# Switching from Eduqas GCSE (9-1) Design and Technology to OCR GCSE (9-1) Design and Technology

### Introduction

Are you currently teaching the Eduqas GCSE Design and Technology specification? Are you thinking of switching? We are here to help.

We will provide you with all the support you could need to switch from the Eduqas GCSE in Design and Technology to our OCR GCSE in Design and Technology, including:

* Mapping of Eduqas’ specification to OCR’s specification
* An overview of the differences in assessment
* Mapping of the Eduqas explicit Specification content to OCR’s open specification content.

### Our offer

* Our GCSE (9-1) Design and Technology qualification has been created by our subject specialist team working with a number of stakeholders including: OCR Design, Technology and Engineering Consultative Forum, teachers, assessors, Higher Education Institutions, industry experts and subject associations. It has been created to be a qualification which engages students so they achieve their full potential.
* Our GCSE team are passionate about design and technology education. With industry, teaching and assessment experience, they are fully committed to supporting centres’ delivery of our GCSE qualifications.
* We have produced a wide range of support materials, including a range of free resources available on our website, CPD opportunities and Design and Technology Subject Advisors  
   are available to support teachers directly. This support will continuously evolve to suit the requirements of teaching and learning through the lifetime of the specification, based on continued feedback from teachers.
* Within this document as well as mapping the specifications, we also provide comparison of the explicit content from Eduqas and non-explicit content of OCR; making it easier for you to see how our approach provides you with opportunity to explore and deliver the course in a flexible way suited to your centre, and challenge students to demonstrate their understanding of different areas of study rather than remembering explicit content and examples.
* Join conversations on the OCR Design and Technology Facebook page and @OCR\_DesignTech on Twitter to discuss and share good practice.

### Key differences

| **OCR GCSE (9-1) Design and Technology** | **Eduqas GCSE (9-1) Design and Technology** |
| --- | --- |
| This qualification relates authentic real-world 21st century awareness of iterative design practices and strategies used by the creative, engineering and manufacturing industries, and shifts the focus of learning onto the process of designing rather than on the outcome. | This qualification offers the opportunity for learners to identify and solve real problems by designing and making products or systems, and be prepared to participate in an increasingly technological world, being aware of and learning from wider influences on design and technology, historical, social, cultural, environmental and economic factors. |
| Specification content is not explicit, allowing centres to engage with teaching the course in a flexible way that works to their existing strengths and assesses students’ ability to apply understanding of their chosen areas of study. | Specification content is explicit (Referred to as Amplification) and requires centres to teach fifteen distinct areas of Core knowledge and understanding, under the following sections; **Technical principles** and **Design and Making principles**, they are also required to cover In depth knowledge and understanding of at least one material under the same two sections. |
| The course offers the opportunity for students to select deeper learning in paper/board, timbers, metals, polymers and fibres and fabrics, as well as Design Engineering as an alternative area of ‘In depth’ learning to the material areas. | In-depth knowledge and understanding is presented in six clear and distinct topic areas:   1. electronic systems, programmable components and mechanical devices 2. papers and boards 3. natural and manufactured timber 4. ferrous and non-ferrous metals 5. thermoforming and thermosetting polymers 6. fibres and textiles. |
| The NEA requirement provides an approximate guide of 40 hours over 24 slides, but does not penalise students for excessive or briefer portfolios, so long as they are concise and relevant. | The NEA requirement provides an approximate guide of 35 hours, and includes:   * a design brief in response to the contextual challenge * a final prototype (or prototypes) * evidence as necessary including a design folio to enable the assessment of attainment in categories A-E. |
| The examination is split into 2 sections, with a maximum of two extended response questions. In depth questions offer accessibility to students no matter which material area(s) they have chosen. | The examination is a mix of short answer, structured and extended writing questions. |
| The examination will assess only the mathematical content from the specification. Science content is considered implicit. | There is no guidance provided in the specification as to the form in which mathematical and scientific content will be assessed in the examination. |
| The NEA is assessed over 3 AO’s, Explore, Create and Evaluate, split into 5 strands for assessment. | The NEA is assessed over 3 AO’s, Identify Investigate and outline, Design and Make, Analyse and Evaluate, split into 5 strands of assessment A to E. |
| The language of assessment in the NEA is clear, requiring students work to either be; convincingly, adequately, or just meeting the statement. | The language of the assessment guidance for the NEA is not consistently structured to differentiate between Bands 1 to 4 for each section. |

### Content mapping

The content within the OCR GCSE (9-1) in Design and Technology covers the key principles and concepts of design and technology and will be very familiar. We’ve laid it out in a logical progression to support teaching the GCSE in a linear way.

Important differences to the course content include:

* The OCR course encourages learners to explore the world of design broadly without barriers, create unique solutions to real world problems that will be reinforced by the genuine insight of looking within the contextual challenge, and evaluating their solutions with the freedom of recognising that their design outcome is; one of many possible outcomes; or merely a point in the evolution of a better solution, that will make a difference to the lives of real users.
* By learning with an enquiry approach, learners on the OCR course will become more exploratory and inquisitive in their practice, just as it would be in industry, which will result in graduating students possessing the skills needed for the modern workplace or for further study of Design and Technology at A Level or other route.
* By teaching learners to interpret and explain why designers have made certain decisions in the development of a solution, and by having an understanding of the complexity of the iterative design process, OCR students will be able to better react to their own challenges with innovation and creativity.
* Through the removal of legacy assessed tasks such as design specifications or heavily weighted manufacturing work, learners on the OCR course will be rewarded for focusing and communicating a genuine design journey that developed without limitations, rather than a closed process of research leading to a design brief and specification, before design ideas are developed into a final design, that is manufactured and tested/evaluated.
* The course content for OCR does not implicitly focus on designing and making as an area of learning, but encourages students to use an iterative approach to exploring a context, managing multiple problems, and solving them through a nonlinear fashion, unrestricted by material areas. Learners have the freedom to use as many or as few materials, processes and techniques that they deem to be required to achieve the appropriate design outcome.
* The OCR course has a unique reference and a requirement to the use of modern digital tools for design and manufacture, which by inclusion ensures that there is a match to how modern industry approaches design.
* Students studying the Eduqas course will be assessed on Core content in both Technical Principles (broad Design and Technology content), and Designing and Making Principles (the NEA content) in the examination, rather than these being assessed separately through the examination for Technical Principles and the NEA task for Designing and Making Principles.
* Students studying the Eduqas course content will find that each In-depth material topic area has a 7 section content table of explicit content under Technical Principles, that is required to be taught, differing in structure for each material area.
* Additionally, students studying the In-depth content will find a 5 section content table of explicit content under Designing and Making Principles, which is also required to be taught. It requires students to be able to respond to examination questions about how to select and work with materials, mark them out, use tools and equipment (including specialist techniques) and surface treatments and finishes.
* Eduqas “Amplification course content” (explicit content), requires students to know in detail areas that include CAD/CAM, Life Cycle Analysis, The Six R’s, Subroutines or macros in control systems, and PIC programming, as part of core content.
* Eduqas core content includes a detailed section relating to modern and smart materials, composites and technical textiles, which includes the need to teach materials including; biometrics; phase charging materials; breathable materials; proactive heat and moisture management; Nomex; Geotextiles and Rhovyl.
* Under Core knowledge and understanding of Designing and Making Principles, students must learn about specific named designers and companies that include; Airbus, Apple, James Dyson, Philippe Starck and Matthew Williamson.
* Whilst not being required within the written examination to undertake design and make activity, or evaluate their own prototypes from the NEA, learners' knowledge and understanding of these designing and making principles will be assessed in Component 1 'Design and Technology in the 21st Century', which would result in questions on any of the NEA tasks as set out in 10 headings for the NEA.

Below is a table to show where Eduqas Design and Technology content is covered in the OCR GCSE Design and Technology specification.

