ASHLAWN SCHOOL

Key Stage 5 Curriculum Journey: Year 12 Engineering

The curriculum in Engineering equips learners with the knowledge to understand the processes of engineering including design, analysis, prototype development and evaluation, and the role that engineering plays in the world. The subject is designed to inspire students to be innovate, creative and apply their knowledge in a way which is transferable to, and draws on different real-life contexts such as design, mechanical and quality control engineering. Students are encouraged to move from theory to practice and to bring their ideas into reality by developing solutions to technical issues

THE YEAR 12 CURRICULUM JOURNEY

	HALF TERM 1	HALF TERM 2	HALF TERM 3	HALF TERM 4	HALF TERM 5	HALF TERM 6
Topic and learning focus	Students' lesson time is divided between 3 units – Maths for Engineering, Science for Engineering and CAD. <u>Maths in Engineering</u> ● LO1 – understand the application of algebra relevant to engineering problems ● LO2 – be able to use geometry and graphs in the context of engineering problems ● LO3 – understand exponentials and logarithms in the context of engineering problems ● <u>Science in Engineering</u> ● LO5 – understand the principles of fluid mechanics ● LO1 – prefixes, SI units and base units ● LO4 – materials – explain the behaviour of materials when placed under stress and explain this behaviour in terms of the forces acting on the atoms. ● LO3 – understand the principles of electrical engineering, modelling and describing the behaviour of circuits and circuit components. <u>Mechanical Design</u>		<u>Maths</u> ● LO4 – be able to use trigonometry to solve engineering problems ● LO5 – understand how to use calculus within the context of engineering ● LO6 – Use statistics to handle and analyse data including probability calculations. <u>Science</u> ● LO3 – understand the principles of electrical engineering, modelling and describing the behaviour of circuits and circuit components. ● LO6 – understand the principles of thermodynamics and heat/energy flow. ● LO2 - principles of mechanics and mechanical energy including kinematics and dynamics. <u>Mechanical Design</u> ● LO3 – design components that can be successfully manufactured. ● LO4 – optimise design to improve performance.		<u>Mechanical</u> ● Revision for Unit 1 examination ● LO1 – the effect of forces on materials, stress, strain and the Young Modulus. ● LO5 - dynamics <u>Electrical Engineering</u> ● Revision for Unit 2 examination ● LO1 – DC circuits, internal resistance and application of Kirchhoff's Laws. ● LO6 – digital electronics, logic gates and flip-flop circuits <u>CAD</u> ● Understand how to create 3D shapes using increasingly complex tools in Fusion 360.	

	• LO1 – use graphical and engineering drawing techniques to communicate design solutions. • LO2 – select appropriate engineering materials to achieve design solutions.		
Foundational Knowledge Prior learning needed	• SI Units and prefixes, scalar and vector quantities. • Rearranging equations and basic algebraic techniques. • How to sketch line graphs and calculate gradients and y-intercepts • Be able to sketch graphs of simple functions • Be familiar with computer aided design tools such as Sketchup, 2D design or Fusion 360. • Understand the geometry of simple 2D and 3D shapes (prisms and spheres) • Understand properties of graphs (gradient and y-intercept) • Operation of Fusion 360 to produce 2d and 3d designs. • Design Cycle and the activities that take place during each stage.	• Understand the geometry of simple 2D and 3D shapes (prisms and spheres) • Basic trigonometric relationships (SOH CAH TOA, sine and cosine rules) • Understand properties of graphs (gradient and y-intercept) • Simple statistics principles and combinations of probabilities. • Behaviour of current and pd in series and parallel circuits. • Interpreting simple circuit diagrams and circuit symbols. • Properties of simple components. • Know how to use multimeters • Velocity and distance time graphs, calculations of speed and acceleration. • Construction and manipulation of 3d shapes in Fusion 360.	• Learning from Year 12 Half terms 1,2,3 and 4: • Effects of forces on beams and materials, principle of moments • Calculations of areas and volumes of simple 2d and 3d shapes. • Newton's Laws of Motion and the SUVAT equations. • Calculations involving kinetic and gravitational potential energy. • Kirchhoff's Laws and V=IR, electrical resistance and resistivity • Be familiar with computer aided design tools such as Sketchup, 2D design or Fusion 360.
Core Knowledge and skills	• Apply fundamental algebraic techniques such as solving quadratic and simultaneous equations and simplifying expressions. • Understand how to solve exponential expressions and apply the log laws to solve equations involving e^x and 10^x.	• Calculate combinations of probabilities to predict outcomes from real-life scenarios. • Perform statistical analysis of data including standard deviation and the normal distribution • Understand how to integrate and differentiate simple functions.	• Perform moment calculations on beams involving combinations and forces acting at angles other than 90 degrees. • Calculate stress, strain and Young Modulus for materials and use this to solve problems. • Resolve forces into orthogonal components • Apply Newton's Laws of Motion to engineering scenarios.

