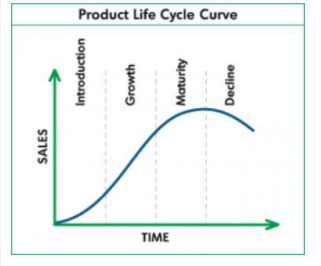
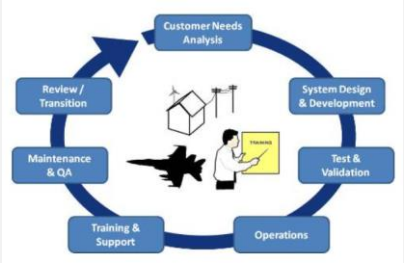
ASHLAWN SCHOOL

Key Stage 4 Curriculum Journey: Year 10 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 innovative, 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 10 CURRICULUM JOURNEY

	HALF TERM 1	HALF TERM 2	HALF TERM 3	HALF TERM 4	HALF TERM 5	HALF TERM 6
	Design Principles and Process 		**Applications of the Design Cycle** 		**Principles of Life-Cycle Analysis and Design Brief** 	
Topic and learning focus	Students are introduced to the basic principles of design and design process. Students then apply their understanding and knowledge of the design process to both original and existing products.		Students explore in more detail the applications of the design cycle to real products, analysing how they are made and how manufacturing and regulatory frameworks have impacted upon the design process. Students develop their drawing skills, learning the conventions and expectations of formal engineering drawings and how to use Fusion360 to produce simple CAD drawings of an original product.		Students analyse the principles of life-cycle analysis and the range of materials (including emerging materials) that might be used. Interpret a design brief and specification for a new product (angle-poise lamp) and use this to develop a manufacturing plan. Begin the manufacturing process exploring a range of different practical techniques including laser cutting and lathe work.	
Foundational Knowledge Prior learning needed	• An understanding of the simple steps involved in the iterative design process. • Simple techniques for sketching including perspective and shading. • A familiarity with some different manufacturing techniques (mass production, batch production and one-off production)		• The design cycle and the activities that take place during each stage of the design cycle. • The different scales of production, why each of those scales might be used for different range of products and the impact that the choice of cycle may have on the design process. • Design briefs and specifications – what needs to be included in each.		• Detailed knowledge of design briefs and specifications – what is required in each of these documents. • Knowledge of a range of materials and their properties (*from KS3 DT)* • *From KS3 DT* – use of hand tools in a safe manner.	

ASHLAWN SCHOOL

	• The learning in this block of work primarily builds upon learning from KS3 DT. • Recognise the imperative to sell products for profit in a market economy.	• *From KS3 DT* – use of hand tools in a safe manner.	
Core Knowledge and skills	• The four distinct stages in the design cycle – *identify, design, optimise and validate.* • The required content of a design brief and specification. • Techniques to develop and enhance sketches showing initial design ideas. • Recognise the advantages and disadvantages of different manufacturing scales. • The legal and regulatory requirements placed upon a designer (e.g. CE mark, British Standards)	• Understand the variety of methods for conducting market research including surveys and focus groups. • Know and apply the concept of *iconic design.* Explain why iconic designs are useful for designers of new products. • Use a variety of tools to disassemble a product identifying the main components and suggesting how the components may have been manufactured. • The requirements and features of engineering drawings. • Use Fusion 360 to draw 3D shapes and apply rendering. • Know what is meant by DFMA and explain how the design of products is affected by this principle.	• The stages of the life-cycle of a generalised product. • Activities that can extend the useful lifetime of a product. The processes/events that take place to decommission/dispose of a product. • Understand the properties of new, emerging materials such as carbon fibre and smart materials. • Form a manufacturing plan considering principles of project management such as Gantt Charts. • Understand the use of workshop tools, the operation and purpose of the laser cutter and the principles and safe operation of a lathe.
Developmental Knowledge and Skills	• Analyse existing products, evaluating the relative strengths and weaknesses of the products against others available in the market. • Justify the selection of different manufacturing scales for a range of products. • Evaluate design briefs and specifications, planning and drafting both briefs and specifications for existing products.	• Analyse an existing product through disassembly, justifying the choice of material and manufacturing technique in terms of cost and function. • From disassembly, infer the content of both the original design specification and design brief of the product. • Justify design and manufacturing decisions made for disassembled product in terms of the principles of DFMA. • Use Fusion 360 to design more complex shapes with a range of materials and shading effects. Incorporate pre-made components such as hinges and plug terminals.	• Explain how end-of-life considerations can be incorporated into and to inform the design of everyday products. • Understand how to translate a specification and brief into a manufacturing plan. • Justify the choice of materials used in the angle poise lamp.
Complex Knowledge	• Interpret complex descriptions of manufacturing processes and draw conclusions about the implications of these manufacturing decisions on the design process originally followed. • Explore example design briefs and specifications, theorising as to why points within those briefs/specifications may have been included or omitted.	• Draw complex conclusions about the design and manufacture of the disassembled product. • Suggest ways in which the product could be made more cheaply by removing components which aren't entirely necessary to the function and/or appearance of the product. • Apply motion and animation effects to the CAD designs.	• Explain and justify how the use of new, emerging materials can influence the design of a product. • Suggest how the manufacturing plan and timescales might change if the materials used were to be altered. Explain how and when this could be justified.