| **Eduqas content in GCSE (9-1) Design and Technology** | **OCR content in GCSE (9-1) Design and Technology** | **Surplus Content In Eduqas GCSE (9-1) Design and Technology** |
| --- | --- | --- |
| **2.1 Technical principles**  **Core knowledge and understanding** |  |  |
| 1. The impact of new and emerging technologies on:   * industry * enterprise * sustainability * people * culture * society * the environment * production techniques * systems. | 2.1 What are the opportunities and constraints that influence design and making requirements?  3.1 What are the impacts of new and emerging technologies when developing design solutions?  3.3 What wider implications can have an influence on the processes of designing and making?  7.4 How do industry professionals use digital design tools when exploring and developing design ideas? | The focus of this content is the impact of new and emerging technologies on the areas identified below:   * market pull – responding to demands from the market * technology push – development in materials and components, manufacturing methods * consumer choice – consumers wishing to own the latest technologies/products * the Product Life Cycle * global production and its effects on culture and people * legislation to which products are subject * consumer rights and protection for consumers when purchasing and using products * advantages and disadvantages of using computer aided design (CAD) * advantages and disadvantages of the use of computer aided manufacture (CAM) * how CAM equipment can be used in a variety of applications: CNC embroidery, vinyl cutting, CNC routing, laser cutting and 3D printing. |
| 2. How the critical evaluation of new and emerging technologies informs design decisions; considering contemporary and potential future scenarios from different perspectives, such as ethics and the environment. | 2.2 How do developments in Design and Technology influence design decisions and practice?  3.3 What wider implications can have an influence on the processes of designing and making?  7.6 How do new and emerging technologies have an impact on production techniques and systems? | * the SIX R's of sustainability; rethink, reuse, recycle, repair, reduce and refuse. |
| 3. How energy is generated and stored in order to choose and use appropriate sources to make products and to power systems. | 3.2 How do designers choose appropriate sources of energy to make products and power systems? | * energy generation and storage in a range of contexts: motor vehicles (e.g. petrol/diesel, electricity) |
| 4. Developments in modern and smart materials, composite materials and technical textiles. | 5.1 What are the main categories of materials available to designers when developing design solutions? | * electroluminescent film or wire i.e. LCD * Quantum Tunnelling Composite (QTC) - when used in circuits the resistance changes under compression * SMA – shape memory alloys * Polymorph * smart fibres and fabrics that respond to the environment or stimuli: * photo-chromic * thermo-chromic * micro-encapsulation * biometrics * carbon fibre, Kevlar and GRP * interactive textiles that function as electronic devices and sensors: circuits integrated into fabrics, such as heart rate monitors; wearable electronics such as mobile phones or music player, GPS, tracking systems and electronics integrated into the fabric itself * micro-fibres in clothing manufacture * phase changing materials: breathable materials; proactive heat and moisture management * sun protective clothing * Nomex * geotextiles for landscaping * Rhovyl as an antibacterial fibre. |
| 5. How electronic systems provide functionality to products and processes, including sensors and control devices to respond to a variety of inputs, and devices to produce a range of outputs. | 4.1 How can design solutions be communicated to demonstrate their suitability to a third party?  6.4 How do electronic systems provide functionality to products and processes? | * the importance of feedback within the system * the methods of providing feedback in different systems * familiar products in terms of their control system * control devices that include counting, switching and timing. |
| 6. The use of programmable components to embed functionality into products in order to enhance and customise their operation. | 6.4 How do electronic systems provide functionality to products and processes? | * sub routines or macros in control systems * programmable microcontrollers can interface with other devices * programmable microcontrollers can be reprogrammed repeatedly * the benefits and limitations of programmable microcontrollers * programmable Interface Controllers (PIC) and how they can be used to control products or systems. |
| 7. The functions of mechanical devices, to produce different sorts of movement, changing the magnitude and direction of forces. | 6.3 How do we introduce controlled movement to products | * analyse everyday mechanical devices and how they function * mechanical systems which: * increase or decrease speed of movement / rotation * change magnitude / direction of force / movement / rotation * simple calculations involving mechanical systems * analyse the function of mechanical products e.g. curtain rails, sewing machine. whisk, hand drill;. scissors; chair lift; automata toys. |
| 8. Papers and boards. | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6.2 How can materials and products be finished for different purposes?  7.2 How can materials be manipulated and joined in different ways in a workshop environment when making final prototypes? | * the use of microns to measure thickness of card |
| 9. Natural and manufactured timber. |  |
| 10. Ferrous and non-ferrous metals. |  |
| 11. Thermoforming and thermosetting polymers. | * the properties of thermoplastics: polythene, polystyrene, polypropylene and PVC * the properties of the thermosetting plastics: UF (urea formaldehyde), MF (melamine formaldehyde), PR (polyester resin) and ER (epoxy resin). |
| 12. Natural, synthetic, blended and mixed fibres, and woven, non-woven and knitted textiles. | * animal polymers: * wool/fleece – mohair, cashmere, angora, alpaca, camel (hair) * insect polymers: silk * plant polymers: * cotton, linen hemp, jute, rayon, viscose * manufactured polymers: * synthetic: polyester, polypropylene, nylon, acrylic, elastane, lycra, aramid fibres * microfibres – Tactel, Tencel (Lyocell). |
| **2.2 Designing and making principles**  **Core knowledge and understanding** |  |  |
| 1. Understand that all design and technological practice takes place within contexts which inform outcomes. | 1.1 How can exploring the context a design solution is intended for inform decisions and outcomes? |  |
| 2. Identify and understand client and user needs through the collection of primary and secondary data. | 1.1 How can exploring the context a design solution is intended for inform decisions and outcomes? |  |
| 3. Demonstrate an ability to write a design brief and specifications from their own and others’ considerations of human needs, wants and interests. | N/A | * write design briefs for specific needs, wants or interests * write specifications that are derived from their own investigations, the needs and wants of clients. |
| 4. Investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making. | 1.1 How can exploring the context a design solution is intended for inform decisions and outcomes? |  |
| 5. Explore and develop their ideas, testing, critically analysing and evaluating their work in order to inform and refine their design decisions thus achieving improved outcomes. | 4.2 How do designers source information and thinking when problem solving? |  |
| 6. Investigate and analyse the work of past and present professionals and companies in the area of design and technology in order to help inform their own ideas. | 2.1 What are the opportunities and constraints that influence design and making requirements? | * investigate and analyse the work of past and present designers and companies: * Airbus * Apple * James Dyson * Philippe Starck * Matthew Williamson. |
| 7. Use different design strategies, such as collaboration, user-centred design and systems thinking, to generate initial ideas and avoid design fixation. | 4.2 How do designers source information and thinking when problem solving? | * use of design strategies such as: * collaboration – discover, define, develop, deliver. |
| 8. Develop, communicate, record and justify design ideas, applying suitable techniques, for example: formal and informal 2D and 3D drawing; system and schematic diagrams; annotated sketches; exploded diagrams; models; presentations; written notes; working drawings; schedules; audio and visual recordings; mathematical modelling; computer-based tools. | 4.1 How can design solutions be communicated to demonstrate their suitability to a third party? |  |
| 9. Design and develop at least one prototype that responds to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics, marketability and consideration of innovation. | 7.1 How can materials and processes be used to make iterative models?  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products? | design and develop a prototype which is fit for purpose |
| 10. Make informed and reasoned decisions, respond to feedback about their own prototypes (and existing products and systems) to identify the potential for further development and suggest how modifications could be made. | No comparable specification content applicable here. |  |
| No comparable content in the Eduqas Course Content. | 1.2 Why is usability an important consideration when designing prototypes? | N/A |
| This is covered in the In-Depth material section for each material area. | 7.5 How do processes vary when manufacturing products to different scales of production? | N/A |
| This is covered in the In-Depth material section for each material area. | 8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | N/A |

# Assessment

### Our Examination Offer

The format for the examination paper, The Principles of Design and Technology, is simple for students to understand, with only two sections to complete, A and B. The paper is well differentiated to deliver a paper that is appropriately accessible to students of all levels.

The Principles of Design and Technology paper will feature two extended response questions only. Both of these questions will allow students the opportunity to apply knowledge and understanding from their chosen area(s) of in-depth learning.

By studying any one single material area to an in-depth level, students will be able to respond to all questions in Section B of the paper, but further areas can be added to offer them further optionality. When delivering the examined content, centres have the option to deliver it in a way that is makes it specific to a design discipline, such as Fashion and Textiles or Design Engineering.

A comparison of the examination assessment is below:

| **OCR GCSE (9-1) Design and Technology** | **Eduqas GCSE (9-1) Design and Technology** |
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| **Coverage of the paper** | |
| One examination paper, worth 50% of the total GCSE, which assesses two areas, core knowledge and understanding of design and technology principles, and in-depth knowledge and understanding of at least one main material area. | Once examination, worth 50% of the total GCSE, which assesses candidates knowledge and understanding of:   * technical principles * designing and making principles * along with their ability to: * analyse and evaluate design decisions and wider issues in design and technology. |
| In-depth material areas include:   * papers and boards * natural and manufactured timber * ferrous and non-ferrous metals * thermo and thermosetting polymers * natural, synthetic, blended and mixed fibres, woven, non-woven and knitted textiles.   Centres have the flexibility to deliver as few or as many in-depth areas dependent on the ability and aspirations of their students. | In-depth knowledge and understanding is presented in six clear and distinct topic areas:   1. electronic systems, programmable components and mechanical devices 2. papers and boards 3. natural and manufactured timber 4. ferrous and non-ferrous metals 5. thermoforming and thermosetting polymers 6. fibres and textiles. |
| In-depth knowledge and understanding is integrated into core learning in most areas, with clear guidance on where in-depth learning is to be covered relating to the material area chosen. | In-depth knowledge and understanding of the chosen topic area is broken into five topics as follows:   * selecting and working with materials and components * marking out * using tools and equipment * using specialist techniques * using surface treatments and finishes. |
| The in-depth material area for the examination can alternatively focus on design engineering. | Design Engineering is not available with the Eduqas Specification |
| **Overview of the paper** | |
| Students have 2 hours to complete the examination paper, and it is assessed out of 100 marks. | Students have 2 hours to complete the examination paper, and it is assessed out of 100 marks. |
| Only 15% of the paper will assess mathematics. | Learners are required to demonstrate an understanding of mathematical and scientific requirements in assessment of technical principles and design and making principles, with no specific amount of assessment assigned to the examination. |
| The science content is considered implicit, therefore no maximums or minimums are set. | The specification provides no guidance on the amount of scientific related assessment in the examination. |
| The examination paper is split into 2 sections, with a supporting booklet of information for Section B.  Section A is worth 55 marks, and focuses predominantly on core knowledge.  Section B is worth 45 marks, and students choose a product within a situational context in their chosen In-depth material area. | The examination paper is split into 2 sections, answering all questions in Section A, and one question in Section B.  Section A is worth 75 marks, and consists of 5 questions, with the following marks awarded: Q1 - 10 Q2 - 10 Q3 - 15 Q4 - 20 Q5 – 20  Section B is worth 25 marks and requires the learner to answer any one question. |
| **Structure of the paper** | |
| Section A comprises of 3 sets of wider questions, with a mixture of different levels of challenge, and will include one extended response question. The question follow the same structure:   * product analysis * main maths question * electronics, mechanics or wider issues. | A mixture of short answer structured and extended writing questions. |
| Section B is complemented with an insert booklet covering a situational context that is the same for all students. It comprises of a mixture of different level questions, and again will include one extended response question. The question follow the same structure:   * core principles not covered in Section A * in-depth technical principles of making and manufacture * wider issues related to the situational context and/or manufacture of the in-depth products. | Section B provides a choice between In-depth material areas, which relate to a product from that topic. The question is then broken into short answer, structured and extended writing questions. |
| **Content covered in each section** | |
| For the 55 mark Section A, students will be assessed on their knowledge of:   * **Identifying requirements** * **Learning from existing products and practice** * **Implications of wider issues** * **Design thinking and communication** * **Core materials considerations** relating to materials available to designers and factors when considering their selection * **Core technical understanding** relating to movement and electronics systems in products * **Core understanding of processes and techniques** relating to new and emerging technologies | For the 75 mark Section A, students will be assessed on their knowledge of:  **Technical Principles** Core Knowledge and Understanding:   * design and technology and our world * smart materials * electronic systems and programmable components * mechanical components and devices * materials   **And**  **Designing and making principles** Core Knowledge and Understanding:   * understanding design and technology practice * understanding user needs * writing a design brief and specifications * investigating challenges * developing ideas * investigating the work of others * using design strategies * communicating ideas * developing a prototype * making decisions |
| For the 45 mark Section B, students will be assessed on their knowledge of:   * **Identifying Requirements** relating to the situational context of a design solution * **Design thinking and communication** relating to graphical communication * **Material considerations** relating to specific materials, their origins and stock forms * **Technical understanding** relating to structural integrity and finishes * **Manufacturing processes and techniques** relating to iterative models, manipulating and joining materials for final prototypes, accuracy, digital manufacture, scales of production, and large scale manufacture. * **Viability of design solutions** | For the 25 mark Section B, students will be assessed on their knowledge and understanding for their chosen In-depth material on five topic areas:   * **selecting and working with materials and components** * **marking out** * **using tools and equipment** * **using specialist techniques** * **using surface treatments and finishes** |
| The Mathematics content required to be covered for the examination includes:   * **Arithmetic and numerical computation** * **Handling data** * **Graphs** * **Geometry and trigonometry** | The Mathematics content required to be covered for the examination includes:   * **Arithmetic and numerical calculation** * **Handling data** * **Graphs** * **Geometry and trigonometry** |
| Implicit within the content of design and technology | The science content required to be covered for the examination includes:   * **Use scientific vocabulary, terminology and definitions** * **Life cycle assessment and recycling** * **Using materials** |

