

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	1. Identifying Requirements			
Autumn Term	<ul style="list-style-type: none"> • 1.1 What can be learnt by exploring contexts that design solutions are intended for? • 1.2 What can be learnt by undertaking stakeholder analysis? • 1.3 How can usability be considered when designing prototypes? 	<p>1.1 Understand that all design practice is context dependent and that investigations are required to identify what makes a context distinct in relation to:</p> <ul style="list-style-type: none"> • How does the environment and other surroundings impact on design? • How do user requirements impact on design? • How can economic and market conditions impact on design? • How do product opportunities influence design? <p>1.2 Demonstrate an understanding of methods used for investigating stakeholder</p> <ul style="list-style-type: none"> • What is user-centred design and stakeholder analysis? • What is a SWOT analysis? • Why are focus groups important? • What is a qualitative observation? • Why is it important to carry out market research to identify gaps for new products or opportunities to update existing products? • How are forecasting companies used to identify technological and fashion trends? <p>1.2 Demonstrate an understanding of how enterprise can help drive the development of new product ideas through routes to innovation such as:</p> <ul style="list-style-type: none"> • How does entrepreneurship lead to product ideas? • How can commercial partnerships lead to product development? • How do venture capitalists and crowd funding websites support design development? <p>1.3 How can usability be considered when designing prototypes?</p> <ul style="list-style-type: none"> • How can a design solution impact on a user's lifestyle? • Why should a designers consider the ease of use and inclusivity of products? • How can ergonomic considerations and anthropometric data support ease of use? • What are aesthetic considerations? <p>1.3 Why is it important to consider ergonomic factors that may need considering when developing products?</p> <ul style="list-style-type: none"> • How does anthropometric data to help define design parameters associated with the human body? • Why is it important to consider user comfort, layout of controls and software user interface. 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	2. Learning from existing products and practice			
Autumn Term	<ul style="list-style-type: none"> • 2.1 Why is it important to analyse and evaluate products as part of the design and manufacturing process? • 2.2 Why is it important to understand technological developments in product design? • 2.3 Why is it important to understand both past and present developments in product design? 	<p>2.1 Analyse and evaluate the features and methods used in existing products and design solutions, to inform opportunities and constraints that may influence design decisions to offer product enhancement.</p> <ul style="list-style-type: none"> • How can the context of the existing products and the context of future design decisions inform opportunities and constraints? • Can you identify the multiple materials and components used in existing products? • Can you name methods of construction and manufacture in existing products? • How functionality is achieved? • How can products be inclusive and appropriate to a wide variety of users? • How do you determine fitness for purpose in a product? • How do existing products impact on user lifestyles? • Can you identify trends, taste and/or style? • What is the effect of marketing and branding? • How do you get a product to market? <p>2.2 Be able to critically evaluate how new and emerging technologies influence and inform the evolution and innovation of products and systems in both contemporary and potential future scenarios, including consideration of blue sky and incremental innovation.</p> <p>2.3 Recognise how past and present product designers, technologies and design thinking have influenced the style and function of products from different perspectives, including:</p> <ul style="list-style-type: none"> • How have past & present designers impacted on industry and enterprise? • How have past & present designers impacted on people in relation to: lifestyle, culture and society? • How have past & present designers impacted on the environment and sustainability? <p>2.3 Understand how key historical movements and figures and their methods have had an influence on future developments in product design.</p> <p>2.4 Demonstrate an understanding of a product's marketing lifecycle from initial launch to decline in popularity, including:</p> <ul style="list-style-type: none"> • What is initial demand, growth in popularity and decline over time? • What methods are used to create more demand and maintain a longer product popularity? • How can products be marketed and what role does social media have in advertising? 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	3. Implications of Wider Issues			
Autumn Term	<ul style="list-style-type: none"> • 3.1 What factors need to be considered whilst investigating design possibilities? • 3.2 What factors need to be considered when developing design solutions for manufacture? 	<p>3.1 Understand how social, ethical and environmental issues have influenced and been impacted by past and present developments in design practice and thinking, including:</p> <ul style="list-style-type: none"> • What is lifecycle assessment (LCA)? • Can you identify the source and origin of materials; and the ecological and social footprint of materials? • How do the depletion and effects of using natural sources of energy and raw materials impact on design? • What is planned obsolescence? • How do buying trends effect product sales? • How do environmental incentives and directives impact on product development? <p>3.2 Awareness of the responsibilities and principles of designing for manufacture (DFM) & total quality management (TQM) including:</p> <ul style="list-style-type: none"> • Why is it important to plan for accuracy and efficiency through testing and prototyping? • What are the issues in relation to different scales of production? • How are products designed for repair and maintenance? • Why is it important to design with consideration of product life? <p>3.2 Awareness of product lifecycle management and engineered lifespans.</p> <ul style="list-style-type: none"> • How are different systems compatible? • Why is there a need for maintenance of machinery? • What forms of product support is there and what is the end of life (EOL). <p>3.2 Demonstrate an understanding of how environmental factors impact on:</p> <ul style="list-style-type: none"> • How are raw material processed and sources • How are materials disposal of? • What happens if there is surplus material and components? • What is a by-product? • Can energy create pollution? • What are the cost implications related to materials and process? <p>3.2 Demonstrate an understanding of sustainability issues relating to industrial manufacture.</p> <ul style="list-style-type: none"> • What is fair trade and the Ethical Trade Initiative (ETI) • Can you identify current economic issues? • What is globalisation? • What is material sustainability and optimisation? • What is material availability? • How are materials recycled? • What is a conservation scheme? • What is the impact of eco-materials? • How can materials be up-cycled? 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	3. Implications of Wider Issues			
Autumn Term	<ul style="list-style-type: none"> • 3.3 What factors need to be considered when manufacturing products? • 3.4 What factors need to be considered when distributing products to markets? • 3.5 What energy factors need to be considered when developing design solutions? 	<p>3.3 Demonstrate an understanding of how to achieve an optimum use of materials and components.</p> <ul style="list-style-type: none"> • What are the cost of materials and/or components? • What is meant by stock size and forms availability? • What is sustainable production? <p>3.4 Understand the issues related to the effective and responsible distribution of products.</p> <ul style="list-style-type: none"> • How do companies implement cost effective distribution? • What environmental issues and energy requirements do companies need to factor? • How does social media and mobile technology influence distribution of products and materials? • What is meant by global production and delivery? <p>3.4 Demonstrate an understanding of the implications of intellectual property (IP), registered designs, registered trademarks, copyright, design rights and patents, in relation to ethics in design practice and consumer rights.</p> <p>3.5 Understand wider issues relating to the selection of energy sources, storage, transmission and utilisation in order to select them appropriately for use.</p>		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
--	--------------------	-----------------	---	----------