ASHLAWN SCHOOL

Links with the National Curriculum	KS3/4 DT use research and exploration, such as the study of different 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	KS3/4 DT develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools use research and exploration, such as the study of different 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	KS3/4 DT 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, components and ingredients, taking into account their properties
Literacy (including reading)	● Reading accounts of the manufacturing processes used for a wide range of products, summarising and identifying the key points. ● Reading articles describing processes such as sand-casting and die casting. ● Summarising and paraphrasing complex ideas into key points.	● Formulating questions and analysing responses to/from surveys and focus groups considering clarity of questions. ● Use of articles and engineering case studies (such as the construction of bridges and the Iphone)	● Research and reading about new materials such as carbon fibre and graphene. ● Use of technical language to describe the properties of these materials.
Cultural Capital	● An understanding of how everyday products are designed and made and how engineering decisions impact our lives.	● Applications of engineering principles to structures and inventions throughout history (for example the construction of the pyramids and ancient structures)	● An appreciation of the impact of scientific discoveries and how these impact the items we use. ● An understanding of project management and how work and tasks can be organised.
Social, Moral, Spiritual and Cultural Development **Fundamental British Values**	● Discussion and teamwork with opportunity for lots of collaborative working. ● 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.		
Assessment	● Assessments take place at regular intervals using exam past paper questions and coursework criteria for R106 which will include: ○ commercial production methods	● Assessments take place at regular intervals using exam past paper questions and coursework criteria (R106 and R107) ● 2 x 20 mark R105 assessments (completed using Google Forms) will include the design cycle (and the phases), the	● Assessments take place at regular intervals using exam past paper questions and coursework criteria (R106 and R107) ● 3 x 20 mark R105 assessments (completed using Google Forms) and will include the requirements of a design brief and the wider influences on the design of new products