### Our NEA Offer

The OCR NEA assessment format is simpler for students to understand, with 3 assessment objectives, **explore**, **create** and **evaluate**, split into just 5 strands for assessment.

OCR will provide 3 contextual challenges for each cohort in June prior to the May submission deadline.

The approximate 40 hours and 24 A3 pages suggested is no more than a guide and students will not be penalised for producing more or less that this amount, so long is their work is relevant and concise.

The OCR NEA encourages students to approach the design process as industry would, by taking risks, managing multiple priorities, working in a non-linear fashion, and unrestricted by material areas.

Assessments of student work rewards the iterative design and make process the student follows rather than focusing on the outcome with a strong weighting towards manufacture. Assessing student work is simplified for the centre to help the assessor first identify an appropriate band for the evidence being assessed, before using easy to understand "convincingly", "adequately" and "just" meeting descriptors to define top, middle or bottom positions within that band.

The language of the NEA matches 21st Century industry approaches, replacing dated terms such as ‘clients’ with ‘stakeholders’, and dated tasks such as writing a design specification are replaced by iterative approaches such as an evolving list of requirements.

A comparison of the **NEA** assessment is below:

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| A single Non Exam Assessment (NEA) Iterative Design Challenge totalling 100 marks and worth 50% of the GCSE | A single Non Exam Assessment (NEA) sustained design and make task, based on a contextual challenge, totalling 100 marks and worth 50% of the GCSE. |
| A guide time for completion of approximately 40 hours work. | A guide time for completion of approximately 35 hours work. |
| Marking criteria giving learners the opportunity to:  **Explore** to identify needs and requirements  **Create** solutions to meet those needs  **Evaluate** whether the needs have been met. | Marking criteria provide learners the opportunity to: a) Identify and investigate design possibilities b) developing a design brief and specification c) generate and develop design ideas d) manufacture a prototype e) analyse and evaluate design decisions and prototypes. |
| Student portfolios can be submitted as a physical document (supported by videos) or as a complete e-portfolio. | Student portfolios follow no set page format. |
| Students must make a working prototype. | Students must make a fully functioning high quality product. To support the practical, all models, jigs, formers, patterns, tests, trials and iterations must be included in the submission. |
| Marks are awarded holistically recognising that the nature of the portfolio is non-linear. | The marks awarded will arise by matching the learner’s performance in the design and make task to each of the five sets of criteria (targeting AO1, AO2 and AO3) and then deciding upon the extent to which the learner has demonstrated those criteria in their work. |
| 3 Contextual Challenges released on the 1st of June prior to NEA submission. | 3 Contextual Challenges released on the 1st of June prior to the NEA submission. |
| A guide of 24 A3 pages of work is suggested, but this is not a restriction, so long as communication is relevant and concise. | A guide suggests the informal presentation of an A4/A3 sketchbook, and the formal presentation of an A3 portfolio. |
| Students are encouraged to take **calculated risks** by **managing competing priorities** when solving their identified **real world problems,** working in an **open ended fashion** not restricted by materials or processes to be used, **regardless of the in-Depth material area** the student may have covered.  A truly iterative process in delivery and assessment. | Students are required to:   * work within a context which will inform the outcome * identify and understand client and user needs * write a design brief and specifications * identify opportunities and constraints that influence the processes of designing and making * explore, develop, test, critically analyse and evaluate ideas * investigate and analyse the work of others * use different design strategies to generate initial ideas * develop, communicate, record and justify design ideas * design and develop at least one prototype\* that is fit for purpose * make informed and reasoned decisions to identify the potential for further development.   In addition, in relation to at least one material area learners are required to:   * select and work with appropriate materials and components to produce a prototype * use appropriate and accurate marking out methods; work within tolerances; understand efficient cutting and minimise waste * use specialist tools and equipment, appropriate to the materials or components used, to create a specific outcome * use specialist techniques and processes to shape, fabricate, construct and assemble a high quality prototype, as appropriate to the materials and/or components being used * use appropriate surface treatments and finishes. |
| The NEA is assessed against 3 Assessment Objectives (AOs) split into 5 strands  AO1 – Explore (Strand 1)  AO2 - Create: Design thinking (Strand 2)  AO2 - Create: Design communication (Strand 3)  AO2 - Create: Final prototype (Strand 4)  AO3 – Evaluate (Strand 5) | The NEA is assessed against 3 Assessment Objectives (AO’s) split into 5 strands  AO1 - Identifying and investigating design possibilities  AO1 - Developing a design brief and specification  AO2 - Generating and developing design ideas  AO2 - Manufacturing a prototype  AO3 - Analysing and evaluating design decisions and prototypes |
| **Across the 5 strands**, the assessor will first place the student in the most appropriate band for each aspect of the NEA work, before deciding the mark within that band. | Across the 5 strands, the assessor will first place the student in the most appropriate band 1-4, before deciding the mark within that band, which has a range of marks between 2 and 7. |
| The students NEA is scored based on the judgement that the work ***convincingly*** meets the statement, ***adequately***  meets the statement, or ***just*** meets the statement.  All statements are given equal weighting. | The student’s NEA is scored based on the judgement that the work matches up to four statements in that band, without specific guidance language relating to these statements.  Statements are not indicative of equal weighting. |
| **Investigations of the context**  Students must select a contextual challenge and use this as an authentic starting point to explore real world problems and opportunities for stakeholders in relation to their interests. | **Identifying and investigating design possibilities**  Students must look at areas and opportunities in which designs can take place.  Students must then pursue ideas and gather information relating to a context.  Students need to identify and investigate interdependently, so that the processes work together and in no particular order. |
| **Investigations of user and stakeholder needs and wants and the outlining of stakeholder requirements (nontechnical specification)**  Students are encouraged to iteratively identify the stakeholder requirements that cover specific needs, wants and interests. This will lead to the development of a relevant design brief. |
| **Investigations of existing products and design practices** Students are encouraged to explore at any time, existing products and practice that might inform the design process no matter at which stage it is at. |
| **Exploration of materials and possible technical requirements**  Students are challenged to consider different materials in order to inform the technical features of their design solution. |
| **Developing a brief**  Students must write their own unique design brief in response to their chosen contextual challenge, that outlines their response to that challenge and how it will meet the needs and wants of related stakeholders. | **Developing a design brief and specification**  Students must produce a design brief and specification to inform AO2.  This includes considering a range of problems/opportunities before deciding on a final design brief, understanding the requirements to be met, writing in respect to the context and based upon research and investigation, and ensure the specification is objective and measurable. |
| **The Technical Specification**  Students present their solution through a technical specification, which is the combination of both written and graphical information of how the solution meets the stakeholder requirements, and detailed sufficient that a third party could produce the final prototype. |
| **Generating Initial Ideas**  Students must conceive ideas that respond to identified problems and requirements and that offer innovative challenge, producing a minimum of 10 ideas. Students should acknowledge when others provide ideas that influence the iterative process. | **Generating and developing design ideas** Students must generate and develop ideas that can be presented to a third party, and can be evaluated and tested (however the actual analysis and evaluation forms part of AO3).  This includes using a range of design strategies, techniques and approaches, considering social, moral and economic factors, testing to evolve ideas, developing proposals comprehensively, and demonstrating sophistication to clearly communicate the ideas to a third party. |
| **Design Developments**  Students must narrow down and improve ideas through iteration, resolving identified requirements technically and conceptually. A minimum of 2 developments are required, but the quality and range of work to find suitable solutions is dependent on the students’ level of thinking. |
| **Developing a Final solution**  Students must consider the look and function of a final prototype as if it were being developed as a potential product, and be the result of experimentation of processes and techniques through modelling and testing. Digital design and manufacture must be used here or in the final prototype. |
| **Quality of chronological progression**  Students are awarded marks for working systematically and evidencing their progress with real time evidence. |  |
| **Quality of initial ideas**  Students are awarded marks for their effective and consistent communication of their initial thinking. |  |
| **Quality of design developments**  Students are awarded marks for using a range of communication techniques when developing design concepts. |  |
| **Quality of final design solution**  Students are awarded marks for formal presentation of their design solution with suitable clarity for a 3rd party. |  |
| **Critical Thinking**  Students must systematically work through identified problems and show evidence of innovation throughout the design process. |  |
| **Producing a final prototype**  Students must produce the outcome authentically and safely. The most suitable alternative processes available should be used to deliver a high quality outcome. Students must use digital design and manufacture here if it has not been used in the iteration work previously. Hand tools and machinery are also required to be used either here or through earlier modelling. | **Manufacturing a prototype**  Students must produce an appropriate working solution to a need or want that is sufficiently developed to be tested and evaluated (for example, full sized products, scaled worked models or functioning systems).  In addition to being a working solution, the students’ prototype must be fit for purpose, addressing the needs/wants of the intended user.  This includes logical sequencing of the production in an achievable timeline, working with materials and components to a defined schedule, producing a high quality functional prototype that meets all requirements, applying an understanding of material working properties and performance characteristics, and selecting and using tools and working safely.  Making skills can be assessed through the designing and making of the prototypes as well as the nature and quality of the final prototype. |
| **Analysing validity of the final prototype**  Students must evaluate the prototype through stakeholder opinions against the technical specification, sought through meaningful sources outside of the school environment, ideally in context. | **Analysing and evaluating design decisions and prototypes**  Students must deconstruct information and/or issues to find connections and provide logical chain(s) of reasoning.  Students must also appraise and/or make judgements with respect to information and/or issues.  This includes critical, objective evaluation and testing during the iterative process, of the final prototype, and responding to feedback to develop and suggest modifications to the prototype throughout the project. |

### The Explicit AQA Specification Content

Below you will find all the information you need to start teaching OCR GCSE (9-1) Design and Technology, with the freedom to deliver areas of learning without the constraint of specific content that must be covered and will be assessed within the exam paper. We have mapped below how our approach allows centres to not fixate on covering specific content.