4. Design Thinking & Communication

Spring Term	<ul style="list-style-type: none"> • 4.1 How do product designers use annotated 2D and 3D sketching and digital tools to graphically communicate ideas? • 4.2 How do industry professionals use digital design tools to support and communicate the exploration, innovation and development of design ideas? 	<p>4.1 Demonstrate an understanding of how to use annotated sketching and digital tools to graphically communicate ideas and sketch modelling to explore possible improvements, in terms of physical requirements, such as:</p> <ul style="list-style-type: none"> • What is Function? • What is Usability? • What is Construction? • What is Movement? • What is Stability? • What is Composition? • What is strength? • What is aesthetic qualities? • What is manufacturing processes? • What is suitability of materials and components? <p>4.1 Demonstrate an understanding of methods used to communicate the construction of design solutions to inform third parties, such as producing:</p> <ul style="list-style-type: none"> • What are working/technical drawings? • What is digital visualisation? • What are schematic diagrams and lay plans? • What is a flowchart and what are the associated symbols? • What are prototypes and models? <p>4.2 Demonstrate an understanding of how designers develop products using digital tools and online collaboration, such as:</p> <ul style="list-style-type: none"> • How do designers exchange ideas with specialists? • What is concurrent design? • How do designers explain and communicating their design decisions to stakeholders? <p>4.2 Demonstrate an understanding of how digital design software is used during design development, such as:</p> <ul style="list-style-type: none"> • What is visual presentation, rendering and photo-quality imaging? • What is product simulation? • How is scientific analysis of real-world physical factors used to determine whether a product will break or work the way it was intended? 		
-------------	--	--	--	--