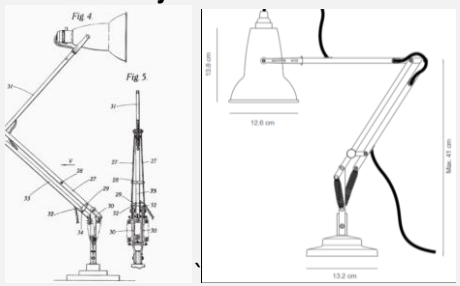
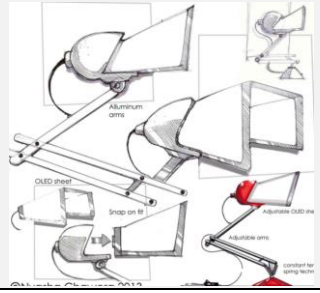
	○ quality and legislation impact on the design of products and components ○ analysis of a product through disassembly and R107 which will include: ● generating a design proposal ● developing a design using engineering drawing techniques ● In addition there will be 3 x 20 mark R105 assessments which will include ○ the design, optimise and validate phase ○ life cycle design, sustainability and end of life ○ understanding user needs ○ product safety ○ manufacturing production (including scales of production) ○ regulations and safeguards ○ legislative design requirements ● Coursework assessed for R107 which will focus on generating a design proposal using a range of taught techniques, and R106 which will focus on commercial product methods and the impact of legislation	identification of design needs, and the relationship between a design brief and design specification. ● Coursework assessed for R107 will focus on developing designs using engineering drawing techniques and annotation; and R106 which will focus on research methods used to inform product analysis, the process of making an evaluation of existing products, and methods used to summarise research outcomes, and the use of sources and procedures for disassembly.	● Coursework assessed for R108 will include the main considerations when making a prototype, interpretation of product specification, processes for making a prototype, use of planning tools and stages.

ASHLAWN SCHOOL

Key Stage 4 Curriculum Journey: Year 11 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 11 CURRICULUM JOURNEY

	HALF TERM 1 and 2	HALF TERM 3, 4 and 5
	Project Production 	**External Examination** 
Topic and learning focus	Students continue the making and evaluation of the Angle poise lamp project. The effectiveness and accuracy of the manufacturing plan is evaluated. Students learn the influence of factors such as ergonomics and anthropometrics on the design process. Past exam papers are used to develop students' exam technique.	Students complete the R105 external examination. The construction of the angle poise-style lamp is completed and the evaluation of its effectiveness and adherence to the requirements of the design brief and specification is evaluated. Coursework tasks from modules R106 and R107 are revisited and improved upon following feedback from teachers.
Foundational Knowledge Prior learning needed	• The design cycle – the stages in the cycle and the activities that take place during each stage in the cycle. • Wider influences on the design process such as market influences, choices of material and DFMA/LCA	• The design cycle – the stages in the cycle and the activities that take place during each stage in the cycle. • Wider influences on the design process including anthropometrics and ergonomics • Understanding the processes required in formulating a product evaluation (*from KS3 DT)*
Core Knowledge and skills	• Meaning of the terms anthropometrics, ergonomics and how these factors influence the design of new products. • Application of knowledge of the design cycle and the wider influences present on designs. • Analysis and evaluation of manufacturing plans including identification of parts of the manufacturing process that caused delays.	• Build and finish the lamp project exploring a range of finishing techniques. • Construct a detailed evaluation of the lamp project exploring what areas were successful and which areas could be improved upon. • Revisit R106 and R107 coursework responding to feedback and applying relevant R105 knowledge.

	• Formulation and use of effective and sensible risk assessments.	
Developmental Knowledge and Skills	• Evaluation of the design brief and specification suggesting areas for improvement and refinement. • Application of knowledge gained over the teaching of the R105 content to a wide range of contexts.	• Produce a detailed set of modifications that could be implemented to improve the lamp. • Justify these changes in relation to the design brief. • Justify any changes to the design specification that may be suitable.
Complex Knowledge	• Application of practical skills to a wider range of tools including the lathe to produce accurately worked bolts and components for the lamp.	• Evaluate why particular aspects of the lamp project took either a longer or shorter time than that identified in the manufacturing plan. Describe how changing the materials used to construct the lamp would affect the manufacturing plan. • Be able to explain how the risk assessment would change if the improvements identified are to be actioned.
Links with the National Curriculum	KS3/4 DT 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, components and ingredients, taking into account their properties use research and exploration, such as the study of different 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	KS3/4 DT develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools use research and exploration, such as the study of different 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
Literacy (including reading)	• Reading accounts of the manufacturing processes used for a wide range of products, summarising and identifying the key points. • Use of case studies on real engineering scenarios • Reading articles describing processes such as sand-casting and die casting. • Summarising and paraphrasing complex ideas into key points.	• Formulating questions and analysing responses to/from surveys and focus groups considering clarity of questions. Use of articles and engineering case studies (such as the construction of bridges and the Iphone)
Cultural Capital	• An understanding of how everyday products are designed and made and how engineering decisions impact our lives. • An understanding of the importance of risk assessment in a range of scenarios.	Applications of engineering principles to structures and inventions throughout history (for example the construction of the pyramids and ancient structures)
Social, Moral, Spiritual and Cultural Development	• Discussion and teamwork with opportunity for lots of collaborative working. • 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.	

