul style="list-style-type: none"> <li>Research the processes used (at least three), including relevant health and safety factors and legislation/regulations; and</li> <li>Research how these engineering processes can be affected by human factors (individual and team).</li> </ul>		<p>You are going to use CAD software to produce a developed orthographic projection and a circuit diagram.</p> <p>To do this: Your tutor will provide you with an engineered component containing at least three different types of common feature and an electrical circuit containing at least six different component types</p>		<p>You are going to carry out engineering processes safely to [manufacture a batch of a product/deliver a batch of a service*] effectively as part of a team.</p> <p>To do this: Your tutor will provide you and your team with a range of technical documentation (such as engineering drawings, production plans and specifications) that will detail the [product to be manufactured/service to be delivered*] and the batch size.</p>		<p>You are going to investigate a) how an engineering organisation allocates costs; and b) the ways in which costs can be controlled within an engineering organisation. You will also use activity-based costing to identify any inefficiencies associated with the engineering activities.</p> <p>To do this: Your tutor will provide you with a case study that includes financial information about an engineering organisation which either produces engineering products or provides an engineering service.</p>		<p>You are going to investigate how an engineering organisation can use quality management systems and value management processes to improve the value of the products or services that they manufacture or provide. You will also investigate international quality standards and the various quality systems that are used by engineering organisations to improve the quality of their outputs.</p>	

	<p>You then need to: Produce a report that evaluates the effectiveness of the engineering processes (at least three) used to [manufacture the product/deliver the service*] and how human factors affect the performance of the engineering processes. Your report should include:</p> <p>Information on the advantages and limitations of the engineering processes used (at least three) compared with the advantages and limitations of using other possible processes, which should include justifications as to which processes are most effective, by referring to the specific requirements of the [product or service*]</p>		<p>You then need to:</p> <ul style="list-style-type: none"> <li>• Generate an accurate orthographic projection of the engineered component to an international standard using appropriate layers, and provide evidence of employing the full range of appropriate CAD commands; and</li> <li>• Generate an accurate circuit diagram of the given electrical circuit to an international standard using appropriate layers and provide evidence of employing the full range of appropriate CAD commands.</li> </ul>		<p>You then need to:</p> <ul style="list-style-type: none"> <li>• Take an active role when meeting with other team members prior to the [manufacture of a batch of an engineered product/delivery of a batch of an engineering service*] to plan effectively and set team targets, and to record who is responsible and accountable for each aspect of the work required;</li> <li>• Take an active role when meeting with other team members during the [manufacture of a batch of an engineered product/delivery of a batch of an engineering service*] to review team roles and responsibilities, targets and timings.</li> <li>• Take on the role of team leader</li> </ul>		<p>You should then:</p> <ul style="list-style-type: none"> <li>• Investigate and report on the reasons why engineering organisations want to analyse and control costs, including how decision making can be influenced.</li> <li>• Use the case study to research the costs associated with either producing a product or providing an engineering service. You should investigate how costs are allocated to individual activities, including direct costs, indirect costs, variable costs, semi-variable costs, fixed costs and general/administration costs.</li> <li>• You should then use the case study to complete and record an iterative activity-based costing exercise to generate an activity-based cost model for an engineering product or service. This costing exercise should include five stages: 1) identifying activities; 2) assigning resource costs to activities; 3) identifying outputs; 4) assigning activity costs to outputs; and 5) assigning activity cost pools.</li> </ul>		<p>To do this:</p> <p>Your tutor will provide you with a case study with background information for an engineering organisation that either produces a product or provides an engineering service. You should use this as a starting point from which to carry out your own research.</p>	
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Term	1		2		3		4		5
Year 13	AO1 Recall basic engineering principles and mathematical methods and formulae Command words: calculate, describe, explain Marks: ranges from 1 to 5 marks	Mock 1	AO4 Analyse information and systems to solve engineering problems Command words: calculate, draw Marks: ranges from 1 to 5 marks	Mock 2	AO1 Demonstrate knowledge and understanding of engineering products and design	Mock 3	AO4 Evaluate engineering product design ideas, manufacturing processes and other design choices	Mock 4	Revision and past paper practice to embed knowledge and apply skills
	AO2 Perform mathematical procedures to solve engineering problems Command words: calculate, find, solve Marks: ranges from 1 to 10 marks		AO5 Integrate and apply electrical, electronic and mechanical principles to develop an engineering solution Command words: calculate, draw, explain Marks: ranges from 1 to 10 marks		AO2 Apply knowledge and understanding of engineering methodologies, processes, features and procedures to iterative design		AO5 Be able to develop and communicate reasoned design solutions with appropriate justification		
	AO3 Demonstrate an understanding of electrical, electronic and mechanical principles to solve engineering problems Command words: find, calculate, describe, draw, explain Marks: ranges from 1 to 5 marks		To achieve a grade a learner is expected to demonstrate these attributes across the essential content of the unit. The principle of best fit will apply in awarding grades		AO3 Analyse data and information and make connections between engineering concepts, processes, features, procedures, materials, standards and regulatory requirements		The essential content is set out under content areas. Learners must cover all specified content before the assessment.		