### Eduqas Explicit Content list

| **Eduqas GCSE (9-1) Design and technology Specification Content** | **Eduqas GCSE (9-1) Explicit Content not Explicitly in the OCR specification** | **Matched OCR GCSE (9-1) Design and technology Specification** | **OCR GCSE (9-1) Explicit or illustrative Content** |
| --- | --- | --- | --- |
| **Technical Principles** | **Technical Principles** |  |  |
| 1. The impact of new and emerging  technologies on:  • industry  • enterprise  • sustainability  • people  • culture  • society  • the environment  • production techniques  • systems. | * The focus of this content is the impact of new and emerging technologies on the areas identified below.   + the impact of new and emerging technologies on industry and enterprise:   + market pull – responding to demands from the market   + technology push – development in materials and components, manufacturing methods   + consumer choice – consumers wishing to own the latest technologies/products   + the Product Life Cycle   + global production and its effects on culture and people   + legislation to which products are subject   + consumer rights and protection for consumers when purchasing and using products   + moral and ethical factors related to manufacturing products and the sale and use of products   + sustainability; meeting today’s needs without compromising the needs of future generations   + advantages and disadvantages of using computer aided design (CAD)   + advantages and disadvantages of the use of computer aided manufacture (CAM)   + how CAM equipment can be used in a variety of applications: CNC embroidery, vinyl cutting, CNC routing, laser cutting and 3D printing. | 3.1 What are the impacts of new and emerging technologies when developing design solutions?  3.3 What wider implications can have an influence on the processes of designing and making?  7.4 How do industry professionals use digital design tools when exploring and developing design ideas?  7.6 How do new and emerging technologies have an impact on production techniques and systems? | **Explicit content:** 3.1 Industry and enterprise such as circular economy, people, lifestyle, culture and society, the environment and sustainability.  3.3 Environmental initiatives, fair trade social and ethical awareness, global sustainable development.  **Illustrative content:** 7.4 a. Rapid prototyping, image creation and manipulation, digital manufacture, 3D models, CAD, CAM, CAE.  7.6 a. Economies of scale, Disruptive Technology - 3D printing and robotics. |
| 2. How the critical evaluation of new and emerging technologies informs design decisions; considering contemporary and potential future scenarios from different perspectives, such as ethics and the environment. | The focus of this content is how the critical evaluation of new and emerging technologies informs design decisions.   * + the importance of sustainability issues and environmental issues when designing and making   + social, cultural, economic and environmental responsibilities in designing and making products   + the SIX R's of sustainability; rethink, reuse, recycle, repair, reduce and refuse   + Life Cycle Analysis to determine the environmental impact of a product   + fair-trade policies and carbon footprint   • ecological footprint. | 2.2 How do developments in Design and Technology influence design decisions and practice  3.3 What wider implications can have an influence on the processes of designing and making? | **Illustrative content:** 2.2 Ethics, the environment and product enhancement  **Explicit content:** 3.3 Environmental initiatives, fair trade social and ethical awareness, global sustainable development |
| 3. How energy is generated and stored in order to choose and use appropriate sources to make products and to power systems. | * + types of renewable and non-renewable energy sources: wind, solar, geothermal, hydroelectric, wood/biomass, wave, coal, gas, nuclear and oil   + issues surrounding the use of fossil fuels: coal, oil and gas   + the advantages and disadvantages of renewable energy sources   + the use of renewable energy sources in modern manufacturing production systems: the use of solar panels and wind turbines in manufacturing sites   + renewable energy sources for products: wind-up and photovoltaic cells energy generation and storage in a range of contexts: motor vehicles (e.g. petrol/diesel, electricity) and household products (e.g. battery, solar, mains electricity). | 3.2 How do designers choose appropriate sources of energy to make products and power systems? | **Explicit/illustrative content:** 3.2 none |
| 4. Developments in modern and smart materials, composite materials and technical textiles. | * + electroluminescent film or wire i.e. LCD   + Quantum Tunnelling Composite (QTC) - when used in circuits the resistance changes under compression   + SMA – shape memory alloys.   + Polymorph   + smart fibres and fabrics that respond to the environment or   stimuli:   * + photo-chromic   + thermo-chromic   + micro-encapsulation   + biometrics   + carbon fibre, Kevlar and GRP   + interactive textiles that function as electronic devices and sensors: circuits integrated into fabrics, such as heart rate monitors; wearable electronics such as mobile phones or music player, GPS, tracking systems and electronics integrated into the fabric itself   + micro-fibres in clothing manufacture   + phase changing materials: breathable materials; proactive heat and moisture management   + sun protective clothing   + Nomex   + geotextiles for landscaping   • Rhovyl as an antibacterial fibre. | 5.1 What are the main categories of materials available to designers when developing design solutions? | **Modern and smart materials** such as graphene, super alloys, biopolymers and nano-materials  **Composite materials** and their purpose in relation to contrasting applications  **Technical textiles** used in different types of products dependent on context |
| 5. How electronic systems provide functionality to products and processes, including sensors and control devices to respond to a variety of inputs, and devices to produce a range of outputs. | * + graphical conventions for communicating concepts: circuit diagrams, block diagrams and flowcharts   + the ‘systems' approach – input; process; output   + principles of a control system:   + input data from a sensor: light dependent resistor (LDR), thermistor   + processing by control devices: semi-conductor, IC, icroprocessor or computer   + output where a signal is received that will perform a desired function: buzzer, light emitting diode (LED)   + the importance of feedback within the system   + the methods of providing feedback in different systems   + familiar products in terms of their control system   + control devices that include counting, switching and timing   + analogue and digital sensors as input components. | 6.4 How do electronic systems provide functionality to products and processes? | **Explicit content:** 6.2 a   1. Sensors - light dependent resistors, infrared sensors 2. switches - tilt switches, push to make and time delay switches.   b   1. light emitting diodes 2. speakers and buzzers 3. motors   c  i. Microcontrollers |
| 6. The use of programmable components to embed functionality into products in order to enhance and customise their operation. | * + sub routines or macros in control systems   + programmable microcontrollers can be used to control a range of systems   + programmable microcontrollers can interface with other devices   + programmable microcontrollers can be reprogrammed repeatedly   + the benefits and limitations of programmable microcontrollers   • programmable Interface Controllers (PIC) and how they can be used to control products or systems. | 6.4 How do electronic systems provide functionality to products and processes? | **Explicit content:** 6.2 a   1. Sensors - light dependent resistors, infrared sensors 2. ii. Switches - tilt switches, push to make and time delay switches.   b   1. Light emitting diodes 2. ii. speakers and buzzers 3. iii. motors   c  i. Microcontrollers. |
| 7. The functions of mechanical devices, to produce different sorts of movement, changing the magnitude and direction of forces. | * + principle of a mechanical device to transform input motion and force into a desired output motion and force   + analyse everyday mechanical devices and how they function   + consider mechanical systems in terms of input; process; output   + mechanical systems which: * increase or decrease speed of movement / rotation * change magnitude / direction of force / movement / rotation   + simple calculations involving mechanical systems   + analyse the function of mechanical products that have   + pulley systems, e.g. curtain rails, sewing machine   + gear systems, e.g. whisk, hand drill   + levers and linkages, e.g. scissors   + rack and pinion, e.g. chair lift   + cams, e.g. automata toys. | 6.3 How do we introduce controlled movement to products? | **Explicit content:**  6.3   * 1. rotary, linear, oscillating, reciprocating   2. load, effort, fulcrum   3. c. cams, gears, pulleys and belts, levers, linkages. |
| 8. Papers and boards. | * + the categorisation and properties of paper, cards, boards and composite materials. Properties to be considered in terms of their strength, folding ability, surface finish and absorbency   + papers, cards and boards can be laminated to improve strength, finish and appearance   + the standard ISO sizes of paper   + the use of grammage i.e. grams per square metre (gsm) to measure weight of paper   + the use of microns to measure thickness of card   + the use of recycled materials to manufacture papers and boards   + the aesthetic and functional properties of common papers, cards and boards: layout paper, tracing paper, copier paper, recycled paper, corrugated board, cartridge paper, mounting board and folding boxboard. | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  6.2 How can materials and products be finished for different purposes? | **Explicit/illustrative content:** 5.1  **Papers and boards, including:**   1. papers, e.g. layout and cartridge, different weights and coatings 2. card, e.g. carton board, bleached card and corrugated card 3. boards/sheets, e.g. foam board, Styrofoam and polypropylene sheet 4. laminated layers, e.g. reflective surfaces.   **Explicit content:**  5.2   * 1. density, strength, hardness, durability, strength to weight ratio, resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity   2. N/A   3. c. Function, aesthetics, environmental, cost, social, cultural and ethical considerations   **Illustrative content:** 5.3   * 1. N/A   2. extraction and conversion   3. mining, harvesting, manufacturing and transporting   4. N/A   5. recycling, sustainability schemes, eco-materials, upcycling   **Explicit content:** 6.2 Surface treatments for function, durability, resistance, environment and aesthetic. |
| 9. Natural and manufactured timber. | * + the categorisation and properties of hardwoods and softwoods   + properties to be considered: strength, grain structure, surface finish and absorbency   + natural timber is harvested from deciduous (hardwoods) and coniferous (softwood) trees   + natural timber is available in the following forms: plank, board, strip, square, and dowel   + natural timber can be identified using a range of discriminators: weight, colour, grain, texture, durability and ease of working   + natural timber is protected using different finishes and these finishes are sometimes used to improve aesthetic appeal   + categorisation and properties of manufactured timbers   + manufactured timbers are made from natural timbers and made from particles/fibres or laminates   + manufactured timbers are available in standard sizes and forms: plywood, MDF (Medium Density Fibreboard), chipboard, hardboard and veneered boards   + manufactured timbers can be protected using finishes and these finishes are sometimes used to improve the aesthetic appeal. | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  6.2 How can materials and products be finished for different purposes? | **Natural and manufactured timber, including:**   1. hardwoods, e.g. oak, birch and teak 2. softwood, e.g. pine, cedar and spruce 3. iii. manufactured boards, e.g. MDF, plywood and block board.   **Explicit content:** 5.2   1. density, strength, hardness, durability, strength to weight ratio, resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity. 2. N/A 3. Function, aesthetics, environmental, cost, social, cultural and ethical considerations   **Illustrative content:**  5.3   1. extraction and conversion 2. mining, harvesting, manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit content:**  6.2 Surface treatments for function, durability, resistance, environment and aesthetic. |
| 10. Ferrous and non-ferrous metals. | * + categorisation and working properties of ferrous metals, non-ferrous metals and alloys   + properties of metals: hardness, elasticity, conductivity, toughness, ductility, tensile strength and malleability   + metals are sold as sheet, bar, rod, tube and angle   + ferrous metals: cast iron, mild steel, medium carbon steel and high carbon steel   + ferrous metals may require a protective finish and the finish is sometimes used to improve the aesthetic appeal   + non-ferrous metals: aluminium, copper, brass, bronze   + alloys of metals are a base metal mixed with other metals or non-metals to change their properties or appearance * non-ferrous metals may require a protective finish and the finish is sometimes used to improve the aesthetic appeal. | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  6.2 How can materials and products be finished for different purposes? | **Ferrous and non-ferrous metals, including:**   1. ferrous metals, e.g. iron, mild steel and stainless steel 2. ii. non-ferrous metals, e.g. aluminium, copper and tin 3. alloys, e.g. brass, pewter and tin/lead solder.   **Explicit content:** 5.2   1. density, strength, hardness, durability, strength to weight ratio, resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity. 2. N/A 3. Function, aesthetics, environmental, cost, social, cultural and ethical considerations   **Illustrative content:**  5.3   * 1. N/A   2. b. extraction and conversion   3. c. mining, harvesting, manufacturing and transporting   4. d. N/A   5. e. recycling, sustainability schemes, eco-materials, upcycling   **Explicit content:** 6.2 Surface treatments for function, durability, resistance, environment and aesthetics. |