ASHLAWN SCHOOL

Fundamental British Values	• Mutual respect is fostered through collaborative working and sharing of ideas.	

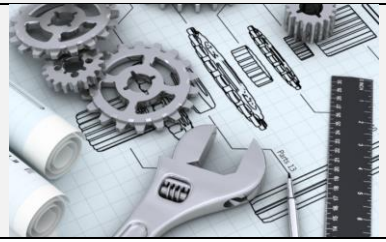
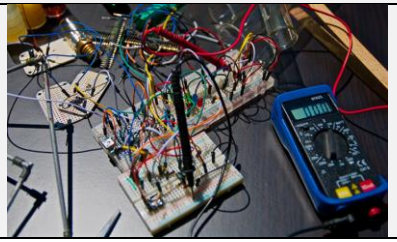
Assessment	• Assessments focussed on the exam content and exam technique for unit R105 in the form of regular past papers (1 per fortnight 60 marks each)
	• which will include:
	  ○ the design, optimise and validate phase
	  ○ understanding user needs
	  ○ product safety
	  ○ manufacturing production (including scales of production)
	  ○ concepts of durability, resilience and tolerances
	  ○ standard and pre-manufactured components
	  ○ production costs
	  ○ regulations and safeguards
	  ○ trends (including technology and the environment)
	  ○ legislative design requirements
	  ○ life cycle design, sustainability and end of life
	• Coursework – R108 assessment which will focus on understanding safe working practices used when making a prototype.
		• R105 External examination in January.
		• R108 assessment which will focus on producing a prototype and evaluating the success of a prototype,
		• Final assessments of R106 and R107 coursework tasks which focuses on product analysis and research, and then developing and presenting an engineering design.

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 and 2	HALF TERM 3 and 4	HALF TERM 5 and 6
Topic and learning focus			
	Students' lesson time is divided between 3 units – Maths for Engineering, Science for Engineering and CAD. <u>Maths/Mechanical Engineering</u> • LO1 – understand the application of algebra relevant to engineering problems • LO4 – be able to use trigonometry to solve engineering problems • LO3 – understand exponentials and logarithms in the context of engineering problems • LO5 – understand how to use calculus within the context of engineering <u>Science/Electrical 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	<u>Maths/Mechanical</u> • LO5 – understand how to use calculus within the context of engineering • LO2 – be able to use geometry and graphs in the context of engineering problems • LO6 – Use statistics to handle and analyse data including probability calculations. <u>Science/Electrical Engineering</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>CAD</u>	<u>Maths/Mechanical</u> • Revision for Unit 1 examination • LO1 – the effect of forces on materials, stress, strain and the Young Modulus. • LO5 - dynamics <u>Science/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> • Using Fusion 360 to design and run physical simulations.

ASHLAWN SCHOOL

	this behaviour in terms of the forces acting on the atoms. <u>CAD</u> ● Understand how to create 3D shapes using increasingly complex tools in Fusion 360.	● Create assemblies of shapes where different bodies interact with each other. ● Learn how to incorporate animations and moving parts in CAD work.	
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) ● Basic trigonometric relationships (SOH CAH TOA, sine and cosine rules)	● Understand the geometry of simple 2D and 3D shapes (prisms and spheres) ● 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 ● Manipulating shapes in 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. ● Use trigonometric identities and expressions to analyse the behaviour of vector quantities so that engineering problems involving velocity and force can be solved. ● 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.	● 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. ● 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.	● 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. ● 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.