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
--	--------------------	-----------------	---	----------

4. Design Thinking & Communication

Autumn Term

- **4.3 How do product designers use different approaches to design thinking to support the development of design ideas?**

4.3 Awareness of different strategies, techniques and approaches to explore, create and evaluate design ideas, including:

- What is iterative designing?
- What is user-centred design?
- What is a circular economy?
- What is meant by systems thinking?

4.3 Understand how design engineers use system design processes to define and develop systems that satisfy specified requirements of users using the three sub-tasks.

- What is a user-interface design?
- What is data design?
- What is process design?

4.3 The importance of collaboration to gain specialist knowledge from across subject areas when delivering solutions in the design and manufacturing industries.

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
--	--------------------	-----------------	---	----------

5. Material Considerations

	<ul style="list-style-type: none"> • 5.1 What factors influence the selection of materials that are used in products? • 5.2 What materials should be selected when designing and manufacturing products and prototypes in product design? • 5.3 Why is it important to consider the properties/characteristics of materials when designing and manufacturing products? 	<p>5.1 Understand that the selection of materials and components is influenced by a range of factors.</p> <ul style="list-style-type: none"> • How do materials have ‘functional performance’? • What are material aesthetics • What are the cost and availability of materials? • What are material properties and characteristics? • What environmental considerations? • What social, cultural and ethical factors need to be considered when selecting materials? <p>5.2 Understand that most products consist of multiple materials and that product designers are required to discriminate between them appropriately for their use, including:</p> <ul style="list-style-type: none"> • How do you classify hardwoods and softwoods? • Can you identify properties and characteristics of woods such as oak, teak and beech; pine, spruce and fir? • What is a manufactured boards? • Can you identify properties and characteristics of plywood, MDF and block board? • How do you classify ferrous and non-ferrous metals? • Can you identify properties and characteristics of cast iron, mild steel and stainless steel; aluminium and copper? • What is metal alloy? • Can you identify properties and characteristics brass, bronze and tungsten? • How do you classify thermopolymers and thermosetting polymers? • Can you identify properties and characteristics of PET, HDPE, PVC, LDPE, polypropylene, polystyrene, HIPS and ABS; urea formaldehyde, epoxy resin and polyester resin? • How do you classify natural and synthetic fibres? • Can you identify properties and characteristics of cotton, wool and silk; polyester and nylon? • What are textile/ reinforcement fabrics? • How are geotextiles used in civil engineering? • What is a composite materials? • What are the main characteristics and uses of fibre-reinforced plastics, glass-reinforced plastics (GRP) and carbon fibre(CFRP)? • What is a modern materials? • What are the characteristics and uses of graphene, bioplastics, nanomaterials, sandwich panels, e-textiles, rare earth magnets, high performance alloys and super-alloys and carbon nanotubes. • What is a smart material? • How do thermochromic, photochromic and electrochromic materials; self healing materials; shape memory alloy and shape memory polymers; conductive paints; e-textiles; motion control gel; thermochromic, photochromic and electrochromic materials function <p>5.3 Understand why the characteristics and properties of the materials in 5.2a make them suitable for use in a variety of products dependent on the contextual application, including:</p> <ul style="list-style-type: none"> • What is density, strength, hardness, durability, strength-to-weight ratio, stiffness, elasticity, impact resistance, plasticity, malleability and ductility, corrosive resistance to chemicals and weather, flammability, absorbency, washability, thermal and electrical conductivity, resistance to decay and biodegradable? <p>5.3 Understand how the available forms, costs and properties of materials contribute to the decisions about suitability of materials when developing and manufacturing their own products.</p>		
--	--	---	--	--

