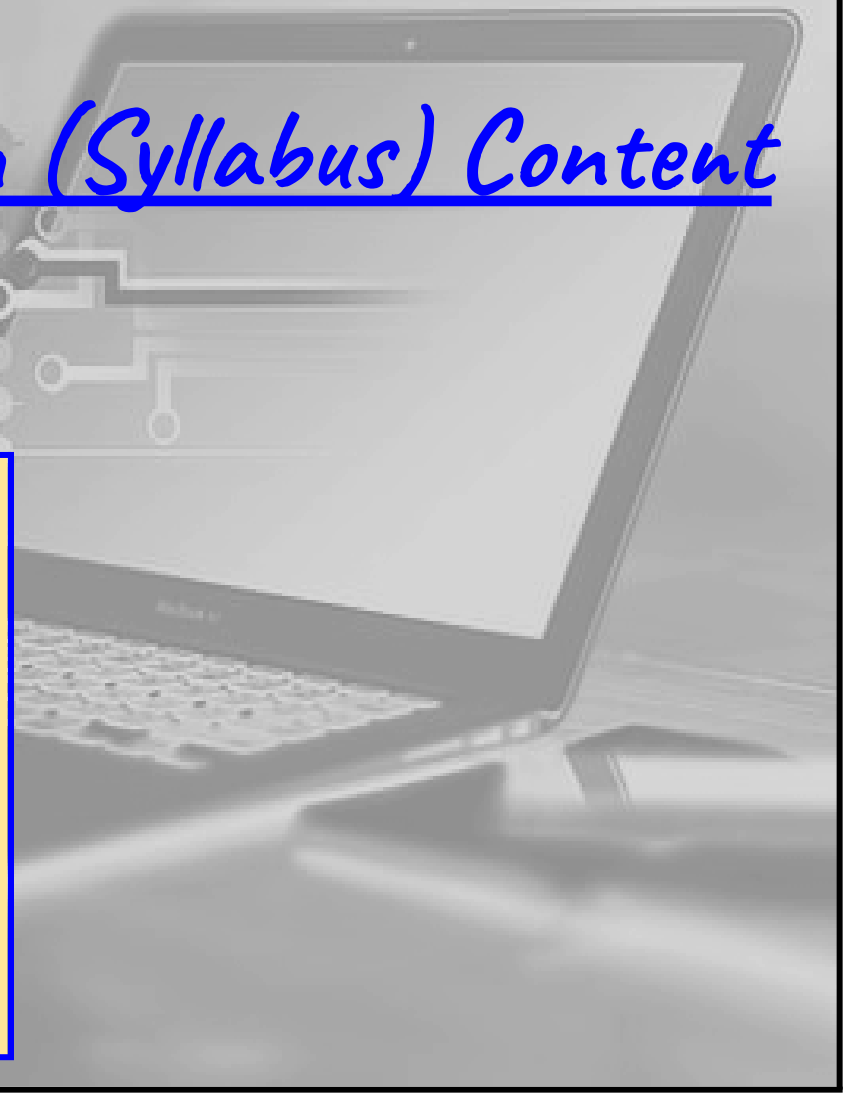
GCSE DESIGN & TECHNOLOGY

Revision Support - Specification (Syllabus) Content



These pages detail the AQA exam-board GCSE Design & Technology specification (the syllabus). It shows everything you COULD be asked about in the written examination (worth 50% of your overall mark).

The content headings are given along with the overview details of what you need to know. These are useful as they give you the parameters to work with - so you can see how much of each topic to learn and revise.

The 'Confidence' column allows you to tick-off the areas you know well, those you have learnt but need to revise and those you need your teacher to teach you. An electronic copy of this document is also available for you to update as your revision and confidence progresses. Use it as a checklist to guide your learning and revision.

Design & Technology - GCSE Specification (Syllabus) Content - Revision List - September 2021.

Syllabus Ref.	Syllabus Content.	Confidence
3.1.1	**New and Emerging Technologies** - **students must know and understand the impact of new and emerging technologies** on contemporary and potential future scenarios in relation to the following areas: ● **Industry** - The impact of new and emerging technologies on: ➢ The design & organisation of the workplace including automation & the use of robotics, ➢ Buildings and the place of work, ➢ Tools and equipment. ● **Enterprise** - Enterprise based on the development of an effective business innovation: ➢ Crowd-funding, ➢ Virtual marketing and retail, ➢ Co-operatives, ➢ Fair trade. ● **Sustainability** - The impact of resource consumption on the planet: ➢ Finite, ➢ Non-finite, ➢ Disposal of waste. ● **People** - ➢ How technology push/market pull affects choice. ➢ Changing job roles due to the emergence of new ways of working driven by technological change. ● **Culture** - ➢ Changes in fashion and trends in relation to new and emergent technologies. ➢ Respecting people of different faiths and beliefs. ● **Society** - How products are designed and made to avoid having a negative impact on others: ➢ Design for disabled, ➢ Elderly, ➢ Different religious groups. ● **Environment** - Positive and negative impacts new products have on the environment: ➢ Continuous improvement, ➢ Efficient working, ➢ Pollution, ➢ Global warming.	

