

GCE Design and Technology: Product Design – Resistant Materials Technology – Cross referencing

The textbook to refer to is: Resistant Materials Technology, 2nd Edition – ISBN: 0435757695

Unit 2: Knowledge and Understanding of Product Design

2.1 Materials and components

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Sources, classification, formation and structure of materials and components.</p> <p>Metals and alloys</p> <p>Sources, classification, structure and production of:</p> <ul style="list-style-type: none"> • ferrous metals <ul style="list-style-type: none"> – steel • non-ferrous metals <ul style="list-style-type: none"> – aluminium – copper – zinc • common alloys <ul style="list-style-type: none"> – stainless steel – aluminium alloys – brass • micro-structures <ul style="list-style-type: none"> – crystals – grain – lattice structures. 	<p>P18 – 19, 66 – 68</p>

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Polymers Sources, classification, polymer structure and production of:</p> <ul style="list-style-type: none"> • thermoplastics <ul style="list-style-type: none"> – acrylic – polystyrene – PVC – PET – polypropylene • thermosetting plastics <ul style="list-style-type: none"> – epoxy resins • micro-structures <ul style="list-style-type: none"> – monomers – polymerisation and cross-linking. 	<p>P19 – 20, 67, 69</p>
<p>Woods Sources, classification, structure and processing of:</p> <ul style="list-style-type: none"> • hardwoods <ul style="list-style-type: none"> – oak – mahogany – beech • softwoods <ul style="list-style-type: none"> – pine – cedar – deal • conversion and seasoning • micro-structures <ul style="list-style-type: none"> – cellular – fibres and grain direction. 	<p>P21, 72 – 74</p>

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Composites and laminates</p> <p>Composition and production of:</p> <ul style="list-style-type: none"> • composites <ul style="list-style-type: none"> – carbon fibre – glass reinforced plastics (GRP) – medium density fibreboard (MDF) • laminates <ul style="list-style-type: none"> – plywood – block-board. 	P22, 69 – 70, 74 – 75
<p>Components</p> <ul style="list-style-type: none"> • Nuts/bolts including thread types and sizes and their various applications. • Rivets <ul style="list-style-type: none"> – pop – snap. • Gears <ul style="list-style-type: none"> – types and applications. • Bushes and bearings and their uses. • Cams including types and applications together with types of followers. • Stock sizes. 	P22 – 23, 76 – 79

2.2 Working properties of materials

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Working properties and functions of materials and components, relating to the composition and structure of materials.</p> <ul style="list-style-type: none"> • Mechanical properties of materials <ul style="list-style-type: none"> – strength – elasticity – plasticity – ductility – hardness – malleability. • Alloying metals to change properties <ul style="list-style-type: none"> – stainless steels – lightweight materials for aviation – special materials for the nuclear and chemical industries. • Heat treatment <ul style="list-style-type: none"> – annealing. • Work hardening, age hardening. • Characteristics and faults of woods <ul style="list-style-type: none"> – cupping – twisting – splitting. 	<p>P72, 79 – 81</p>

2.3 Hand and commercial processes

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Hand and commercial methods of preparing, processing, manipulating and combining materials and components to enhance their properties. This will include associated tools, machinery and equipment including CAD/CAM in relation to:</p> <ul style="list-style-type: none"> • CAD <ul style="list-style-type: none"> – 2-dimensional design to create and modify designs – 3-dimensional modelling for creating ‘virtual’ products 	<p>P132, 135 – 136</p>
<ul style="list-style-type: none"> • 2D/3D modelling and prototyping <ul style="list-style-type: none"> – rapid prototyping using CAD/CAM – block modelling 	<p>P132 – 134, 143</p>
<ul style="list-style-type: none"> • fabrication/manufacture in one or more resistant materials <ul style="list-style-type: none"> – permanent – semi-permanent joints 	<p>P81 – 82</p>
<ul style="list-style-type: none"> • CNC machining <ul style="list-style-type: none"> – lathes – routers – milling machines – laser cutters 	<p>P143 – 149</p>
<ul style="list-style-type: none"> • machine processes <ul style="list-style-type: none"> – casting and sintering – shearing – stamping – milling – drilling – turning – grinding – spark erosion – forging 	<p>P82 – 87</p>