| 11. Thermoforming and thermosetting polymers. | * categorisation and physical properties of polymers * polymers can be made from both natural and synthetic resources * polymers are sold as sheet, film, bar, rod and tube * the differences between a thermoforming (thermoplastic) and thermosetting material * properties of polymers: weight, hardness, elasticity, conductivity / insulation, toughness and strength * the properties of thermoplastics: polythene, polystyrene, polypropylene and PVC * the properties of the thermosetting plastics: UF (urea   formaldehyde), MF (melamine formaldehyde), PR (polyester resin) and ER (epoxy resin). | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  6.2 How can materials and products be finished for different purposes? | **Thermo and thermosetting polymers, including:**   1. thermo polymers, e.g. PET, HDPE, PVC, LDPE, PS, PP, ABS, acrylic and TPE 2. thermosetting polymers, e.g. silicone; epoxy resin and polyester resin.   **Explicit content:** 5.2   * 1. density, strength, hardness, durability, strength to weight ratio, resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity.   2. Function, aesthetics, environmental, cost, social, cultural and ethical considerations   **Illustrative content:** 5.3   1. extraction and conversion 2. mining, harvesting, manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling   **Explicit content:** 6.2 Surface treatments for function, durability, resistance, environment and aesthetics |
| 12. Natural, synthetic, blended and mixed fibres, and woven, non-woven and knitted textiles. | * the categorisation and working properties of fibres and textiles. * the raw materials of textiles are classified according to their source * natural polymers: * animal polymers: wool/fleece – mohair, cashmere, angora, alpaca, camel (hair) * insect polymers: silk * plant polymers: cotton, linen hemp, jute, rayon and viscose * manufactured polymers * synthetic: polyester, polypropylene, nylon, acrylic, elastane, lycra, aramid fibres * Microfibres – Tactel, Tencel (Lyocell) * the properties of textiles fibres: strength, elasticity, absorbency, durability, insulation, flammability, water-repellence, anti-static and resistance to acid, bleach and sunlight * blending and mixing fibres improves the properties and uses of yarns and materials. | 5.1 What are the main categories of materials available to designers when developing design solutions?  5.2 What factors are important to consider when selecting appropriate materials and/or system components when designing?  5.3 Why is it important to understand the sources or origins of materials and/or system components?  6.2 How can materials and products be finished for different purposes? | **Textile fibres and fabrics, including:**   1. natural fibres, e.g. cotton, wool and silk 2. synthetic fibres, e.g. nylon, polyester and acrylic 3. mixed/blended fibres, e.g. cotton/polyester 4. woven, non-woven and knitted fabrics   **Explicit content:** 5.2   * 1. density, strength, hardness, durability, strength to weight ratio, resistance to chemicals and weather, flammability, absorbency, thermal and electrical conductivity.   2. Function, aesthetics, environmental, cost, social, cultural and ethical considerations.   **Illustrative content:** 5.3   1. extraction and conversion 2. mining, harvesting, manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit content:** 6.2 Surface treatments for function, durability, resistance, environment and aesthetics. |
| **Designing and Making Principles** | **Designing and Making Principles** |  |  |
| 1. Understand that all design and technological practice takes place within contexts which inform outcomes. | * contexts are a starting point to inform possible outcomes, situations to create design briefs. | 1.1 How can exploring the context a design solution is intended for inform decisions and outcomes? | **Explicit content:** 1.1 Where and how, primary user and wider stakeholder requirements, social, cultural, moral and economic factors. |
| 2. Identify and understand client and user needs through the collection of primary and secondary data. | * identify the needs and wants of the end user * suggest possible design problems from the contexts * explore and investigate existing products, situations before deciding upon whether there is a real need for a product * explore and investigate existing products, situations to inform possible specification points for designing * primary research data: collecting data and using this to explore and aid further work * secondary research data: collecting existing data and using this to explore and aid further work. | 2.1 What are the opportunities and constraints that influence design and making requirements?  2.2 How do developments in Design and Technology influence design decisions and practice? | **Explicit content:** 2.1 Materials, components, processes, fashion, trends, taste, style, marketing, branding, society, usability, environment, lifecycle, past and present professionals.  **Illustrative content:** 2.2 Ethics, the environment and product enhancement |
| 3. Demonstrate an ability to write a design brief and specifications from their own and others’ considerations of human needs, wants and interests. | * write design briefs for specific needs, wants or interests. * write specifications that are derived from their own investigations, the needs and wants of clients. | N/A | N/A |
| 4. Investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making. | * designing should not take place in isolation but there are wider needs to be considered: * ergonomics * anthropometrics * environmental * social * • economic. | 1.1 How can exploring the context a design solution is intended for inform decisions and outcomes?  1.2 Why is usability an important consideration when designing prototypes? | **Explicit content:** 1.1 Where and how, primary user and wider stakeholder requirements, social, cultural, moral and economic factors.  **Explicit content:** 1.2 Lifestyle, ease of use and inclusivity, ergonomics and anthropometrics, aesthetics. |
| 5. Explore and develop their ideas, testing, critically analysing and evaluating their work in order to inform and refine their design decisions thus achieving improved outcomes. | * the importance of testing and evaluating ideas * continuously reviewing and critically analysing work as it develops to improve the final design outcome * refine and modify design ideas based upon learners' own decisions and those of others. | 7.1 How can materials and processes be used to make iterative models? | **Illustrative content:** 7.1 N/A |
| 6. Investigate and analyse the work of past and present professionals and companies in the area of design and technology in order to help inform their own ideas. | * investigate and analyse the work of past and present designers and companies: * Airbus * Apple * James Dyson * Philippe Starck * Matthew Williamson * Where appropriate, review and link the work of past and present designers and companies to inform, refine and modify their design ideas. | 2.1 What are the opportunities and constraints that influence design and making requirements? | **Explicit content:** 2.1 Materials, components, processes, fashion, trends, taste, style, marketing, branding, society, usability, environment, lifecycle, past and present professionals. |
| 7. Use different design strategies, such as collaboration, user-centred design and systems thinking, to generate initial ideas and avoid design fixation. | * use of design strategies such as: * collaboration – discover, define, develop, deliver * user-centred design - contexts, requirements, design solutions, evaluate, iteration * systems thinking. | 4.2 How do designers source information and thinking when problem solving? | **Explicit content:** 4.2 User Centred Design and Systems Thinking |
| 8. Develop, communicate, record and justify design ideas, applying suitable techniques, for example:  formal and informal 2D and 3D drawing; system and schematic diagrams; annotated sketches;  exploded diagrams; models; presentations; written notes; working drawings; schedules; audio and visual recordings; mathematical modelling; computer-based tools. | * formal and informal 2D and 3D drawing * system and schematic diagrams * annotated sketches * exploded diagrams * models * presentations * written notes * flow diagrams * working drawings * schedules * audio and visual recordings * mathematical modelling * computer-based tools. | 4.1 How can design solutions be communicated to demonstrate their suitability to a third party?  7.4 How do industry professionals use digital design tools when exploring and developing design ideas? | **Illustrative content:** 4.1 2D/3D sketching, sketch modelling, exploded drawings, mathematical modelling and flow charts.  **Illustrative content:** 7.4 a. Rapid prototyping, image creation and manipulation, digital manufacture, 3D models, CAD, CAM, CAE |
| 9. Design and develop at least one prototype that responds to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics, marketability and consideration of innovation. | design and develop a prototype which :   * responds to needs and/or wants * is fit for purpose * demonstrates functionality. | 7.1 How can materials and processes be used to make iterative models? | **Illustrative content:** 7.1 N/A |
| 10. Make informed and reasoned decisions, respond to feedback about their own prototypes (and existing products and systems) to identify the potential for further development and suggest how modifications could be made. | * respond thoughtfully and make informed judgements when evaluating their own prototype * act on the views of others * make suggestions for improvements of their own prototype and how these modifications could be made * respond to feedback from others or clients and suggest improvements / modifications of their prototype. | N/A | N/A |
| **Technical Principles** | **Technical Principles** |  |  |
| **Electronic systems, programmable components and mechanical devices.** | **Electronic systems, programmable components and mechanical devices.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint (cont.) | Operational amplifiers and gain.   * programmable microcontrollers to control a variety of input and output devices * the function of AND, OR, EOR, NOT, and NAND logic gates * combining logic gates to form control systems.   Output Components   * lamps, LEDs, buzzers, piezo sounders, loudspeakers, sirens, motors and solenoids.   Functions of mechanical devices / systems   * simple and compound pulley and belt systems * calculate velocity ratio * RV of driver\*dia of driver= RV of driven\*dia of driven * simple and compound gear systems * calculate velocity ratio * RV of driver\*teeth on driver= RV of driven\*teeth on driven * worm drive systems * bevel gear systems.   Levers   * classification * calculation of mechanical advantage * calculate forces acting in simple lever systems using the principle of moments   Others   * rack and pinion * pawl and ratchet * crank and slider * cams.   Ecological and social footprint   * changing society’s view on waste, encourage recycling * living in a greener world * life-cycle analysis of a material or product * sustainable design, e.g. with reference to rapidly updated products such as mobile phones. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   * 1. N/A   2. extraction and conversion   3. manufacturing and transporting   4. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. stock forms - lengths, sheets, pellets, reels, rolls and rods 3. standard components -system components, e.g. resistors, capacitors, diodes, transistors and drivers, microcontrollers mechanical components, e.g. gears and cams, pulleys and belts, levers and linkages.   **Illustrative content:** 6.1   * 1. reinforced and stiffened to withstand forces and stresses   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   **Illustrative content:** 6.2 Surface treatments for function, durability, resistance, environment and aesthetics.  **Explicit/illustrative content:** 7.2  a   1. **wastage-** design engineering, e.g. etching\* 2. **addition -** design engineering, e.g. soldering\* 3. **deforming and reforming -** design engineering, e.g. moulding\*.   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste.   **Explicit/illustrative content:**  7.5   1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods 2. design engineering, e.g. laser cutting, rapid prototyping and 3D printing.   **Explicit content:** 8.1   * 1. commercial viability, different stakeholder needs and marketability  1. calculate quantities. |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * components and their functional benefits or limitations * miniaturisation to reduce the size of control systems, or the number of components for functional or cost reasons * cultural, social, ethical and environmental responsibilities of designers and manufacturers with respect to: material/component selection should not be harmful to people or the environment; working conditions; recyclability and waste. |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * how mechanical components are strengthened to withstand forces * casing and protecting electronic components. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * standard stock electronic components sizes * dual In Line (DIL) standard for electronic ICs * stock materials for the manufacture of products * • calculate cost of materials and components for products. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * mass production * just in time manufacturing * the use of CAD/CAM in production * batch production * jigs and devices to control repeat activities * one-off production. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming and reforming, as appropriate to the materials and/or components being used. | Wastage/Addition   * appropriate tools and equipment to mark out, hold, cut, shape, drill and form materials * the pillar drill to drill holes to various diameters * jigs and formers to ensure accuracy.   Deforming/Reforming   * bending plastics * hot/cold working of sheet metals, casting * drilling and turning materials * vacuum forming, moulding * laser cutting * 3D printing.   Assembly and components   * components for a particular purpose: nuts, bolts, washers, screws, rivets * joining components together, e.g. soldering components to circuit boards * joining materials - mechanical or chemical bond * joining like and unlike materials together * material joining - permanent and temporary. |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * surface finishes applied to electronic devices for functional or aesthetic purposes * powder and plastics coating of metals. |