	• **Production techniques and systems** - The contemporary and potential future use of: ➢ Automation, ➢ Computer aided design (CAD), ➢ Computer aided manufacture (CAM), ➢ Flexible manufacturing systems (FMS), ➢ Just in time (JIT), ➢ Lean manufacturing. • **How the critical evaluation of new and emerging technologies informs design decisions** - That it is important to consider scenarios from different perspectives and considering: ➢ Planned obsolescence, ➢ Design for maintenance, ➢ Ethics, ➢ The environment.	
3.1.2	**Energy Generation and Storage - Students should understand how energy is generated and stored** and how this is used as the basis for the selection of products and power systems: • **Fossil fuels** - How power is generated from Coal, Gas & Oil with arguments for and against fossil fuels use. • **Nuclear power** - How nuclear power is generated with arguments for and against its use for power. • **Renewable energy** - How power is generated from: ➢ Wind, ➢ Solar, ➢ Tidal, ➢ Hydro-electrical, ➢ Biomass. **Understand and present arguments for and against the selection of renewable energy**. • **Energy storage systems including batteries** - How to choose appropriate energy sources, including: ➢ Kinetic pumped storage systems, ➢ Alkaline and re-chargeable batteries.	

3.1.3	**Developments in New Materials** - **students should be aware of developments in NEW materials**: ● **Modern Materials**. ➢ Developments made through the invention of new or improved processes e.g. **Graphene**, **Metal Foams** and **Titanium**. ➢ Alterations to perform a particular function e.g. **Coated Metals**, **Liquid Crystal Displays** & **Nanomaterials**. ● **Smart Materials**. ➢ That materials can have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, temperature, moisture, or PH e.g. **shape memory alloys**, **thermochromic pigments** and **photochromic pigments**. ● **Composite Materials**. ➢ That composite materials are produced by combining two or more different materials to create an enhanced material e.g. **glass reinforced plastic** (GRP) and **carbon-fibre reinforced plastic** (CRP). ● **Technical Textiles**. ➢ How fibres can be spun to make enhanced fabrics e.g. **conductive fabrics**, **fire resistant fabrics**, **kevlar** and **microfibres** incorporating micro encapsulation.	
3.1.4	**Systems Approach to Designing** - **students should consider electronic systems** including programmable components to provide functionality to products and processes, and enhance and customise their operation: ● **Inputs**. The use of the following to provide functionality to products and processes: ➢ Light sensors, ➢ Temperature sensors, ➢ Pressure sensors, ➢ Switches. ● **Processes**. The use of the following to provide functionality to products and processes: ➢ Programming microcontrollers as counters, timers and for decision making. ● **Outputs**. The use of the following to provide functionality to products and processes: ➢ Buzzers, ➢ Speakers, ➢ Lamps.	

3.1.5	**Mechanical Devices** - **students should understand the following in relation to Mechanical Systems:** ● **Different types of movement** - The functions of mechanical devices to produce the following types of movement: ➢ Linear, ➢ Rotary, ➢ Reciprocating, ➢ Oscillating. ● **Changing magnitude and direction of force** - The action of forces and how levers and gears transmit and transform the effects of forces. This includes: **Levers:** ➢ First order, ➢ Second order, ➢ Third order. **Linkages:** ➢ Bell cranks, ➢ Push/pull. **Rotary systems:** ➢ Cams and followers, ➢ Simple gear trains, ➢ Pulleys and belts.	
3.1.6 **3.1.6.1** Material Categories.	**Materials and Their Working Properties** - **students should know and understand** the categorisation of the types and properties of the following **Material Categories:** ● **Papers and boards**. **Papers** include; ➢ Bleed proof, Cartridge paper, Grid, Layout paper, Tracing paper. **Boards** include; ➢ Corrugated card, Duplex board, Foil lined board, Foam core board, Ink jet card, Solid white board.	

- **Natural and manufactured timbers** - **Students should have an overview of** the main categories and types of natural and manufactured timbers:

Hardwoods including:
- ➢ Ash, Beech, Mahogany, Oak, Balsa.

