Swindon Academy Engineering Curriculum Map 2020-21

Intent

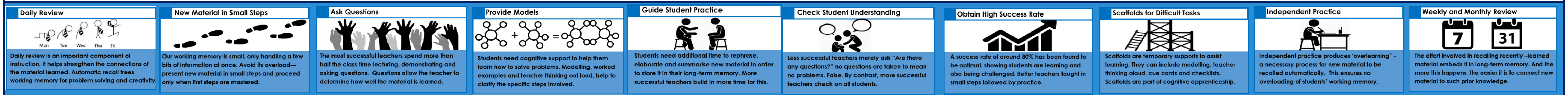
1. BTECs embody a fundamentally learner-centred approach to the curriculum. With a flexible, unit-based structure and knowledge applied in project-based assessments, they focus on the holistic development of the practical, interpersonal and thinking skills required to be able to succeed in employment and higher education.

2. We have addressed these requirements with: a range of BTEC sizes, each with a clear purpose, so there is something to suit each learner's choice of study programme and future progression plans, refreshed content that is closely aligned with employers' and higher education needs for a skilled future workforce and assessments and projects chosen to help learners progress to the next stage. This means some are set by you to meet local needs, while others are set and marked by Pearson, so that there is a core of skills and understanding that is common to all learners. For example, a written test can be used to check that learners are confident in using the technical knowledge to carry out a certain job.

3. Students completing their BTEC Nationals in Engineering will be aiming to go on to employment, often via the steppingstone of higher education. It was, therefore, essential that we developed these qualifications in close collaboration with experts from professional bodies, businesses and universities, and with the providers who will be delivering the qualifications. To ensure that the content meets providers' needs and provides high-quality preparation for progression, we engaged experts. We are very grateful to all the university and further education lecturers, teachers, employers, professional body representatives, and other individuals who have generously shared their time and expertise to help us develop these new qualifications.
At the end of KS4 an engineering Swindon Academy student will have a solid understanding of basic engineering principles and will be awarded a Level 2 Engineering qualification.
At the end of KS5 an engineering Swindon Academy student will have a solid understanding of further engineering principles and will be awarded a Level 3 Engineering qualification.

4. Why is this knowledge-based curriculum important for the context of this academy? This qualification has been designed as a two-year, full-time course that supports progression to an apprenticeship in engineering or to a further year of study at Level 3. If taken as part of a programme of study that includes other BTEC Nationals or A Levels, it supports progression to higher education.

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.*



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.		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		A2 Engineering organisations, functions, job roles and career progression Learners will examine organisations, functions and job roles,			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.			

	can use their skills to help solve real-world problems.	developing their understanding of how these contribute to career progression in engineering. • Examples of engineering organisations: o size, e.g. 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.		

Term	1			2			3			4			5	6		6
Year 12	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*]. 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.	Assessment 1	Review and reteach	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.	Assessment 2	Review and reteach	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. Your manager wants you to work with colleagues to organise the team and set targets.	Assessment 3	Review and reteach	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. 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. 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.	Assessment 4	Review and reteach	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. 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.		Assessment 5	Review and reteach
	You are going to evaluate the effectiveness of engineering processes and how human factors affect them. 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: • Research the processes used (at least three), including relevant health and safety factors and legislation/regulations; and • Research how these engineering processes can be affected by human factors (individual and team).			You are going to use CAD software to produce a developed orthographic projection and a circuit diagram. 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			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. 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.			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. 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.			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.			

	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: 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*]		You then need to: • 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 • 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.		You then need to: • 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; • 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. • Take on the role of team leader		You should then: • Investigate and report on the reasons why engineering organisations want to analyse and control costs, including how decision making can be influenced. • 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. • 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.		To do this: 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.	

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.		

Impact – This section should address the following questions:

Exam results show an increase in attainment over the past three years and consistent outstanding progress at Level 2 and 3. Level 2 results also show that all groups of learners are making positive progress with 100% of learners achieving at least a pass. At level 3

Our curriculum regularly monitors and progress and addresses any misconceptions using CEAT exam testing. At KS4 students are given tasks to improve their knowledge of a module, also teachers provide whole class feedback after a task and re-teach any class misconceptions.

Students at Level 3 have achieved an APS score of +1 last academic year, and level 2 students have previously achieved scores of +1.6