| **Papers and boards.** | **Papers and boards.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint. | * how wood pulp is made * the differences between mechanical and chemical wood pulp * recycled paper * how paper is made by hand * surface finishes of paper and card * commercial manufacture of papers and boards * the physical and working properties of paper and board: texture, weight, thickness, strength, surface finish, transparency, folding ability and absorbency.   Ecological and social footprint:   * the impact on the environment * greenhouse gases * changing society’s view on waste, encourage recycling of all materials * living in a greener world * packaging – is it always needed? * life-cycle analysis of a material or product * sustainable design. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   1. N/A 2. extraction and conversion 3. harvesting, manufacturing and transporting 4. N/A 5. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. stock forms - lengths, sheets, pellets, reels, rolls and rods 3. standard components - paper and boards, e.g. clips, fasteners, bindings.   **Illustrative content:** 6.1   * 1. Reinforced and stiffened to withstand forces and stresses   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   **Illustrative content:**  6.2 Surface treatments for function, durability, resistance, environment and aesthetics.  **Explicit/illustrative content:** 7.2  a.   1. **wastage -** paper and boards, e.g. cutting and punching 2. **addition -** paper and boards, e.g. adhesion and laminating 3. **deforming and reforming -** paper and boards, e.g. perforating and folding.   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste.   **Explicit/illustrative content:** 7.5   * 1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods   2. paper and boards, e.g. offset lithography, screen process printing, digital printing, vinyl cutting, die cutting.   **Explicit content:** 8.1   * 1. Commercial viability, different stakeholder needs and marketability  1. b. Calculate quantities. |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * Aesthetic and functional properties of cards and boards. * Advantages and disadvantages of common paper, card and boards for commercial and everyday use: layout paper, tracing paper, copier paper, recycled paper, cartridge paper, mounting board, folding boxboard and corrugated board. * The reasons for use of paper, card and boards in everyday products. * The aesthetic properties of paper, card and boards. * Responsibilities of designers and manufacturers who design using paper card with respect to: * the environment; * working conditions in third world countries, low labour costs and poverty * exploitation of employees * recyclability and waste * biodiversity and deforestation * Estimating the true costs of a prototype or product. |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * the behaviour of papers and board under forces or stress * reinforcement of papers and boards by corrugating, folding, gluing * stiffening papers and boards by increasing thickness, adding ribs * structural integrity, stiffness and strength of papers and card boards by laminating and the design of the cross-section of the board, e.g. corrugated card board has a fluted core between two layers of card * the strength of paper and boards in products will depend upon the design and the joining or fixing methods used. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * standard sizes of papers and boards, i.e. rolls, A5, A4, A3 * paper is measured in grams per square metre * cardboard is available in different forms with different cores * costs and how to calculate the cost of materials for different forms of products. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * advantages and disadvantages of producing single, one off products * the advantages and disadvantages of producing products in limited quantities (batch production) * the need to produce a number of identical products * jigs and devices to control repeat activities * the advantages and disadvantages of high volume, continuous production * issues related to high volume production * the importance of CAM in modern high volume production * pre-press, on-press and the finishing processes used by commercial printers to produce products in batches or mass/high volume * pre-press operations * grids, registration marks, layout, imposition and colour separation * on-press operations * finishing processes * die cutting, spirit varnishing, and UV varnishing, laminating, embossing, debossing, cropping, folding and binding methods * techniques used to produce books, magazines, leaflets, flyers, packages and other printed products. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming and reforming, as appropriate to the  materials and/or components being used. | Wastage/Addition   * tools and equipment to mark out, hold, cut, shape, drill, form laminates of plastics, papers/boards * marking out materials using a range of workshop tools * jigs and formers to ensure accuracy as part of the process of drilling, bending, cutting and forming.   Deforming/Reforming   * bending plastics * vacuum forming * laser cutting * 3D printing * press forming / moulding * blow moulding * CAM machines * 3D Printers * score and fold paper and card * assembly and components * components for a particular purpose * material joining - permanent and temporary. |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * the application of a variety of finishing materials * die cutting, spirit varnishing, U.V. varnishing, laminating, embossing, debossing, cropping, folding and binding methods * the use and importance of product labelling and symbolic images that convey messages. |
| **Natural and manufactured timber.** | **Natural and manufactured timber.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint (cont.). | * The physical and working properties of hardwoods, softwoods and man-made boards: toughness, flexibility, grain structure, strength, absorbency, surface finish, colour and hardness * Natural solid timber - strengths and weaknesses * Defects: shrinkage, splits, shakes, knots, fungial attack * Hardwoods: beech, oak, mahogany, balsa and jelutong * Softwoods: scots pine, western red cedar and parana pine * Strengths, weaknesses of the following manufactured boards; plywood, MDF - medium density fibreboard, chipboard and hardboard * the impact on the environment of deforestation * ecological and social footprint. * changing society’s view on waste, encourage recycling * living in a greener world * life-cycle analysis of a material or product. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   1. extraction and conversion 2. harvesting, manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. ii. stock forms - lengths, sheets, pellets, reels, rolls and rods 3. iii. standard components -timber, e.g. hinges, brackets, screws.   **Illustrative content:** 6.1   * 1. reinforced and stiffened to withstand forces and stresses   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   **Illustrative content:** 6.2 surface treatments for function, durability, resistance, environment and aesthetics.  **Explicit/illustrative content:** 7.2   1. **wastage -** timber, e.g. sawing, drilling and turning 2. **addition -** timber, e.g. adhesion, joining and laminating 3. **deforming and reforming -** timber, e.g. steaming and pressing.   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste.   **Explicit/illustrative content:** 7.5   * 1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods   2. timber, e.g. CNC routers, sawing and steam bending machines and lathes.   **Explicit content:** 8.1   * 1. commercial viability, different stakeholder needs and marketability  1. calculate quantities. |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * aesthetic properties of natural and manufactured timbers * functional properties of natural and manufactured timbers * Responsibilities of designers and manufacturers who design using metals with respect to: * the environment * working conditions in third world countries, low labour costs and poverty * exploitation of employees * recyclability and waste * biodiversity and deforestation * estimating the true costs of a prototype or product * comparison costs of hardwoods, softwoods and manufactured board. |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * the behaviour of natural and manufactured timber under forces or under stress * the stiffness and a strength of natural timber will depend upon the wood, the cross sectional area and the depth of the section. * reinforcement of natural timber by laminating * the strength of plywood will depend upon the number of layers and the wood grain being at right angles * the strength of a timber product will depend upon how the product is jointed or what fixing method is used. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * natural timber is available in different sectional forms, various standard sizes and can have a different finish (sawn or planed) * manufactured boards are commonly available in sheet form and in standard sizes and various thicknesses * calculate the costs involved in the design of products: fixtures, fittings, finishes required and the material cost. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * advantages and disadvantages of producing single, one off products * the advantages and disadvantages of producing products in limited quantities (batch production) * the need to produce a number of identical products * jigs and devices to control repeat activities * the advantages and disadvantages of high volume, continuous production * issues related to high volume production * the importance of CAM in modern high volume production. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming and reforming, as appropriate to the  materials and/or components being used. | Wastage/Addition   * tools and equipment to mark out, hold, cut, shape, drill and form laminates of natural timbers and manufactured boards * the pillar drill to drill holes to various diameters * jigs and formers to ensure accuracy as part of the process of drilling, bending, cutting wood materials.   Deforming/Reforming   * material joining can be permanent or temporary * the principles of producing wood products using the following processes: jointing, veneering, laminating and steam bending * classification of wood joints as frame or box construction * frame: mitre, dowel, mortise and tenon, halving and bridle joint * box/carcass: butt, lap, housing, dovetail and comb joint * adhesives: PVA (wood to wood), contact adhesive and epoxy resin (wood to other materials) * temporary: screw (countersunk and round head) and knock down fittings * lasers * CAM machines |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * surface treatments of natural timber and manufactured boards to prolong life of a product: sealants and primers. * finishes for aesthetic or functional reasons: varnish, wood stains, oils, polishes and preservative paints. |
| **Ferrous and non-ferrous metals.** | **Ferrous and non-ferrous metals.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint (cont.). | * classification as ferrous metals, non-ferrous metals and alloys * metals are soured from ores and are a natural resource.   Ferrous Metals   * strengths and weaknesses * cast iron, mild steel, medium carbon steel and high carbon steel * stainless steel, high-speed steel and high-tensile steel * physical properties of metals: melting point, thermal and electrical conductivity * mechanical properties of metals: tensile strength, toughness, plasticity, malleability and hardness * heat treatment of ferrous metals: annealing, hardening, tempering and case hardening   Non-Ferrous Metals   * strengths and weaknesses. * aluminium, duralumin, copper, brass, bronze, pewter and silver * heat treatment of non-ferrous metals: annealing and hardening * physical properties of metals: melting point, thermal and electrical conductivity * mechanical properties of metals: tensile strength, toughness, plasticity, malleability and hardness.   Ecological and social footprint:   * the impact on our environment of mining for ores * greenhouse gases during the production of metals * changing society’s view on waste, encouraging recycling of metals * living in a greener world * life-cycle analysis of a material or product. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   1. extraction and conversion 2. mining,, manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. stock forms - lengths, sheets, pellets, reels, rolls and rods 3. standard components -metals, e.g. bolts, rivets, hinges.   **Illustrative content:** 6.1   * 1. reinforced and stiffened to withstand forces and stresses   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   6.2 Surface treatments for function, durability, resistance, environment and aesthetics  **Explicit/illustrative content:** 7.2 a.   1. **wastage -** metals, e.g. sawing, drilling, shearing and turning o polymers, e.g. sawing and drilling 2. **addition -** metals, e.g. adhesion, welding/brazing and riveting 3. **deforming and reforming -** metals, e.g. pressing, bending and casting.   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. ii. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste   **Explicit/illustrative content:** 7.5   * 1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods metals, e.g. CNC milling, turning, sheet metal folding, pressing and stampings, and die casting.   **Explicit content:** 8.1   * 1. commercial viability, different stakeholder needs and marketability  1. b. calculate quantities. |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * aesthetic and functional properties of the following: aluminium, duralumin, copper, brass, bronze, pewter, silver, cast iron, mild steel and medium carbon steel * Responsibilities of designers and manufacturers who design using metals with respect to: * the environment * working conditions in third world countries, low labour costs and poverty * exploitation of employees * recyclability and waste * biodiversity * estimating the true costs of a prototype or product. |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * the ability of a metal to withstand forces will depend upon the type of metal and the natural ability of the metal to be hardened or tempered by the action of heat * the stiffness and strength of metals will depend upon the metal’s natural properties, stock form, cross sectional area and the depth of the section. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * metals are available in a number of common forms: (round) rod, square rod, hexagonal rod, strip, sheet, round tube, square tube, angle and channel. * sizes of metals are normally related to their cross section and are available in stock lengths. * costs and how to calculate the cost of metals for different forms of products. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * manufacturing systems: one off, batch and high volume production * manufacturing systems, the advantages and disadvantages of producing single, one off products * the advantages and disadvantages of producing products in limited quantity (batch production) * jigs and devices to control repeat activities. * the advantages and disadvantages of high volume, * continuous production * issues related to high volume production * commercial production line and its features * the importance of CAM in modern high volume production. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming and reforming, as appropriate to the  materials and/or components being used. | Wastage/Addition   * cutting metals to the required shape or contour * tools and equipment to mark out, hold, cut, shape, drill and form metals * the pillar drill to drill holes to various diameters * jigs and formers to ensure accuracy as part of the process of drilling * pilot, clearance, tapping, countersunk and counterbored holes.   Deforming/Reforming   * metal joining can be permanent or temporary, by welding, soldering and the use of nuts, bolts, washers, screws, rivets, hinges, catches * lathe to turn materials * milling machine to create a slot or face edge   The main stages in the following joining processes:   * permanent: riveting, welding, brazing, silver soldering and use of epoxy resins   temporary: screws, nuts, bolts.   * lasers * CAM machines. |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * Metal surface treatments finishing processes: plastic coating, enamelling, oil finishing black steel, paint and primer. |