Softwoods including:
- ➢ Larch, Pine, Spruce.

Manufactured boards including:
- ➢ Medium density fibreboard (MDF), Plywood, Chipboard.

- **Metals and Alloys**. **Students should have an overview of** the main categories & types of **Metals & Alloys**:

Ferrous metals including:
- ➢ Low carbon steel, Cast Iron, High carbon/tool steel.

Non ferrous metals including:
- ➢ Aluminium, Copper, Tin, Zinc.

Alloys including:
- ➢ Brass, Stainless Steel, High Speed Steel (HSS).

- **Polymers**. Students should have an overview of the main categories and types of polymers, being able to describe the main differences between the two groups.

Thermo plastic (or Thermoforming plastic) including:
- ➢ Acrylic (PMMA), High impact polystyrene (HIPS), High density polythene (HDPE), Polypropylene (PP), Polyvinyl chloride (PVC), Polyethylene terephthalate (PET).

Thermosetting plastic including:
- ➢ Epoxy resin (ER), Melamine-formaldehyde (MF), Phenol Formaldehyde (PF), Polyester Resin (PR), Urea-formaldehyde (UF).

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3.1.6.2	**Material Properties**: **Students should have an understanding of the working and physical properties of materials**. Students should know and understand **Physical Properties** such as: ➢ Absorbency (resistance to moisture), ➢ Density, ➢ Fusibility, ➢ Electrical and thermal conductivity. Students should know and understand **Working Properties** such as: ➢ Strength, ➢ Hardness, ➢ Toughness, ➢ Malleability, ➢ Ductility and elasticity.	
3.2.1	**Selection Of Materials Or Components**. **Students should be able to select materials and components considering the factors listed below**: ➢ **Functionality**: application of use, ease of working, ➢ **Aesthetics**: surface finish, texture and colour, ➢ **Environmental factors**: recyclable or reused materials, ➢ **Availability**: ease of sourcing and purchase, ➢ **Cost**: bulk buying, ➢ **Social factors**: social responsibility, ➢ **Cultural factors**: sensitive to cultural influences, ➢ **Ethical factors**: purchased from ethical sources such as FSC.	

3.2.2	**Forces and Stresses**. **Students should know and understand the impact of forces and stresses** and the way in which materials can be reinforced and stiffened. ● Materials and objects can be manipulated to resist and work with forces and stresses: ➢ Tension, ➢ Compression, ➢ Bending, ➢ Torsion, ➢ Shear. ● Materials can be enhanced to resist and work with forces and stresses to improve functionality: ➢ How materials can be reinforced, stiffened or made more flexible: e.g. lamination, bending, folding, webbing, fabric interfacing.	
3.2.3	**Ecological and Social Footprint**. **Students should have a knowledge and understanding of the ecological and social footprint left by designers**. ● **Ecological issues** in the design and manufacture of products, including: ➢ Deforestation, mining, drilling and farming, ➢ Mileage of product from raw material source, manufacture, distribution, user location and final disposal, ➢ That carbon is produced during the manufacture of products. ● **The Six Rs** which include: ➢ Reduce, ➢ Refuse, ➢ Re-Use, ➢ Repair, ➢ Recycle, ➢ Rethink. ● **Social issues** in the design and manufacture of products, including: ➢ Safe working conditions, ➢ Reducing oceanic/ atmospheric pollution, ➢ Reducing the detrimental (negative) impact on others.	

3.2.4	**Sources and Origins**. In relation to **at least one** material category, **students should know and understand the sources and origins of materials**. This should include understanding the primary sources of materials and the main processes involved in converting into workable forms for at least one material area. ● **Paper and board**; ➢ How cellulose fibres are derived from wood and grasses and converted into paper. ● **Timber based materials**: ➢ Seasoning, conversion and creation of manufactured timbers. ● **Metal based materials**: ➢ Extraction and refining. ● **Polymers**: ➢ Refining crude oil, fractional distillation and cracking.	
3.2.5	**Using and Working With Materials**. In relation to at least one material category or system, **students should know and understand** in addition to material properties, the factors listed below. ● **Properties of Materials**. **Students must know and understand** how different properties of materials and components are used in commercial products, how properties influence use and how properties affect performance. Students must know and understand the physical and mechanical properties relevant to commercial products: ➢ Papers and boards (flyers/leaflets and card based food packaging), ➢ Timber based materials (traditional timber children's toys and flat pack furniture), ➢ Metal based materials (cooking utensils and hand tools), ➢ Polymers (polymer seating and electrical fittings), ➢ Textile based materials (sportswear and furnishings), ➢ Electronic and mechanical systems (motor vehicles and domestic appliances).	