ASHLAWN SCHOOL

	• 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.	• Apply animations to Fusion 360 designs to show how moving parts might behave in a working physical product.	• Recognise the symbols and functions of the logic gates. • Produce simple physical simulations using Fusion 360.
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. • Construct realistic and original jewellery designs on Fusion 360 comprised of a number of different 3d shapes and wires.	• 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 • Compare the strengths and weaknesses of designs using animations to provide a more realistic view of the product.	• 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. • Produce accurate and detailed physical simulations from CAD models showing points of high stress and highlighting the function of the product.
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. • Enhance the jewellery designs using a range of complex shading and rendering techniques.	• 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.	• 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.
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. • Subject specific vocabulary and terminology		

ASHLAWN SCHOOL

<table>
<tr><td>Cultural Capital</td><td colspan="3">

Recognition of how significant engineers, engineering projects and design contribute to the value of British and global culture
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.

</td></tr>
<tr><td>Social, Moral, Spiritual and Cultural Development

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

Discussion and teamwork with opportunity for lots of collaborative working.
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.
Appreciation of how mutual respect and tolerance in the engineering workplace are essential to the commercial success of companies and projects
During the course, British laws are studied in terms of regulation and Health and Safety legislation

</td></tr>
<tr><td>Assessment</td><td>For units 1 (maths/mechanical engineering) and 2 (electrical engineering) are 2 x 40 mark assessments past paper and will include properties of materials; using geometry and graphs in the context of engineering problems; exponentials and logarithms in the context of engineering problems; using algebra and trigonometry to solve problems in an engineering context.

For CAD assessment of LO1 x 2 assessments on understand how to create 3D shapes using increasingly complex tools in Fusion 360.</td><td>For units 1 and 2:
2 x 40 mark assessments per unit past paper
2 x 60 mark past papers per unit past paper
which will include using calculus in the context of engineering; scientific principles of mechanical engineering; using geometry and graphs in the context of engineering problems; understanding alternating voltage and current; using algebra, equations, functions and graphs to engineering problems.

For CAD:
Two assessments of LO2 and LO3 which will focus on creating assemblies of shapes where different bodies interact with each other, and incorporate animations and moving parts in CAD work.</td><td>Units 1 and 2 :
Externally assessed 60 mark paper per unit

Units 3 and 4:
1 x 40 mark assessment per unit which will include properties of beams; dynamic systems; pulleys and gearing; electronic motors and generators; voltage and current.

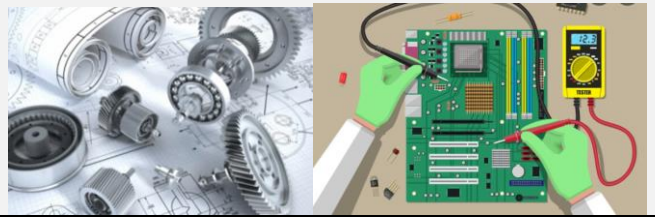
For CAD:
Two assessments of LO4 using Fusion 360 to design and run physical simulations.
Overall Unit coursework assessment and moderation.</td></tr>
</table>

ASHLAWN SCHOOL

Key Stage 5 Curriculum Journey: Year 13 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 13 CURRICULUM JOURNEY