| **Thermoforming and thermosetting polymers.** | **Thermoforming and thermosetting polymers.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint (cont.). | * natural and synthetic plastic * polymers and the polymerisation process * common thermoplastics, their strengths, weaknesses and working properties: acrylic, polythene, PVC, polypropylene, polycarbonate, Styrofoam, expanded polystyrene and nylon * common thermosetting plastics, their strengths, weaknesses and working properties: urea formaldehyde, melamine and epoxy resins * physical properties of plastics: thermal conductivity and electrical conductivity/insulation * mechanical properties of plastics: tensile strength, toughness, plasticity, malleability and hardness.   Ecological and social footprint:   * the impact on our environment of oil exploration and extraction * greenhouse gases during the extraction and production of polymer plastics * changing society’s view on waste, encourage recycling of all plastics * living in a greener world * life-cycle analysis of a material or product. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   1. extraction and conversion 2. manufacturing and transporting 3. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. stock forms - lengths, sheets, pellets, reels, rolls and rods 3. standard components polymers, e.g. caps, fasteners, bolts   **Illustrative content:** 6.1   * 1. reinforced and stiffened to withstand forces and stresses.   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   6.2 surface treatments for function, durability, resistance, environment and aesthetics.  **Explicit/illustrative content:** 7.2 a.   1. **wastage -** polymers, e.g. sawing and drilling 2. **Addition -** polymers, e.g. adhesion and heat welding 3. **deforming and reforming -** polymers, e.g. moulding, vacuum forming and line bending.   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste.   **Explicit/illustrative content:** 7.5   * 1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods polymers, e.g. compression moulding, injection moulding, vacuum forming, rotational moulding, extrusion and blow moulding.   **Explicit content:** 8.1   * 1. commercial viability, different stakeholder needs and marketability  1. calculate quantities. |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * aesthetic and functional properties and the advantages and disadvantages plastics in everyday products * responsibilities of designers and manufacturers who design using metals with respect to: * the environment * working conditions in third world countries, low labour costs and poverty * exploitation of employees * recyclability and waste * biodiversity * estimating the true costs of a prototype or product * new polymers are being developed often for specific purposes: biodegradability and compostability. |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * the behaviour of thermoforming and thermosetting plastics under forces or stress * the stiffness and a strength of thermoforming and thermosetting plastic polymers depends upon the type of plastic, the cross sectional area and the depth of the section * thermoforming and thermosetting plastic polymers can be strengthened by laminating * different forms of fibres can affect the strength of thermosetting plastics and act as reinforcement. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * polymers are available in expanded forms open cell – foams; closed cell - expanded plastics * plastic polymers are available in a wide range of forms: powders, granules, pellets, liquids, films, sheets and extruded shapes * calculate material costs for products. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * advantages and disadvantages of producing single, one off products * the advantages and disadvantages of producing products in limited quantities (batch production) * the need to produce a number of identical products * jigs and devices to control repeat activities * the advantages and disadvantages of high volume, continuous production * the importance of CAM in modern high volume production * a range of products suitable for high volume, continuous production * the principles of producing plastic products and components using the following processes: blow moulding, vacuum forming, press moulding and compression moulding. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming and reforming, as appropriate to the  materials and/or components being used. | Wastage/Addition   * cutting thermosetting and thermoforming plastics to the required shape or contour * tools and equipment to mark out, hold, cut, shape, drill, and form plastics * the pillar drill to drill holes to various diameters * jigs and formers to ensure accuracy as part of the process of drilling * pilot, clearance, tapping, countersunk and counterbored holes.   Deforming/Reforming   * plastics joining can be permanent or temporary, by plastic welding and the use of nuts, bolts, washers, screws, rivets, hinges, catches * lathe to turn materials * milling machine to create a slot or face edge * lasers * CAM machines * blow moulding * vacuum forming * press moulding. |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * self-finishing nature of many thermosetting and thermoforming plastics * textured finishes of plastics. |
| **Natural, synthetic, blended and mixed fibres; woven, non-woven and knitted textiles.** | **Natural, synthetic, blended and mixed fibres; woven, non-woven and knitted textiles.** |  |  |
| 1. The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint (cont.). | * Construction methods and how their advantages and disadvantages affect end use * weaving: plain, twill, satin, herringbone, pile * knitting: weft knit and a warp knit * bonding: sticking with adhesives; heating thermoplastic fibres; stitching a web of fibres * laminating * felting * fibres are the raw material of textiles and they can be classified according to their source * the nature of staple and continuous filaments; textured yarns; novelty yarn (chenille) and these determine fabric weight, flexibility, handle and end use * the properties of the main natural and manufactured fibres/fabrics: strength, elasticity, absorbency, durability, insulation, flammability, water repellence, anti-static and resistance to acid, bleach, sunlight * blending and mixing fibres to improve the properties and uses of yarns and materials * blends: polyester and cotton, silk and viscose, hemp and cotton or silk * mixture: cotton and wool, lycra with wool cotton or nylon * bonding breathable waterproof membranes to outer fabrics for all-weather wear (Gore-Tex, Permatex) * bonding foam to knitted or woven fabrics * bonding plastic to loosely woven cotton to simulate leather * quilting – polyester wadding between an outer and lining material * ecological and social footprint: * the impact on our environment e.g. pollution from the processing of textiles, in parts of the world * changing society’s view on waste, encourage recycling * living in a greener world * life-cycle analysis of a material or product. | 5.3 Why is it important to understand the sources or origins of materials and/or system components?  5.4 Why is it important to know the different available forms of specific materials and/or systems components?  6.1 What gives a product structural integrity?  6. 2 Material finishing for function, durability and aesthetics  7.2 Specialist techniques, hand tools and equipment to shape, fabricate, construct and assemble high quality prototypes.  7.3 How do designers and manufacturers ensure accuracy when making prototypes and products?  7.5 How do processes vary when manufacturing products to different scales of production?  8.1 How can cost and availability of specific materials and/or system components affect their selection when designing? | **Illustrative content:** 5.3   1. N/A 2. extraction and conversion 3. harvesting, manufacturing and transporting 4. N/A 5. recycling, sustainability schemes, eco-materials, upcycling.   **Explicit/illustrative content:** 5.4   1. weights and sizes 2. stock forms - lengths, sheets, reels, rolls and rods fibres and fabrics, e.g. zips, buttons, poppers   **Illustrative content:** 6.1   * 1. Reinforced and stiffened to withstand forces and stresses.   2. triangulation, boning, darts, layering, plastic webbing, reinforcing.   **Illustrative content:** 6.2 surface treatments for function, durability, resistance, environment and aesthetics.  **Explicit/illustrative content:** 7.2 a.   1. **wastage -** fibres and fabrics, e.g. cutting and shearing. 2. **addition -** welding fibres and fabrics, e.g. sewing, bonding and laminating 3. **deforming and reforming -** fibres and fabrics, e.g. heat treatments, pleating and gathering   **Explicit content:** 7.3   1. measuring points, lines and surfaces 2. templates, jigs or patterns 3. working in tolerances 4. cutting to minimise waste   **Explicit/illustrative content:** 7.5   * 1. batch production, mass production, lean manufacturing and just-in-time (JIT) methods fibres and fabrics, e.g. band saw cutting, flatbed and rotary screen printing, digital lay planning, industrial sewing machines and overlockers, automated presses and steam dollies   **Explicit content:** 8.1   * 1. commercial viability, different stakeholder needs and marketability  1. calculate quantities |
| 2. The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic,  environmental, availability, cost, social, cultural and ethical. | * a variety of finishing processes and why they are important for aesthetic and functional reasons. * different methods of enhancing the appearance, prolonging and protecting life * to enhance aesthetic quality * colouring, surface decoration, embossing, glazing, moiré effect, stiffening, increasing lustre (calendering, mercerising), brushing, stain resistance (Scotchguard, Teflon). * to enhance fabric life * flame retardant, moth proofing. * to improve functionality * shower proofing using PVA or PVC or wax; crease resistance using resin; waterproofing using silicones; shrink resistance using chlorine treatment; anti-static finish, coating with PVC, neoprene, silicone rubber, polyurethane; use of barrier membranes laminated to an outer or inner shell to make them breathable yet waterproof; windproof materials made by very close weave construction * responsibilities of designers and manufacturers who design using metals with respect to: * the environment * working conditions in third world countries, low labour costs and poverty * exploitation of employees * recyclability and waste * biodiversity |
| 3. The impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened. | * textile materials and components behave differently when subjected to force or stress e.g. a loaded rucksack, tents, uses in geotextiles, active sportswear, workwear, in normal daily wear * the strength, durability and elasticity of textile materials will depend upon the fibre source and the construction method for the material or components * textile materials can be strengthened by laminating, bonding and quilting to improve functionality * the strength of textile products will depend upon the combination of joining or fixing methods used. |
| 4. Stock forms, types and sizes in order to calculate and determine the quantity of materials or components required. | * textile materials come in standard widths 90cm, 115cm, 150cm, 200cm, 240cm * estimate material quantities and costs based on best use of materials * calculate costs and quantities for components. |
| 5. Alternative processes that can be used to manufacture products to different scales of production. | * products can be manufactured in quantity * different methods of manufacture: job production (custom-made or one–off); batch production; mass production and when each is appropriately used * the scale of production depends on the quantity of products required * how manufacturing systems are organised: line production; progressive bundle system; cell production. |
| 6. Specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype,  including techniques such as wastage, addition, deforming  and reforming, as appropriate to the materials and/or components being used. | * the correct materials, hand tools and equipment for a range of practical tasks such as template production; stencil preparation; cutting out and assembly * change accessories when appropriate for special processes e.g. using a zipper foot for piping * industrial manufacturing processes, e.g. stitch, trim and neaten seams with the over locker * CAD/CAM equipment for cutting templates accurately and continuously * pattern language and markers for lay plans * visual checks for pattern drop/match * the importance of accuracy and working to a tolerance - correct use of seam tolerances in joining/trimming * correct use of thread-colour, type, shade, stitch length * the appropriate choice of construction and decorative processes for fabric type and product end use * the basic procedures for lay planning and use of pattern language * lengthwise / crosswise folds, cutting on the cross or bias, notches, grain lines, balance marks, tuck/pleat lines, dart markings, positions for pockets, buttons / holes, centre front / back lines, seam tolerance * different methods of transferring important marks onto material prior to product manufacture. * tailor’s chalk * hot notch marking in industry * different types of cutting tools and equipment used industry and know why they are used * cutting tools * straight knives, round or band knives, automated die cutters for products of constant shapes, computer controlled cutting machines and laser cutters * other equipment used for: lay planning and estimating material quantities, fabric spreading to include several plies. |
| 7. Appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes. | * dyeing: piece, dip, random, tie and dye, batik * printing: silk screen, roller, discharge, block, burn out; stencilling; marbling; air brushing * painting: felt tip, dimensional, fabric paint, silk paints * transfers: image-maker, ink-jet transfer (CAM) * embroidery: hand embroidery, machine embroidery, CAM * appliqué; beadwork. |