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	6. Technical Understanding			
September to Easter	<ul style="list-style-type: none"> • 6.1 What considerations need to be made about the structural integrity of a design solution? • 6.2 How do mechanisms provide functionality to products and systems? • 6.3 What forces need consideration to ensure structural and mechanical efficiency? • 6.4 How can electronic systems offer functionality to design solutions? 	<p>6.1 Learners should understand how and why some materials and/or system components need to be reinforced or stiffened to withstand forces and stresses to fulfil the structural integrity of products.</p> <p>6.1 Learners should understand processes that can be used to ensure the structural integrity of a product.</p> <ul style="list-style-type: none"> • How are structures stiffened by use of triangulation? • What is meant by the term reinforcing? <p>6.2 Demonstrate an understanding of the functions that mechanical devices offer to products, providing different types of motion.</p> <ul style="list-style-type: none"> • What is rotary motion? • What is linear motion? • What is reciprocating motion? • What is oscillating motion? <p>6.2 Demonstrate an understanding of devices and systems that are used to change the magnitude and direction of forces and torques.</p> <ul style="list-style-type: none"> • Can you identify and calculate gears, cams, pulleys and belts, levers, linkages, screw threads, worm drives, sprockets, chain drives and belt drives? • What is an epicyclic gear systems? • How do we achieve efficiency through bearings and lubrication? • How do we achieve efficiency in mechanical systems? <p>6.3 Demonstrate an understanding of static and dynamic forces in structures and how to achieve rigidity.</p> <ul style="list-style-type: none"> • What is tension, compression, torsion, shear and bending? • How do you define stress, strain and elasticity? • What is the difference between mass and weight? • How do you define rigidity? • What are modes of failure? <p>6.4 Demonstrate an understanding of how electronic systems provide input, control and output process functions.</p> <ul style="list-style-type: none"> • What are the various switches and sensors, to produce signals in response to a variety of inputs? • Can you use programmable control devices? • How do you achieve signal amplification? • Can you list devices to produce a variety of outputs including light, sound, motion. 		

Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
6. Technical Understanding			
<ul style="list-style-type: none"> 6.4 How can electronic systems offer functionality to design solutions? 	<p>6.4 Demonstrate an understanding of the function of an overall system, referring to aspects.</p> <ul style="list-style-type: none"> What is a passive component? What is an Input component? What is a process? What is an output component? Can you show an understanding of resistors, capacitors and diodes? Can you show an understanding of sensors for position, light, temperature, sound, infra-red, force, rotation and angle? Can you show an understanding of process control: programmable microcontroller? What is signal amplification: MOSFET, driver Ics? Can you show an understanding of LED, sounder, solenoid, DC motor, servo motor, stepper motor, piezoactuator and displays? Do you understand analogue and digital signals and conversion between them? What is an open and closed loop systems including feedback in a system and how it affects the overall performance? What is a sub-system and systems thinking? <p>6.4 Demonstrate an understanding of what can be gained from interfacing electronic circuits with mechanical and pneumatic systems and components.</p> <ul style="list-style-type: none"> Can you explain the ability to add electronic control as an input to mechanical or pneumatic output? How do you integrate the use of flow restrictors to control cylinder speed? How do you integrate the use of sensors to measure rotational speed, strain/force, distance? <p>6.4 Demonstrate an understanding of networking and of communication protocols.</p> <ul style="list-style-type: none"> How are wireless devices, such as: RFID, NFC, Wi-Fi, Bluetooth used to improve networking and communication? What is an embedded device? What are smart objects? Do you understand how networking electronic products are used to exchange information? <p>6.4 Demonstrate an understanding of the basic principles of electricity.</p> <ul style="list-style-type: none"> What is voltage and how is it calculated? What is current and how is it calculated? What is Ohm's law and how is resistance calculated? What is power? 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	6. Technical Understanding			
	<ul style="list-style-type: none"> • 6.5 How can programmable devices and smart technologies provide functionality in system design? 	<p>6.5 Demonstrate an understanding of how smart materials change the functionality of engineered products.</p> <ul style="list-style-type: none"> • Can you suggest which smart materials can have colour changing properties? • Can you suggest which smart materials have shape-shifting properties? • Can you suggest which smart materials have motion control properties? • Can you suggest which smart materials are self-cleaning and self-healing. <p>6.5 Demonstrate an understanding of how programmable devices are used to add functionality to products, relating to coding of and specific applications of programmable components.</p> <ul style="list-style-type: none"> • How do you incorporate enhanced features that can improve the user experience and solve problems in system design? • How do you use basic techniques for measuring, controlling, storing data and displaying information in practical situations? • How do you use electronic prototyping platforms and integrated development environments (IDE) for simulation in virtual environments? • Can you identify programmable components and microcontrollers found in products and systems, such as robotic arms or cars? • Can you create flowcharts to describe processes and decisions within a process to control input and output components? 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	7. Manufacturing Processes & Techniques			
	<ul style="list-style-type: none"> • 7.1 How can materials and processes be used to make iterative models? • 7.2 How can materials and processes be used to make final prototypes? 	<p><i>7.1 Understand that 3D iterative models can be made from a range of materials and components to create block models and working prototypes to communicate and test ideas, moving parts and structural integrity.</i></p> <p><i>7.1 Demonstrate an understanding of simple processes that can be used to model ideas using hand tools and digital tools, such as rapid prototyping, or digital simulation packages.</i></p> <p><i>7.2 Understand how to select and safely use common workshop tools, equipment and machinery to manipulate materials.</i></p> <ul style="list-style-type: none"> • What is meant by the term 'wasting techniques' e.g. such as drilling, cutting, turning and milling? • What is meant by the term 'addition processes' such as soldering, brazing, welding, adhesives and fasteners? • What is meant by 'deforming and reforming' such as bending and vacuum forming? <p>7.2 Demonstrate an understanding of the role of computer-aided manufacture (CAM) and computer-aided engineering (CAE) to fabricate parts of a final prototype.</p> <ul style="list-style-type: none"> • How do engineers use additive manufacturing (3D printing) to fabricate a usable part? • How is subtractive CNC manufacturing such as laser/plasma cutting, milling, turning and routing used in engineering? <p>7.2 Demonstrate an understanding of measuring instruments and techniques used to ensure that products are manufactured accurately or within tolerances as appropriate.</p> <p><i>7.2 Understand how the available forms, costs and working properties of materials contribute to the decisions about suitability of materials when developing and manufacturing products.</i></p>		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
--	--------------------	-----------------	---	----------

7. Manufacturing Processes & Techniques

- **7.3 How can materials and processes be used to make commercial products?**
- **7.4 How is manufacturing organised and managed for different scales of production?**
- **7.5 How is the quality of products controlled through manufacture?**

Demonstrate an understanding of the industrial processes and machinery used for manufacturing component parts in various materials.

- Can you describe a range of polymer moulding methods? E.g. injection moulding, blow moulding, vacuum forming, rotational moulding, line bending and extrusion.
- What is compression moulding and thermoforming?
- How does die casting and sand casting differ for one off and mass produced production?
- What sheet metal forming methods are used in engineering? E.g. punches, rollers, shears and stamping machines.

Demonstrate an understanding of the industrial methods used for assembling electronic products.

- What is surface mount technology (SMT)
- How are PCBs assembly using solder stencils, pick-and-place machines and reflow soldering ovens.

Demonstrate an understanding of the benefits and flexibility of using computer controlled machinery during industrial production.

- What are automated material handling systems?
- Where and why are robot arms used to stack, assemble, join and paint parts?

7.4 Understand how and why different production methods are used when manufacturing products dependent on market demand.

- What is one-off and bespoke, batch and high volume production?
- What is modular/cell production?
- What is lean manufacturing?
- What is just-in-time manufacture
- What examples are there of bought-in parts and components, standardised parts?
- Where are there examples of fully automated manufacture?