Unit Content	Cross reference from new content to textbook – 2 nd edition
<ul style="list-style-type: none"> • thermoforming <ul style="list-style-type: none"> – blow moulding – injection moulding – vacuum forming 	P31 – 32, 70 – 71
<ul style="list-style-type: none"> • removal – methods of cutting, abrading 	P85 – 87
<ul style="list-style-type: none"> • joining using permanent and semi-permanent methods <ul style="list-style-type: none"> – mechanical – chemical – fusion – adhesives. 	P33, 71, 77 – 79, 87 – 88
<p>Finishing processes Applied finishes to improve quality and enhance aesthetic or functional properties:</p> <ul style="list-style-type: none"> • surface coating <ul style="list-style-type: none"> – anodising – painting – varnishing – preservation methods • self-finishing • surface decoration <ul style="list-style-type: none"> – engraving – pyrography – transfer techniques on plastic – spray painting – etching • the relationship between finishes, properties and quality. 	P89 – 91

2.4 Product manufacture

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Scale of production</p> <p>How and why products are manufactured using:</p> <ul style="list-style-type: none"> • one-off production • batch production • high volume (mass) production • continuous production. 	P24 – 26
<p>Systems and control</p> <ul style="list-style-type: none"> • ‘Just in time’ and stock control, including the use of ICT. • Production planning, including the use of ICT. 	P235 – 236, 238 – 239
<p>Quality control in production</p> <ul style="list-style-type: none"> • Using quality assurance (QA), quality control (QC) and total quality management (TQM) systems. • Use of jigs, patterns, standard components, making aids and appropriate processes for accurate production. • Meeting specifications and tolerances. 	P34 – 35
<p>Quality standards</p> <ul style="list-style-type: none"> • Meeting aesthetic, performance and price requirements. • Testing against external quality standards such as British, European and International Standards. • Standard performance tests <ul style="list-style-type: none"> – tensile strength – hardness – toughness and ductility workshop tests. 	P35 – 36, 93
<p>Health and safety procedures in production</p> <ul style="list-style-type: none"> • Principles of health and safety legislation <ul style="list-style-type: none"> – The Health and Safety at Work Act (1974). • Principles of health and safety at work <ul style="list-style-type: none"> – Health and Safety Executive (HSE) risk assessments. 	P36 – 38

2.5 Design in practice

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>The effects of design and technological changes on society</p> <ul style="list-style-type: none"> • Mass production and the consumer society. • The 'new' industrial age of high-technology production. • The global marketplace. • Issues related to local/global production. 	P96 – 100
<p>Influences on the development of products</p> <ul style="list-style-type: none"> • Aesthetics, balance, colour, decoration, design, form, function, line, scale, shape, styling, surface pattern, texture. • Design and culture, for example Arts and Crafts, Art Nouveau, Art Deco, Bauhaus, Memphis and modern design movements. • New materials, processes and technology <ul style="list-style-type: none"> – computers and design – eco-design – environmentally-friendly processes – miniaturisation – modern production techniques – 'smart' materials. 	P100 – 109
<p>The basic principles and application of anthropometrics and ergonomics</p> <ul style="list-style-type: none"> • Interacting with products, users, equipment and environments. • Applying anthropometric data. • Ergonomic considerations for designs and models <ul style="list-style-type: none"> – standard sizes and dimensions. 	P118 – 120

Unit 3: Further Study of Product Design

3.1 Modern technologies and materials

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>The creation and use by industry of modern and ‘smart’ materials</p> <ul style="list-style-type: none"> • Glass <ul style="list-style-type: none"> – tinted – reactive – glass for welding shields. • Solar panels and materials that are appropriate in the production of pollution-free energy supplies. • Thermo-ceramics. • Shape memory alloys (SMA). • LCD displays. • Piezo-electric actuators. • Composites <ul style="list-style-type: none"> – carbon fibres – smart composites. • New materials as used in the computer and electronics industry. 	<p>P187 – 192</p>
<p>The impact of modern technology and biotechnology on the development of new materials and processes</p> <ul style="list-style-type: none"> • Genetic engineering in relation to woods – altering genes to provide quicker-growing trees, or to supply wood that resists wear, rot or infestation. • The use of micro-organisms to aid the disposal of environmentally-friendly plastics. • The recycling of materials – producing materials that are totally recyclable. 	<p>P192 – 195</p>