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	• Understand how to integrate and differentiate simple functions.
	• Identify the 7 base units and explain the significance of these.
	• Know the standard prefixes to modify the order of magnitude of units.
	• Understand what is meant by pressure and be able to calculate pressures in solids and fluids.
	• Create simple 3d shapes in Fusion 360 and modify these by extruding and filleting.
	• Combine 3d objects into more complicated assemblies of shapes.
	• The conventions and symbols for engineering drawings (e.g. standard components, scaling etc)
	• Rendering and freehand drawing techniques to enhance drawings.
	• Analyse existing products through research and disassembly to determine materials used and production methods.
		• Use trigonometric identities and expressions to analyse the behaviour of vector quantities so that engineering problems involving velocity and force can be solved.
		• Use V=IR and Kirchhoff's Laws to calculate currents, pds and emfs in both series and parallel circuits.
		• Explain the significance of the term resistivity.
		• Apply the SUVAT equations to analyse the motion of objects under constant acceleration.
		• Calculate energies required to heat and change the state of substances, explaining the meaning of the terms sensible and latent heat.
		  • DFMA – design for manufacture and assembly and its implications on design.
		  • Life-cycle analysis and how an understanding of the full life-cycle of a product including end-of-life considerations impact the design process and influence the choice of materials used.
		  • Practical aspects of design optimisation and its importance within the design cycle.
			• Manipulate the SUVAT equations to solve constant acceleration problems
			• Use the principle of the conservation of energy to solve problems.
			• Apply Kirchhoff's Laws to circuits containing a mixture of series and parallel components.
			• Calculate the internal resistance of emf sources and know how to obtain this value experimentally.
			• Distinguish between emf and p.d.
			• Recognise the symbols and functions of the logic gates.
			  • Create simple 3d shapes in Fusion 360 and modify these by extruding and filleting.
			  • Combine 3d objects into more complicated assemblies of shapes.

Developmental Knowledge and Skills	• Create equations and sets of simultaneous equations to model situations mathematically.
	• Use trigonometry to solve physical problems with forces acting at angles other than 90 degrees to each other.
	• Combine base units to produce derived units, representing common derived quantities such as energy and potential difference in terms of the constituent base units.
	• Apply Archimedes' Principle to real life scenarios justifying intuitive assumptions made about the behaviour of objects in fluids.
	• Use of CAD to produce rendered 3d images from 2d designs.
	• Evaluate choices of materials based on properties and cost.
		• Use statistical analysis of data to evaluate conclusions.
		• Be able to differentiate and integrate more complex functions and functions of functions.
		• Use graphs of functions or data to solve problems and analyse practical situations.
		• Explain the behaviour of capacitors and how they might be used in practical circuits.
		• Apply Kirchhoff's laws to circuits consisting of combinations of series and parallel elements.
		• Derive the SUVAT equations
		  • Effects of tolerances, finishing and manufacturing processes on the design cycle.
		  • How designs can be modified to be more sustainable.
		  • Optimising designs using statistical analysis.
			• Use the concepts of stress, strain and Young Modulus to solve problems involving breaking stress and UTS.
			• Use moments to solve more complicated structures problems including loading beams.
			• Use the coefficient of friction to calculate the effects of forces.
			•
			• Explain the significance of internal resistance, reasoning when high or low internal resistance values are most beneficial.
			• Use the Boolean algebra symbols for the logic gates and formulate Boolean expressions to summarise and represent combinational logic circuits.
			• Describe the function of D and T type flip flop circuits.
			• Construct realistic and original jewellery designs on Fusion 360 comprised of a number of different 3d shapes and wires.

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Complex Knowledge	• Be able to model physical scenarios using exponential and logarithmic equations. Apply log laws to practical results so that a straight line graph can be obtained and useful information extracted from the gradient. • Justify the choice of just 7 base units explaining why no more or less are needed. • Use calculated quantities such as conductivity or Young Modulus to justify material choice.	• Apply calculus to real life physical problems, explaining where calculus can be used to solve problems that cannot be tackled without calculus. • Explain how inductors work and how they could be used in real-life circuits. • Calculating probability of mechanical failure using statistical data.	• Understand the effects of Young Modulus on the properties of a material and apply this knowledge to make recommendations as to when and how a specific material might be used. • Understand and apply Max Power Theorem to circuits and explain quantitatively why it holds. • Understand how large combinations of flip-flop circuits can be used to form the basis of memory in computing. • Enhance the jewellery designs using a range of complex shading and rendering techniques.
Links with the National Curriculum			
Literacy (including reading)	• Reading and notetaking homework regularly set. For example reading from "Structures – or why things don't fall down" • Reading Fusion 360 tutorial work. • Use of engineering case studies and latest news articles for homework and class based tasks. • Use of research studies on new, emerging materials and their properties.		
Cultural Capital	• Understanding of the use and application of maths to solve real-world problems. • Mathematical based problem solving skills. • An appreciation of the complexity of everyday systems. • An understanding of the widespread use of electricity, how it is generated and subsequently transmitted to our homes. • How structures work and what is required for buildings to be safely constructed. Use of computer software to develop and present ideas.		
Social, Moral, Spiritual and	• Discussion and teamwork with opportunity for lots of collaborative working.		

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<tr><td>Cultural Development

Fundamental British Values</td><td colspan="3">

Environmental impact of our manufacturing and design choices. The importance of careful use and selection of materials for minimal cost and environmental impact. The need to balance environmental impact against cost and economic factors.
An appreciation of the legal framework in which designers and companies are required to operate in including safe working and the development and testing of safe products.
Analysis of products, identifying strengths and weaknesses to ensure that the correct products are chosen for the appropriate tasks.
Mutual respect is fostered through collaborative working and sharing of ideas.

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<tr><td>Assessment</td><td>

For units 1 and 2:

Assessments following each learning outcome

For Mechanical design:

Assessment of LO1 x 2

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For units 1 and 2:
<ol start="3">
2 x 40 mark assessments per unit
2 x 60 mark past papers per unit

For Mechanical design:

Assessment of LO2 and LO3 x 2

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Units 1 and 2 :
<ol start="2">
Externally assessed 60 mark paper per unit

Units 3 and 4:
<ol start="3">
Past paper based assessments

For CAD:
<ol start="4">
Assessment of LO1

For Mechanical design:
Overall Unit coursework assessment and moderation.
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