7.4 Understand how ICT and digital technologies are changing modern manufacturing:

- What is a customised manufacturing systems?
- What is rapid prototyping?
- What is additive and digital manufacturing?
- Where in industry is stock control, monitoring and purchasing logistics used?

7.5 Understand the processes that need to be undertaken to ensure products meet legal requirements and are of high quality.

- How does industry ensure quality control?
- What is meant by quality assurance?
- What is 'Total Quality Management' (TQM)?
- What are European and British standards?

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	8. Viability of Design Solutions			
	<ul style="list-style-type: none"> • 8.1 How can designers assess whether a design solution meets its stakeholder requirements? • 8.2 How can product designers and manufacturers assess whether a design solution meets the criteria of technical specifications? • 8.3 How do designers and manufacturers determine whether design solutions are commercially viable? 	<p>8.1 Critically evaluating how a design solution has met its intended requirements.</p> <ul style="list-style-type: none"> • How is 'functionality' evaluated? • How is 'ease of use and inclusivity of the solution' evaluated? • How are 'user needs' evaluated? <p>8.1 Demonstrate an understanding of the needs and methods for testing design solutions with stakeholders throughout the design development, and when testing the success of a product.</p> <p>8.1 Demonstrate an understanding of the importance of testing the feasibility of getting a product to market including considerations of cost, packaging and appeal.</p> <p>8.1 Understanding the relevant standards that need to be met and how to ensure these are delivered.</p> <ul style="list-style-type: none"> • What is the British Standards Institute (BSI) • What is the International Organisation for Standardisation (ISO)? <p>8.2 Demonstrate an understanding of the methods and importance of undertaken physical testing on a product to ensure it meets the criteria it is meant to fulfil.</p> <ul style="list-style-type: none"> • How is 'functionality' tested? • How is 'accuracy' tested? • How is 'performance' tested? <p>8.2 Recognise how physical testing systems are integrated into the manufacturing process to test functionality.</p> <ul style="list-style-type: none"> • What are destructive and non-destructive methods? • How are materials tested for durability? • What methods can models and prototypes be tested for performance and fitness for purpose? • What is consumer testing? • What is virtual testing? <p>8.3 Demonstrate an understanding of the value of feasibility studies to determine the likely factors that influence the commercial viability of a product to market.</p> <ul style="list-style-type: none"> • What is the design solution's impact on user lifestyle? • how well could a product perform? • what are the likely technical difficulties of manufacture? • what is the stock availability of materials and components? • what would be the costs and profit involved in bringing a product to market? • What timescales are involved in bringing a product to market? • How could the product be promoted, include brand awareness and have advertising potential? • How do you balance supply and demand? • Do you know how to carry out market analysis of similar products? 		

	Big Question/Theme	Small Questions	Assessment Opportunities and Criteria. Teacher Feedback point (TFP)	Homework
	9. Health & Safety			
	<ul style="list-style-type: none"> • 9.1 How can safety be ensured when working with materials in a workshop environment? • 9.2 What are the implications of health and safety legislation on product manufacture? 	<p>9.1 Demonstrate an understanding of safe working practices in the workshop situation</p> <ul style="list-style-type: none"> • What is a risk assessment? • How do you identify hazards to help control measures and minimise risks? <p>9.1 Demonstrate an understanding of how to work safely with specialist tools, techniques, processes, equipment and machinery during the design and manufacture of products.</p> <p>9.2 Demonstrate an understanding of how the regulatory and legislative framework in the Health and Safety at Work Act (HASAW) sets out duties of employers and employees in the product manufacturing industries.</p> <ul style="list-style-type: none"> • What is Control of Substances Hazardous to Health (COSHH) • What is the Personal Protective Equipment at work regulations (PPE). <p>9.2 The responsibility of manufacturers to appropriately label products and offer guarantees to their consumers to deliver the correct levels of product assurance related to safety.</p>		