

TOPICS - DESIGN TECHNOLOGY: A-LEVEL

REVISED

TESTED

EXAM
READY**Topic 1 - Materials:****1.1 Woods:**

- a) hardwoods – oak, mahogany, beech, jelutong, balsa.
- b) b) softwoods – pine, cedar, larch, redwood.

1.2 Metals:

- a) Ferrous metals – mild steel, carbon steels, cast iron
- b) Non-ferrous metals – aluminium, copper, zinc, tin
- c) Alloys (ferrous and non-ferrous) – stainless steel, duralumin, brass.

1.3 Polymers:

- a) Thermoplastics – acrylic, polyethylene, polyethylene terephthalate (PET), polyvinyl chloride (PVC), polypropylene (PP), acrylonitrile butadiene styrene (ABS)
- b) Thermosetting plastics – epoxy resins (ER), urea formaldehyde (UF), polyester resin (PR).
- c) Elastomers – rubber.

1.4 Composites:

- a) Composites – carbon fibre (CFRP), glass fibre (GRP), Medium Density Fibre Board (MDF), hardboard, chipboard, plywood.

1.5 Papers and boards:

- a) Drawing papers – layout, tracing, copier, cartridge
- b) Commercial printing papers – bond, coated
- c) Boards – mounting board, corrugated board, foam board, folding box board, foil-lined board.

1.6 Textiles:

- a) Natural fibres – cotton, linen, wool
- b) Manmade fibres – nylon, polypropylene, polyester
- c) Textile treatments – flame resistant, polytetrafluoroethylene (PTFE).

1.7 Smart and modern materials:

- a) Thermo-ceramics
- b) Shape memory alloys (SMA)
- c) Reactive glass
- d) Liquid crystal displays (LCD)
- e) Photo-chromic materials
- f) Thermo-chromic materials
- g) Quantum tunnelling composites.

Topic 2 - Performance characteristics of materials:**2.1 Performance characteristics:**

- a) Conductivity
- b) Strength
- c) Elasticity
- d) Plasticity
- e) Malleability
- f) Ductility
- g) Hardness
- h) Toughness
- i) Durability
- j) Biodegradability.

Topic 3 - Processes, techniques and specialist tools:
3.1 - processes, techniques and specialist tools:

- a) Heat treatments – hardening and tempering, case hardening, annealing, normalising (including use of specialist tools)
- b) Alloying (including use of specialist tools)
- c) Printing – offset lithology, flexography, screen-printing, gravure (including use of specialist tools)
- d) Casting – sand (to include investment), die, resin, plaster of Paris (including use of specialist tools)
- e) Machining – milling/routing, drilling, turning, stamping, pressing (including use of specialist tools)
- f) Moulding – blow moulding, injection moulding, vacuum forming, extrusion, rotational moulding (including use of specialist tools)
- g) Lamination (including use of specialist tools)
- h) Marking out techniques – woods, metals, polymers, paper and boards (including use of specialist tools).

3.2 - Application of specialist measuring tools and equipment:

- a) Marking, cutting and mortise gauges
- b) Odd leg, internal and external callipers
- c) Squares (set, try, engineers and mitre)
- d) Micrometer and vernier callipers
- e) Densitometer
- f) Dividers
- g) Jigs and fixtures
- h) Go and no-go gauges

3.3 - Use of media to convey design decisions, to record to recognised standards, explain and communicate information and ideas using the following methods and techniques:

- a) Pictorial drawing methods for representing 3D forms – isometric, 2-point perspective
- b) Working drawings for communicating 2D technical information – 3rd angle orthographic projection, triangulation
- c) Nets (developments) for communicating information about 3D forms in a 2D format
- d) Translation between working drawings, pictorial drawings and nets (developments)
- e) Report writing.

3.4 - permanent and semi-permanent joining techniques:

- a) adhesives – contact adhesive, acrylic cement, epoxy resin, polyvinyl acetate (PVA), hot melt glue, cyanoacrylate (superglue), polystyrene cement (including use of specialist tools)
- b) mechanical – screws, nuts, bolts, washers, rivets, press (including use of specialist tools)
- c) heat – oxy-acetylene welding, MIG welding, brazing, hard soldering, soft soldering (including use of specialist tools)
- d) jointing – traditional wood joints, knock-down fittings (including use of specialist tools).