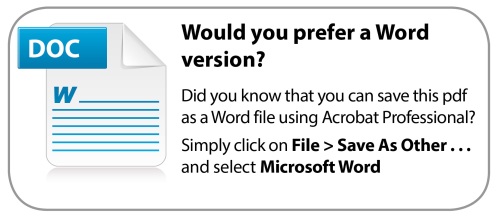
### Want to switch to OCR?

If you’re an OCR-approved centre, all you need to do is download the specification and start teaching. Your exams officer can complete an intention to teach form which enables us to provide appropriate support. When you’re ready to enter your students, you just need to speak to your exams officer to:

Make estimated entries by **10th October** so we can prepare the question papers and ensure we’ve got enough examiners.

Make final entries by **21st February**. If you are not already an OCR-approved centre please refer your exams officer to the centre approval section of our admin guide.

### Next steps

1. Familiarise yourself with the specification, sample assessment materials and teaching resources on the Design and Technology qualification page of the OCR website.   
   <https://www.ocr.org.uk/qualifications/gcse/design-and-technology-j310-from-2017/>
2. Browse the online delivery guides for teaching ideas.  
   <https://www.ocr.org.uk/qualifications/gcse/design-and-technology-j310-from-2017/planning-and-teaching/>
3. Get a login for our secure extranet, Interchange – this allows you to access the latest past/practice papers and use our results analysis service, Active Results.   
   <https://interchange.ocr.org.uk>
4. Sign up to receive subject updates by email.   
   <http://www.ocr.org.uk/i-want-to/email-updates>
5. Sign up to attend a training event or take part in webinars on specific topics running throughout the year and our QandA webinar sessions every half term.   
   <https://www.cpdhub.ocr.org.uk>
6. [](https://www.surveymonkey.co.uk/r/ZL5Z53B)A Contact your OCR Subject Advisor to find out about arranging a local network meeting with other centres in your region. These are hosted at the end of the school day in a school or college near you, with teachers sharing best practice and subject advisors on hand to lead discussion and answer questions.  
   [design.technology@ocr.org.uk](mailto:design.technology@ocr.org.uk)

***DISCLAIMER***

This resource was designed using the most up to date information from the specification at the time it was published. Specifications are updated over time which means there may be contradictions between the resource and the specification, therefore please use the information on the latest specification at all times.If you do notice a discrepancy please contact us on the following email address: [resources.feedback@ocr.org.uk](mailto:resources.feedback@ocr.org.uk)