	● **The Modification of Properties for Specific Purposes**. ➢ Additives to prevent moisture transfer (*paper and boards*), ➢ Seasoning to reduce moisture content of timbers (*timber based materials*), ➢ Annealing to soften material to improve malleability (*metal based materials*), ➢ Stabilisers to resist UV degradation (*polymers*), ➢ Anodizing aluminium to improve surface hardness (*electronic and mechanical systems*). ● **How to Shape and Form Using Cutting, Abrasion and Addition**. ➢ *Papers and boards* (how to cut, crease, score, fold and perforate card), ➢ *Timber based materials* (how to cut, drill, chisel, sand and plane), ➢ *Metal based materials* (how to cut, drill, turn, mill, cast, braze and weld), ➢ *Polymers* (how to cut, drill, cast, deform, print and weld), ➢ *Electronic & mechanical systems* (how to cut, drill and solder).	
3.2.6	**Stock Forms, Types and Sizes**. **Students should know and understand the different stock forms, types and sizes** in order to calculate the quantity of materials required. ● Commercially available types and sizes of materials and components: **Papers and boards**: ➢ Sheet, roll and ply - sold by size e.g. A3, thickness, weight and colour, ➢ Standard components e.g. fasteners, seals and bindings, ➢ Cartridge paper and corrugated card. **Timber based materials**: ➢ Planks, boards and standard moldings - sold by length, width, thickness and diameter, ➢ Standard components e.g. woodscrews, hinges, KD fittings. **Metal based materials**: ➢ Sheet, rod, bar and tube - sold by length, width, thickness and diameter, ➢ Standard components e.g. rivets, machine screws, nuts, and bolts. **Polymers**: ➢ Sheet, rod, powder, granules, foam and films - sold by length, width, gauge and diameter, ➢ Standard components e.g. screws, nuts and bolts, hinges.	

3.2.7

Scales of Production. **Students should be able to select materials considering scales of production**.

- How products are produced in different volumes.

- The reasons why different manufacturing methods are used for different production volumes, including:
  - ➢ Prototype,
  - ➢ Batch,
  - ➢ Mass,
  - ➢ Continuous.

3.2.8

Specialist Techniques and Processes. **Students should know and understand** the factors listed below:

- **The Use of Production Aids**.
  - ➢ How to use measurement / reference points, templates, jigs and patterns where suitable.

- **Tools, Equipment and Processes**.
  - ➢ A range of tools, equipment and processes that can be used to shape, fabricate, construct and assemble high quality prototypes, as appropriate to the materials and/or components being used including:

Wasting / Wastage, including:	**Addition**, including:	**Deforming and Reforming**, including:
➢ Die cutting, ➢ Perforation, ➢ Turning (lathe), ➢ Sawing, ➢ Milling, ➢ Drilling, ➢ Cutting and shearing	➢ Brazing, ➢ Welding, ➢ Lamination, ➢ Soldering, ➢ 3D printing.	➢ Vacuum forming, ➢ Creasing and Pressing, ➢ Drape forming, ➢ Bending, ➢ Folding, ➢ Blow moulding, ➢ Casting, ➢ Injection moulding, ➢ Extrusion.

- **How Materials are Cut, Shaped and Formed to a Tolerance**.
  - ➢ The manufacture to minimum and maximum measurements,
  - ➢ Using tolerances to control the quality of products,
  - ➢ Why tolerances are applied during making activities.

	● **Commercial Processes**. **Students should know about & understand the following processes**: ➢ *Papers and Boards* offset lithography and die cutting, ➢ *Timber Based Materials* routing and turning, ➢ *Metal Based Materials* milling and casting, ➢ *Polymers* injection molding and extrusion. ● **Quality Control**. Students should know about the application and use of quality control methods, including measurable and quantitative systems used during manufacture. ➢ *Papers and Boards* registration marks, ➢ *Timber Based Materials* dimensional accuracy using go/no go fixture, ➢ *Metal Based Materials* dimensional accuracy using a depth stop, ➢ *Polymers* dimensional accuracy by selecting correct laser settings.	
3.2.9 **3.3.2**	**Surface Treatments and Finishes**. **Students should have knowledge and understanding of surface treatments and finishes**. This must include understanding of the preparation and application of treatments and finishes to enhance functional and aesthetic properties. ➢ *Papers and Boards* printing, embossing and UV varnishing, ➢ *Timber Based Materials* painting, varnishing and tanalising, ➢ *Metal Based Materials* dip coating, powder coating and galvanizing, ➢ *Polymers* polishing, printing and vinyl decals. **Environmental, Social And Economic Challenge**. Students should understand the environment, social and economic challenges that influence design and making. ● How the following might present opportunities and constraints that influence the processes of designing and making: ➢ Deforestation, ➢ Possible increase in carbon dioxide levels leading to potential global warming, ➢ The need for fair trade.	