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Modification of properties of materials</p> <ul style="list-style-type: none"> • Metals <ul style="list-style-type: none"> – alloying – heat treatment – work and age hardening – sintering. • Plastics <ul style="list-style-type: none"> – co-polymerisation – cross-linking – use of plasticizers – fillers – fibres – stabilisers and foamants. • Woods <ul style="list-style-type: none"> – seasoning – laminating. 	<p>P195 – 198</p>

3.2 Product manufacture

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Uses of ICT in the manufacture of products</p> <p>The impact and advantages/disadvantages of ICT within the total manufacturing process:</p> <ul style="list-style-type: none"> • Electronic communications <ul style="list-style-type: none"> – email – Electronic Data Interchange (EDI) – Integrated Services Data Network (ISDN) – Local Area Networks (LAN) – global networks (internet) – video conferencing – new communications technology. • Electronic information handling <ul style="list-style-type: none"> – market analysis – specification development. • Automated stock control <ul style="list-style-type: none"> – ‘just in time’. • Production scheduling and production logistics. • Flexible manufacturing systems <ul style="list-style-type: none"> – quick response manufacturing (QRM). • Production control, for example monitoring quality using lasers and coordinate measurement machines (CMMs). • Product marketing, distribution and retailing <ul style="list-style-type: none"> – electronic point of sale – internet marketing. 	P256 – 266

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Systems and control</p> <p>Computer-Aided Design, Manufacture and Testing (CADMAT), Computer-Integrated Manufacture (CIM), Flexible Manufacturing Systems (FMS) and their wider application in industry.</p> <ul style="list-style-type: none"> • Creative and technical design. • Modelling and testing <p>– CAD</p> <ul style="list-style-type: none"> – rapid prototyping (RPT) – virtual reality modelling. <ul style="list-style-type: none"> • Production planning. • Control of equipment, processes, quality and safety. • Control of complex manufacturing processes. • Integrated and concurrent manufacturing. 	<p>P234 – 245</p>
<p>The use of block flow diagrams and flow process diagrams for representing simple and complex production systems including open/closed loop control, feedback and degrees of freedom.</p> <p>The advantages and disadvantages of automation and its impact on employment, both local and global.</p> <p>Complex automated systems using artificial intelligence (AI) and new technology.</p>	<p>P249 – 255</p>

3.3 Design in practice

Unit Content	Cross reference from new content to textbook – 2 nd edition
<p>Values issues</p> <p>The impact of values issues on product design, development and manufacture:</p> <ul style="list-style-type: none"> • Life Cycle Assessment (LCA). <p>Responsibilities of ‘developed’ countries in relation to production and the environment:</p> <ul style="list-style-type: none"> • global sustainable development. 	<p>P199 – 200</p>
<p>Environmental implications of the industrial age:</p> <ul style="list-style-type: none"> • the use of non-renewable raw materials and fossil fuels during the manufacturing process • renewable sources of energy, energy conservation and the use of efficient manufacturing processes • new technology and environmentally-friendly manufacturing processes • importance of using sustainable technology • minimising waste production. 	<p>P222 – 230</p>
<p>Economics of production</p> <p>Economic factors in the production of one-off, batch, high-volume (mass) and continuous manufactured products, relating to, for example:</p> <ul style="list-style-type: none"> • sources, availability and costs of materials • advantages of economies of scale of production • the relationship between design, planning and production costs • the material and manufacturing potential for a given design solution. 	<p>P204 – 210</p>

Unit Content	Cross reference from new content to textbook – 2 nd edition
Advertising and marketing The role of the media, including film, television, radio, video, newspapers and magazines, the internet, in marketing products.	P216
The basic principles of marketing and associated concepts such as brand loyalty, competitive edge, consumer demand, lifestyle marketing, market pull, market share, price range, product proliferation, promotional gifts, target market groups.	P220 – 222
Organisations that provide guidance, discrimination and approval: <ul style="list-style-type: none"> • British Standards Institute (BSI). • Advertising Standards Authority (ASA) • consumer magazines/TV programmes. 	P210 – 211
Relevant legislation on the rights of the consumer when purchasing goods: <ul style="list-style-type: none"> • statutory rights. 	P213 – 215