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3.5 - Finishing techniques and methods of preservation: a) finishes – paints, varnishes, sealants, preservatives, anodising, electro-plating, powder coating, oil coating, galvanisation, cathodic protection (including use of specialist tools) b) paper and board finishing process – laminating, varnishing, hot foil blocking, embossing (including use of specialist tools).			
Topic 4 - Digital technologies:			
4.1 - CAD /CAM and rapid prototyping: a) computer-aided design (CAD) – 2D and 3D design to create and modify designs and create simulations, 3D modelling for creating ‘virtual’ products b) computer-aided manufacture (CAM) and rapid prototyping – CNC lathes, CNC routers, CNC milling machine, CNC laser, CNC vinyl cutters, rapid prototyping.			
Topic 5 - Factors influencing the development of products:			
5.1 - User Centered design: a) User needs, wants and values b) Purpose c) Functionality d) Innovation e) Authenticity.			
5.2 - Anthropometrics and Ergonomics: a) sources and applications of anthropometric data. b) ergonomic factors for a designer to consider when developing products and environments with which humans react.			
5.3 - The influence of aesthetics, ergonomics and anthropometrics on the design, development and manufacture of products: a) Form over function b) Form follows function.			
5.4 - Design theory through the influences and methods of the following key historical movements and figures: a) Arts and Crafts – William Morris b) Art Nouveau – Charles Rennie Mackintosh c) Bauhaus Modernist – Marianne Brandt d) Art Deco – Eileen Gray e) Post Modernism – Philippe Starck f) Streamlining – Raymond Lowey g) Memphis – Ettore Sottsass			

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READY**Topic 6 Effects of Technological developments:****6.1 - Current and historical technological developments that have had an effect on the work of designers and technologists and their social, moral and ethical impacts:**

- a) Mass production – the consumer society, built-in obsolescence, the effect mass production has on employment
- b) The ‘new’ industrial age of high-technology production – computers and the development and manufacture of products, miniaturisation of products and components, the use of smart materials, products from innovative applications
- c) The global marketplace – multinational companies in developed and developing countries, manufacturing ‘offshore’ in developing countries and local and global production.

Topic 7 - Safe working practices, potential hazards and risk assessment:**7.1 - Adopting safe working practices, recognise and react to potential hazards:**

- a) Understanding safe working practices for yourself and others when designing and making, including when selecting and safely using machinery, equipment and tools in order to ensure safe working environments
- b) Understanding the need for risk assessments – identification of potential hazards, identification of people at risk, evaluation of risks, implement control measures, recording and storing of risk assessment documentation.

Topic 8 - Features of manufacturing industries:**8.1 - Characteristics and stages of the following methods of production when applied to products and materials:**

- a) One-off production
- b) Batch production
- c) High-volume production.

8.2 - Characteristics, application, advantages and disadvantages of the following types of quality monitoring systems:

- a) quality control – the monitoring and achieving of high standards and degree of tolerance by inspection and testing, computer-aided testing
- b) quality assurance – monitoring the quality of a product from its design and development stage, through its manufacture, to its end-use performance and degree of customer satisfaction
- c) Total Quality Management (TQM) – when applied to quality assurance procedures and its impact on employees at every stage of the production process, ISO 9000.