3.3.3	**<u>The Work of Others</u>. Students should investigate, analyse and evaluate the work of past and present designers and companies to inform their own designing.** ● Students should investigate the work of a **minimum of two** of the following designers: ➢ Alexander McQueen, ➢ Aldo Rossi, ➢ Charles Rennie Macintosh, ➢ Coco Chanel, ➢ Ettore Sottsass, ➢ Gerrit Reitveld. ➢ Harry Beck, ➢ Louis Comfort Tiffany, ➢ Marcel Breuer, ➢ Mary Quant, ➢ Norman Foster. ➢ Philippe Starck, ➢ Raymond Templier, ➢ Sir Alec Issigonis, ➢ Vivienne Westwood, ➢ William Morris. ● Students should investigate **the work of a minimum of two of the following companies**: ➢ Alessi, ➢ Apple, ➢ Braun, ➢ Dyson, ➢ Gap, ➢ Primark, ➢ Under Armour, ➢ Zara.	

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7.1 Links to Maths.	**Links to Maths**. **Students must apply relevant knowledge, skills and understanding from Key Stage 3 and 4 courses in the Sciences and Maths**. The examples in the tables below are illustrative of how the mathematical skills and scientific knowledge and skills identified could be applied in design and technology. ● **Arithmetic and Numerical Computation**. ➢ Recognise and use expressions in decimal and standard form. ➢ Use ratios, fractions and percentages. ➢ Calculate surface area and volume. ➢ Calculation of quantities of materials, costs and sizes. ➢ Scaling drawings, analysing responses to user questionnaires. ➢ Determining quantities of materials. ● **Handling Data**. ➢ Presentation of data, diagrams, bar charts and histograms. ➢ Construct and interpret frequency tables; present information on design decisions. ● **Graphs**. ➢ Plot, draw and interpret appropriate graphs. ➢ Translate information between graphical & numeric form. ➢ Analysis and presentation of performance data and client survey responses. ➢ Extracting information from technical specifications.	

	● **Geometry and Trigonometry**. ➢ Use angular measures in degrees. ➢ Visualise & represent 2D & 3D forms including two dimensional representations of 3D objects. ➢ Calculate areas of triangles and rectangles, surface areas and volumes of cubes. ➢ Measurement and marking out, creating tessellated patterns. ➢ Graphic presentation of design ideas and communicating intentions to others. ➢ Determining the quantity of materials required.	
7.2 Links to Science.	**<u>Links to Science</u>**. **Students must know and apply the following scientific knowledge and skills**. ● **Use Scientific Vocabulary, Terminology And Definitions**. ➢ Quantities, units and symbols. ➢ SI units (e.g. kg, g, mg; km, m, mm; kJ, J), prefixes & powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano). ➢ Metals and non-metals and the differences between them, on the basis of their characteristic physical & chemical properties. ➢ Appropriate use of scientific terms when developing a design brief & specifications. ➢ ➢ Calculation of quantities, measurement of materials and selection of components. ➢ Classification of the types and properties of a range of materials. ● **Life Cycle Assessment and Recycling**. ➢ The basic principles in carrying out a life cycle assessment of a material or product. ➢ Selection of materials and components based on ethical factors, taking into consideration the ecological and social footprint of materials.	

	● **Using Materials**.		
	➢ The conditions which cause corrosion and the process of corrosion and oxidisation.	➢ Understanding of properties of materials and how they need to be protected from corrosion through surface treatments and finishes.	
	➢ The composition of some important alloys in relation to their properties and uses.	➢ Selecting appropriate materials.	
	➢ The physical properties of materials; how the properties of materials are selected related to their uses.	➢ Knowledge of properties of materials to be applied when designing and making.	
	➢ The main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro-electricity, the tides and the Sun), the ways in which they are used and the distinction between renewable and non- renewable sources.	➢ Understanding of how to choose appropriate energy sources.	
	➢ The action of forces and how levers and gears transmit and transform the effects of forces.	➢ Knowledge of the function of mechanical devices to produce different sorts of movement, changing the magnitude and direction of forces.	