	HALF TERM 1 and 2 	**HALF TERM 3,4 and 5** 
Topic and learning focus	Mechanical Engineering ● LO2 – the fundamental geometrical properties ● LO3 – levers, pulleys and gears ● LO4 – properties of beams Electrical Engineering ● LO3 – Power supplies and power transmission ● LO4 – DC Motors and Generators ● LO5 – Analogue circuits – the operational amplifier Mechanical Design ● LO1 – use graphical and engineering drawing techniques to communicate design solutions. ● LO2 – select appropriate engineering materials to achieve design solutions.	External examinations in Mechanical and Electrical Engineering. Mechanical Design ● LO3 – design components that can be successfully manufactured. ● LO4 – optimise design to improve performance.
Foundational Knowledge Prior learning needed	● Kirchoff's Laws and how they are applied to a variety of circuits. ● Concepts of emf and pd, current and resistance ● An understanding of Alternating current ● Fuses, resistors and diodes ● A good understanding of algebra, standard form and SI units and trigonometry (including graphs of trigonometry functions). ● Calculations of areas and volumes of simple 2d and 3d shapes ● Principle of moments ● Operation of Fusion 360 to produce 2d and 3d designs. ● Design Cycle and the activities that take place during each stage.	● Scales and methods of production – mass/batch/one-off/just in time, die casting, sand casting etc. ● Stages of design cycle. ● Sustainability and recycling Statistics and statistical analysis (from Unit 1)
Core Knowledge and skills	● The components and sequence of a stabilised power supply. ● Recall the 3 main methods for AC-DC rectification.	● DFMA – design for manufacture and assembly and its implications on design.

ASHLAWN SCHOOL

	• Justify the need for 3 phase power and the relationships between the different phases. • The general circuit layout of separately excited and self-excited DC motors and generators. • Analyse motors and generators using the defining equations. • Understand the structure of a DC power supply. • Describe the operation and properties of inverting and non-inverting op-amps. • Calculate the gain of the inverting and non-inverting op-amp. • Calculate the volumes of prisms • Use the density equation to calculate density, mass and volume of bodies. • Calculate the centre of mass of 2d objects and understand the concept of centroid. • Mechanical advantage and velocity ratio • The three classes of lever and how these can be used to solve engineering problems. • Applications of moments to beams. • Types of beam and support conditions • 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.	• 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.
Developmental Knowledge and Skills	• Describe how the 3 methods for rectification work and compare how they might be used in different situations. • Calculate phase and line voltage, describing the difference between them and explaining how the star and delta wiring configurations might be used. • Describe the advantages and disadvantages of shunt wound and series wound motors and use these to justify the choice of motor type for different practical scenarios. • Explain the operation of the summing amplifier, calculating the gain and suggesting uses. • Perform calculations analysing the effects of different sizes of gear and gear ratios. • Calculate the reactions of beams with simple supports or cantilevers. • Use of CAD to produce rendered 3d images from 2d designs. • Evaluate choices of materials based on properties and cost.	• 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.
Complex Knowledge	• Represent 3 phase power graphically and using trigonometric equations. • Evaluate the implications of back emf for both motors and generators. • Evaluate and calculate the effect of flux and other factors on motor speed.	Calculating probability of mechanical failure using statistical data.

ASHLAWN SCHOOL

	● Calculate the mechanical advantage and velocity ratio for belt-driven systems ● Analyse beam systems by drawing bending moment diagrams. ● Use calculated quantities such as conductivity or Young Modulus to justify material choice.	
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 Cultural Development **Fundamental British Values**	● Discussion and teamwork with opportunity for lots of collaborative working. ● 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. ● Appreciation of how mutual respect and tolerance in the engineering workplace are essential to the commercial success of companies and projects	
Assessment	For unit 3 (2 x 40 mark assessments per unit) and for unit 4, 2 x 60 mark past papers which will include: the fundamental geometrical properties levers, pulleys and gears properties of beams power supplies and power transmission DC Motors and Generators analogue circuits – the operational amplifier For Mechanical Design assessments will include: using graphical and engineering drawing techniques to communicate design solutions. selecting appropriate engineering materials to achieve design solutions	60 mark exam paper in Units 3 and 4 Externally assessed 60 mark exam paper for units 3 and 4 which will include: the fundamental geometrical properties; levers, pulleys and gears, properties of beams; power supplies and power transmission; DC Motors and Generators; analogue circuits – the operational amplifier Assessments of LO3 and LO4 for Mechanical Design which will focus on design components that can be successfully manufactured and optimising design to improve performance