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<p>8.3 - Characteristics, processes, application, advantages and disadvantages and the importance of considering accuracy of production and efficiency of modern manufacturing methods and systems when designing for manufacture for small, medium and large scale production:</p> <p>a) production scheduling and production logistics</p> <p>b) robotics in production – robots on fully-automated production and assembly lines/cells</p> <p>c) materials handling systems – automated storage and retrieval systems (ASRS), automatic guided vehicles (AGVs)</p> <p>d) flexible manufacturing systems (FMS), modular/cell production systems</p> <p>e) lean manufacturing using just-in-time (JIT) systems</p> <p>f) standardised parts, bought-in components</p> <p>g) quick response manufacturing (QRM) h) data integration – product data management (PDM), enterprise resource planning (ERP) systems i) concurrent manufacturing</p>			
Topic 9 - Designing for maintenance and the cleaner environment:			
<p>9.1 - ‘cleaner’ design and technology – a product’s life cycle in relation to the following sustainable development issues:</p> <p>a) material selection – source, quantity, quality, range, recyclability, biodegradability</p> <p>b) manufacture – minimising energy use, simplification of processes, achieving optimum use of materials and components, giving consideration to material form, cost and scale of production</p> <p>c) distribution – efficient use of packaging, reduction of transport, alternatives to fossil fuels</p> <p>d) use – repair versus replacement, energy efficiency, efficiency ratings</p> <p>e) repair and maintenance – standardisation, modular construction, bought in parts</p> <p>f) end of life – design for disassembly, recovered material collection, sorting and re-processing methods, energy recovery, environmental implications of disposal to landfill.</p>			
<p>9.2 - The wider issues of using cleaner technologies:</p> <p>a) cost implications to the consumer and manufacturer</p> <p>b) sustainability – designing without jeopardising the potential for people in the future to meet their needs.</p>			
Topic 10 - Current legislation:			
<p>10.1 - From the consumer’s point of view the implications of consumer rights legislation to consumers and manufacturers:</p> <p>a) Consumer Rights Act (2015)</p> <p>b) Sale of Goods Act (1979).</p>			
<p>10.2 - Health and safety laws and regulations:</p> <p>a) Health and safety regulation – the Health and Safety Executive and an awareness of relevant regulations to manufacturing industries</p> <p>b) Health and Safety at Work etc Act (1974) – the procedures to safeguard the risk of injury to people: personal protective equipment (PPE), signage, warning symbols</p> <p>c) Control of Substances Hazardous to Health (COSHH) regulations – the storage and use of solvent-based substances containing volatile organic compounds (VOCs)</p>			

Topic 11 - Information handling, modelling and forward planning :
11.1 - Collection, collation and analysis of information:

- a) Marketing – marketing analysis, research techniques, raw data/analysed data to enable enterprise to be encouraged
- b) Innovation management – cooperation between management, designers and production engineers, the encouragement of creativity
- c) The use of feasibility studies on the practicability of proposed solutions.

11.2 - Modelling the costing of projects to achieve an optimum outcome:

- a) Budgets – undertake financial forecasts
- b) Planning for production – allocation of:
 - employees
 - materials
 - scale of production
- c) selection of appropriate tools, machines and manufacturing processes

11.3 - The importance, implications and ways of protecting the intellectual property rights of designers, inventors and companies:

- a) Patents
- b) Copyrights
- c) Design rights
- d) Trademarks.

11.4 - Implication to designers, manufacturers and consumers of the following standards when developing designs and manufacturing products:

- a) British Standards (BSI and kite mark)
- b) European (CEN and CE)
- c) International Standards (ISO).

Topic 12 - Further processes and techniques:
12.1 - Strategies, techniques and approaches to explore, create and evaluate design ideas:

- a) User-centred design:
 - Framework process
 - Problem solving
 - User needs, wants and values
 - Limitations of end user consideration
- b) circular economy – biologically-based systems and an understanding of how waste and pollution can be eliminated
- c) Systems thinking – the influence of systems on commercial activity to enable all elements of a manufacturing enterprise to work together.

Topic 12 - Further processes and techniques:
12.2 - Applications, characteristics, advantages and disadvantages of the following project management strategies:

- a) critical path analysis – the handling of complex and time sensitive operations
- b) scrum – how flexible, holistic product development is achieved
- c) Six Sigma – the improvement of output quality of a process by identifying and removing the causes of defects and setting value targets of:
 - reduce process cycle time
 - reduce pollution
 - reduce costs
 - increase customer satisfaction
 - increase profits.

12.3 - The cost, sales, profit and market implications to the designer and manufacturer of the stages of a product's life cycle:

- a) Stages of the PLC:
 - Introduction Stage
 - Growth Stage
 - Maturity Stage
 - Decline Stage.
- b) Additional issues related to PLC.